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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 19, NUMBER 5
MAY 1986

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 5
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MARCH 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

HYDROLOGY OF MID-ALTITUDE TUSSOCK GRASSLANDS, UPPER WAIPORI CATCHMENT: II - WATER BALANCE, FLOW DURATION AND STORM RUNOFF,

New Zealand Forest Service, Rotorua. Forest Research Inst.
A. J. Pearce, L. K. Rowe, and C. L. O'Louglin.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 60-72, 1984. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Storm runoff, *Grasslands, *Hydrologic models, *Upper Waipori Catchment, *New Zealand, Flow, Rainfall, Vegetation, Interception, Transpiration, Groundwater storage, Quickflow.

Water balances over 3 years in two catchments in largely unmodified narrow leaved snow tussock indicate that evaporative losses are substantially smaller than would be predicted from Penman or other methods of estimation. Runoff, particularly delayed runoff, is high in comparison with other vegetative covers in either similar or substantially wetter rainfall climates. Interception losses, at about 20% of gross rainfall, are somewhat higher than anticipated for vegetation of this type and stature, and are comparable with scrub vegetation or low density forest stands. Transpiration on a daily, monthly, or annual basis, except in winter months, is much less than would be predicted by Penman's or Priestley and Taylor's equation. The low transpiration values are also consistent with the observed high, persistent rates of delayed runoff from shallow, unconfined groundwater storage, indicating that upward fluxes of soil water to transpiration do not compete effectively with drainage of the groundwater to delayed runoff. Storm runoff responses are moderate and are comparable to areas of indigenous forest with similar rainfall climates in terms of the ratio of quickflow to storm rainfall over a wide range of event sizes. Quickflow as a proportion of total runoff is less than in most areas studied in detail in New Zealand, but this reflects the persistence of high rates of delayed flow, rather than small yields of quickflow. A simple conceptual model of daily water balance with an interception store and regolith store discharged by transpiration and drainage is capable of fitting the major components of the water balance to a precision of better than 10%. This model, however, does not identify precisely the mechanisms by which either quick flow or delayed runoff are generated. (Baker-IVI)
W86-01384

CONCEPTUAL RUNOFF MODEL FOR A MOUNTAINOUS RAIN-ON-SNOW ENVIRONMENT, CRAIGIEBURN RANGE, NEW ZEALAND,

Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
R. D. Moore, and I. F. Owens.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 84-99, 1984. 6 Fig, 4 Tab, 22 Ref.

Descriptors: *Runoff, *Model studies, *Snow, *Rainfall, *New Zealand, *Craigieburn Range, Evaporation, Storm seepage, Air temperature, Estimating, Snowmelt, Wind.

A runoff model incorporating a distributed snow routine and a lumped transformation routine was developed for conditions in non-glacierized mountainous basins in the eastern South Island of New Zealand, and was applied in the Camp Stream catchment. A major problem was the overestimation of runoff. The magnitudes of the water-balance components in the South Island mountain regions, particularly evaporation and subsurface basin outflow, should be investigated to improve the model. Mean daily air temperature is inadequate for discriminating rain from snow at elevations lower than about 1500 m. Precipitation and temperature data with a resolution of three hours or less may be required to simulate snow accumulation. Further modelling work on this environment should include distributed transformation routines and the refinement of snowmelt indices. In particular, the use of alternative wind-speed indices, such as wind speeds from upper air-pressure, should be explored. (Baker-IVI)
W86-01386

RECURRENCE INTERVAL OF DROUGHT EVENTS THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA,

Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Hydrological Sciences Journal, Vol. 30, No. 2, p 197-206, June, 1985. 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Drought, *Recurrence intervals, *Rainfall, *Streamflow, *Stochastic hydrology, *Victoria, *Australia, Temporal distribution, Model studies, Data interpretation.

The efficient management of an agricultural system or the operation of a water supply scheme requires knowledge about critical droughts, such as their length, severity and frequency of occurrence. Several theoretical distributions are fitted to drought events of up to one year's duration and the average recurrence intervals calculated. A methodology based on stochastically generated data is proposed and used to obtain the average recurrence intervals of events of duration longer than one year. These methods are applied to five river basins in Victoria, Australia. The accuracy of the method is dependent on the adequacy of the generating model. (Author's abstract)
W86-01444

PROBABILITY-DISTRIBUTED PRINCIPLE AND RUNOFF PRODUCTION AT POINT AND BASIN SCALES,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W86-01449

GENERATION OF DELAYED PEAKS IN STREAM DISCHARGE,

Oxford Univ. (England). Geography School.
T. P. Burt, and D. P. Butcher.
Journal of Hydrology, Vol. 78, No. 3/4, p 361-378, June, 1985. 13 Fig, 1 Tab, 25 Ref.

Descriptors: *Storm seepage, *Stream discharge, *Delayed peaks, Flood peaks, Computer models, Simulation, Slopes, Soil water, Rainfall, Runoff, England.

Where deep permeable soils overlie impermeable bedrock and where steep hillslopes border a narrow floodplain, subsurface stormflow dominates the hydrograph. In such cases delayed peaks in stream discharge may occur several days after rainfall, providing the major volumetric response and possibly also the highest peak discharge. The general occurrence of such delayed peaks is considered, making reference to field data from two small drainage basins in southwest England, and to the results of computer simulations using a distributed hillslope model. The importance of soil-water convergence into hillslope hollows is stressed. The relative roles of rainfall and antecedent soil moisture in controlling the size and timing of the delayed peak is discussed. The implications of the results for hillslope runoff modelling are briefly considered. (Author's abstract)
W86-01480

MACROSCOPIC ESTIMATION OF AVAILABLE WATER RESOURCES IN KAGOSHIMA PREFECTURE, JAPAN (IN JAPANESE),

Kagoshima Prefectural Office (Japan). Planning Dept.
Y. Osako, T. Tsuyuki, S. Koriyama, and K. Hyakumoto.
Reports of the Faculty of Science, Kagoshima University, No. 17, p 89-101, December, 1985. 5 Fig, 7 Tab, 8 Ref.

Descriptors: *Water resources, *Kagoshima, *Japan, *Hydrologic cycle, Groundwater, Surface water, Precipitation, Runoff.

Proper planning for the development and management of water resources requires the quantitative estimation of available water including surface and ground water. A method of macro-estimate of available water resources is presented using rainfall, streamflow and evaporation data accumulated by Kagoshima Weather Bureau and Kagoshima Prefectural Office. In general, precipitation minus evaporation equals streamflow plus percolation. As percolating ground water ultimately reaches streams, quantities of water resources or surface runoff are calculated by annual precipitation minus evapo-transpiration. Compared with measured stream flow data, those calculated figures are rather large. This is presumably due to the nonuniform distribution of precipitation by orographic effect. The average annual runoff coefficient of rivers in Kagoshima Prefecture is 0.65. To estimate the safe yield, the annual low precipitation and runoff data in 1942 are selected to be expected to occur once every ten years. Rivers in Kagoshima Prefecture can be classified into four types by unit flow states (illustrated in tables). Each type of rivers reflects the geologic conditions of their drainage basins. Rivers of type I are characterized by very stable flow states through the year. Pyroclastic flow deposits or so-called shirasu are widely distributed in the basin of rivers of type I. Under a natural flow state, ratios of quantities of available surface water to total runoff in each type of river are 48.0%, 34.0%, 24.0%, and 18.0% respectively. Calculated quantities of available water under a natural flow state in Kagoshima Prefecture are given. (Author's abstract)
W86-01604

MAXIMUM LIKELIHOOD PARAMETER ESTIMATION OF HYDROLOGIC SPATIAL PROCESSES BY THE GAUSS-NEWTON METHOD,

Iowa Inst. of Hydraulic Research, Iowa City.
P. K. Kitanidis, and R. W. Lane.
Journal of Hydrology, Vol. 79, No. 1/2, p 53-71, July, 1985. 2 Fig, 2 Tab, 26 Ref. Department of the Interior project CT 381702, NSF grant CME-8106577.

Descriptors: *Maximum likelihood, *Parameter estimation, *Hydrology, Mathematical studies, Spatial properties, Gauss-Newton method, Optimization.

The Gauss-Newton method for maximum likelihood (ML) parameter estimation of spatially correlated hydrologic fields is described with emphasis on computational aspects associated with its implementation. The essence of the Gauss-Newton method is that, for purposes of applying Newton's optimization method, the Hessian of the function to be minimized is replaced by its average value eliminating the need to calculate second derivatives. In ML estimation, the parameters are determined through minimization of the negative log-likelihood function and the average of the Hessian is known as the information matrix. The information matrix provides a lower bound to the covariance matrix of parameter estimation error. Methodologies to account for near-singular information matrix and to enforce lower or upper bounds in the parameters are described. A general method to eliminate the bias in covariance parameter estimates caused by unknown drift parameters is also presented. Some simple examples are presented to illustrate the potential advantages of Gauss-Newton. The conditions under which this method should perform well are also discussed. (Author's abstract)
W86-01656

CORRELATION BETWEEN SAMPLE FIRST AUTOCORRELATION COEFFICIENT AND EXTREME HYDROLOGIC RUNS,

George Washington Univ., Washington, DC. International Water Resources Inst.
V. Yevjevich, and J. T. B. Obeysekera.
Journal of Hydrology, Vol. 79, No. 1/2, p 171-186, July, 1985. 9 Fig, 9 Tab, 15 Ref. NSF grant CEE-8405289.

Descriptors: *Runoff, *Autocorrelation, *Hydrologic series, Drought, Hydrologic models, Water demand, Autoregression.

Differences between the annual runoff series, as the systems water supply and the annual output series, as the systems water demand, define various types of runs. The extreme runs of samples of these differences are positively correlated with the parameters of series dependence in general, and series first autocorrelation coefficient r1, estimated from these samples, in particular. This correlation is made between the estimated r1 and each of the three variables of sample extreme runs. These variables are defined as summations of n longest or largest positive and longest or largest negative sample extreme runs. The resulting regression equations of r1 versus these variables permit an alternative estimation of rho 1, if this estimate is needed for any purpose. As expected, these correlations are always positive and relatively high. To show how high these correlations are, two models are used to generate samples of different sizes with various population p1 values and to study the resulting correlation: (1) first-order autoregressive normal process; and (2) dependent lognormal process, obtained by the exponential transformation of the first-order autoregressive normal process. (Author's abstract)
W86-01666

WATERSHED COMPUTER MODELS,
Flaherty-Giavara Associates, New Haven, CT.
J. G. MacBroom.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 187-199, June, 1985. 4 Fig.

Descriptors: *Computers, *Model studies, *Watershed management, Simulation, Water supply development, Water resources, Water management, Reservoir operation.

Two types of computer models are described that are useful tools for analyzing water supply reservoirs and dams. The use of watershed computer models is of particular importance to water supply utilities that depend on surface water reservoirs for raw water, and who are responding to increased demand for dependable supplies. In addition, computer models are critical for evaluating low flow conditions downstream of reservoirs, hydropower potential at reservoirs, and dam safety. The first type discussed in a continuous simulation model that mathematically represents the flow and storage of water over an extended period of time and is commonly used to determine safe yields. The second model mathematically simulates a single rainfall event, and is typically used to evaluate flood flows and spillway capacity at dams. The watershed computer models represent a major improvement in the ability to plan, manage, and operate water supply reservoirs. The use of calibrated computer models is vital in gaining a better understanding of reservoir operations, limitations, and potential development of resources. (Baker-IVI)
W86-01754

DETERMINATION OF GROWING SEASON SOIL WATER DEFICITS ON A FORESTED SLOPE USING WATER BALANCE ANALYSIS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
D. G. Giles, T. A. Black, and D. L. Spittlehouse.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 107-114, February, 1985. 5 Fig, 4 Tab, 38 Ref.

Descriptors: *Soil water, *Soil moisture deficiency, *Forests, *Hydrologic budget, Slopes, Solar radiation, Air temperature, Rainfall, Root zone, Storage capacity, Elevation, Evapotranspiration.

Coefficients for the calculation of soil water balance components at seven sites on a forested slope were determined using only measurements of daily solar irradiance, maximum and minimum air temperature and rainfall, and weekly root zone soil water content during a 2-year period. Site parameters required were root zone depth, soil water retention characteristics, and rainfall interception coefficients. Based on daytime net radiation, the Priestley-Taylor evapotranspiration coefficient (alpha) was found to be 0.73 +/- 0.07, which is similar to values reported in other conifer forest studies. Growing season water deficit increased with decreasing root zone water storage capacity, which was mainly a function of root zone depth. A comparison between high and low elevations on the slope showed 100-year site indices ranging from 17 to 53 m corresponding to growing season soil water deficits during the driest year of the study, ranging from 79 to 4 mm. Basal area annual increments were found to be correlated with soil water deficits and growing season transpiration, both for the study period and when both variables were averaged over the last 18 years. (Author's abstract)
W86-01786

2B. Precipitation

CONCEPTUAL RUNOFF MODEL FOR A MOUNTAINOUS RAIN-ON-SNOW ENVIRONMENT, CRAIGIEBURN RANGE, NEW ZEALAND,
Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W86-01386

YEAR OF WORLD WIDE EXTREMES; FLOODS AND DROUGHTS,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Assessment Branch.
D. LeComte.
Weatherwise, Vol. 37, No. 1, p 8-11, 15-17 and 19, February, 1984. 10 Fig.

Descriptors: *Weather patterns, *Drought, *Floods, Rainfall, Storms, Climate, Heat, Cold, Monsoons, Hurricanes, Cyclones.

The year 1983 was a year of extremes - severe drought, heavy rains, extreme heat, unseasonable cold, the culmination of the El Nino event. Specific events cited in this review include the record floods in the California, Utah and Colorado areas, torrential rains in Ecuador, ferocious storms in winter and spring which swept eastward across the North Atlantic into northern Europe and Scandinavia, drought in southern Africa, fires brought on by extreme heat and drought in Australia, heavy rains later causing floods in the same areas, rivers flooding in South America, drought and heat in the United States and Europe, below normal rainfall in western and central Africa, monsoons in southeast Asia, heavy rains in Mexico and southern United States, hurricanes and cyclones, and record cold in November in the United States. (Baker-IVI)
W86-01427

UNEVEN PATTERN; THE 1982-83 SNOW SEASON,
D. M. Ludlum.
Weatherwise, Vol. 37, No. 1, p 20-23, February, 1984. 3 Fig.

Descriptors: *Weather, *United States, *Snow, Snow cover, Snow pack.

In the United States the snow season of 1982-83 was characterized by its uneveness. The most unusual early-season snowstorms occurred in central Wyoming where Lander measured a total of 32.9 inches, a new September record. The big snow scene in October shifted to the Black Hills of South Dakota. The heavy snow season got underway in November in the Sierra of California with 105 inches at Twin Lakes. El Paso recorded the most unusual December snows, with a total of 18.2 inches. Precipitation in New England was deficient, and January showed record warming trends in all the snow country. March of 1983 brought the biggest snows of the year to California and the season continued at a good rate into April. Very heavy wet snows fell at higher elevations of the West topped by a storm which left an estimated four feet in the Bearpaw Mountains of north central Montana. Winter totals for the Pacific Mountains included 707 inches at Twin Lakes, California, and 667 inches at Rainier Paradise, Washington. At Donner summit in the central Sierra, the season total exceeded all others in a record dating back to 1870. The snowpack disappeared at Crater Lake on July 22 after 270 days with 1 inch or more on the ground and at Rainier Paradise on July 25 after 280 days with snow cover. (Baker-IVI)
W86-01428

YEAR OF THE AFRICAN DROUGHT,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Assessment Branch.
D. LeComte.
Weatherwise, Vol. 38, No. 1, p 8-15, February, 1985. 12 Fig.

Descriptors: *Climatology, *Africa, *Sahel, *Drought, *United States, *Madagascar, *Philippines, *Korea, *Canada, *USSR, Cyclones, Flooding, Weather data collections, Weather patterns.

Although drought in Africa has not been unusual in recent years, during 1984 it covered an extraordinary area. Early in the year hot, dry weather cut crop production by one-half across the southern part of the continent. Later, during the (Northern Hemisphere) spring, one of the worst droughts of the century damaged food crops in East Africa. Finally, major drought during the summer affected Sahel zone agriculture, in west and central Africa. By the end of the year, the occurence of drought with other factors such as civil war and reduced food stocks had produced famine in at least three African countries and resulted in food shortages in nearly two dozen more. Highlights of weather extremes in other areas in 1984 included cold waves and storms early in the year in Europe and the United States, tropical cyclones hitting Madagascar, the Philippines, and the east coast of the United States, floods in Korea, and drought in Canada and the USSR. (Collier-IVI)
W86-01429

HEAVY IN THE WEST, LIGHT IN THE EAST: SNOWFALL IN 1983-84,
D. M. Ludlum.
Weatherwise, Vol. 38, No. 1, p 26-30, February, 1985. 7 Fig.

Descriptors: *Weather patterns, *Snow, *United States, Air temperature, Precipitation, Snow cover.

Very little snowfall was recorded during the first month of the 1983 snow season, September. Even October, being a very warm month, had only insignificant snowfalls. A crippling storm swept from the central Rockies to the western Great Lakes on Thanksgiving weekend and all of New England experienced a white Christmas with a moderate storm on the 22-23 of December. The first months of 1984 were very dry across the country with snowfall far below normal. Most areas of the country experienced unseasonably warm temperatures in February but March brought the greatest snow of the season to New England. Excessive amounts of snow also fell in an area across southern Montana and northern Wyoming and spread eastward into the Dakotas on April 25 to 28. In May only the western mountains witnessed any sizeable snowfalls. In June-July the snow cover at Berthoud Pass in Colorado dropped from 53 inches to bare ground by July 1. (Baker-IVI)
W86-01430

RECURRENCE INTERVAL OF DROUGHT EVENTS THROUGH STOCHASTIC ANALYSIS OF RAINFALL AND STREAMFLOW DATA,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-01444

GENERALISED TECHNIQUE FOR THE ESTIMATION OF PROBABLE MAXIMUM PRECIPITATION IN INDIA,

Bureau of Meteorology, Melbourne (Australia).
P. R. Rakhecha, and M. R. Kennedy.
Journal of Hydrology, Vol. 78, No. 3/4, p 345-359, June, 1985. 10 Fig, 22 Ref.

Descriptors: *Probable maximum precipitation, *Estimation, Design floods, Rainfall, Rainstorms, Topography, Dew point, Mountains, Catchment area.

A version of a generalized method of estimating probable maximum precipitation (PMP) is applied to the catchments of four large dams in India. The value of a secure dam is high both in terms of human life and in economic terms. Reliable estimates of PMP are required in estimating the design flood for spillways of large earth and rockfill dams. Estimates of PMP obtained using the traditional method of moisture maximization and storm transposition can be unreliable as highly efficient rain storms may not be represented in the rainfall records of an area. Generalized methods of (calculating) PMP are used to obtain reliable estimates of PMP and also to give estimates which are consistent over a region. This is done by pooling together all the rainfall data from a very large area. The rainfall depths are normalized for such factors as storm dew-point temperature, distance of the storm from the coast, topographic effects and any intervening mountain barriers between the rainfall area and the moisture source. These normalized values can then be applied to any individual catchment, with the appropriate adjustment factors. (Author's abstract)
W86-01479

SOUTHERN OSCILLATION AND RAINFALL PATTERNS IN THE SOUTHERN HEMISPHERE,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
R. G. Vines, and A. I. Tomlinson.
South African Journal of Science, Vol. 81, No. 3, p 151-156, March, 1985. 8 Fig, 36 Ref.

Descriptors: *Rainfall, *Southern Oscillation, *Southern Hemisphere, Rainfall distribution, Precipitation, Climatology, Sea surface temperatures, El Nino.

An index of the Southern Oscillation was examined in order to determine whether there were any connections between the Southern Oscillation and rainfall variations occurring in the southern hemisphere - particularly in the south Pacific region. When the results for the separate seasonal indices were compared, an interesting and striking observation was that there were only minor differences between the curves obtained in all four cases. Such an observation implies strong persistence of the Southern Oscillation from month to month. The present findings appear to substantiate commonly held ideas of a link between the behavior of the Southern Oscillation and rainfall variations in the southern hemisphere. Any such link no doubt depends on changes in atmospheric circulation and known connections between the Southern oscillation and fluctuations in sea-surface temperatures in the Pacific Ocean. On this basis, the out of phase relationship seen between the 6-7 year rainfall cycle in South America and elsewhere in the southern hemisphere from South Africa to Australia becomes understandable. This particular phenomeon is probably explainable in terms of El Nino events and the time lags involved in the movement of currents across the Pacific Ocean. (Baker-IVI)
W86-01497

DIURNAL VARIABILITY OF PRECIPITATION IN THE NORTHEASTERN UNITED STATES,

State Univ. of New York at Albany. Dept. of Atmospheric Science.
M. G. Landin, and L. F. Bosart.
Monthly Weather Review, Vol. 113, No. 6, p 989-1014, June, 1985. 28 Fig, 1 Tab, 19 Ref, 1 Append.

Descriptors: *Diurnal variation, *Precipitation, *Weather patterns, Probability, Seasonal variation, Rainfall distribution, New England, New York, New Jersey, Pennsylvania.

The diurnal and semidiurnal variations of precipitation over the northeastern United States (New England, New York, New Jersey and Pennsylvania) are investigated using 25 years of hourly precipitation data for 271 stations. The hourly data were harmonically analyzed for all measurable precipitation events ranging upwards to amounts $<$ 10.0 mm. Additionally, a regional probability of precipitation analysis was performed for homogeneously grouped stations. The winter season (November-March) displays a general early-to-mid-morning diurnal maximum for all measurable precipitation events across the Northeast with a shift to just before noon southward into Pennsylvania. For heavier precipitation events, much of the region retains the morning maximum, a notable exception being the northern mountains of New York and New England, where there is a late-evening maximum. The spring (April-May) season is quite similar to winter, although the diurnal amplitudes become weaker everywhere except from southeastern Pennsylvania, up across the New York City metropolitan area, and into southern New England, where a stronger early-morning maximum appears. Evidence for nocturnal activity is seen across western New York and Pennsylvania in the heavier precipitation category, possibly in association with stagnating warm fronts that seldom move eastward due to cold air damming in New England. Summer (June-August) features a prominent diurnal cycle at most inland locations for all precipitation categories. A strong 1800 LST maximum exists in western Pennsylvania, with a trend towards a later maximum as one moves eastward towards southern New England. Coastal stations and those along the shores of Lakes Erie and Ontario show a tendency towards nocturnal precipitation, as there appears to be a suppression of daytime convection due to the cooler ocean and lake waters. The autumn (September-October) season displays a return to a weaker diurnal pattern, similar to spring. The morning maxima return to most places, except in the mountainous areas, where late season convection tends to peak in the afternoon. The semidiurnal cycle is weak across all seasons and tends to reflect the influence of local circulations. The regional probability of precipitation analysis reveals that much of the interior northeastern United States, with the exception of western and central Pennsylvania, has maxima centered at 0300, 1000 and 1800 LST for all measurable precipitation events during the cool season. These maxima appear to be the result of a blend of synoptic scale and mesoscale forcing involving phenomena peculiar to the local geography. During the spring and summer the afternoon convective signal is most strongly evident inland. It is especially pronounced in western Pennsylvania where a further nocturnal springtime maximum is seen. Finally, an analysis of precipitation by day of the week and by day of the lunar synodic cycle is presented. No concrete evidence is found to support either signal. (Author's abstract)
W86-01525

ROLE OF LIQUID WATER ON AN ICE SURFACE DURING RIMING ELECTRIFICATION - BASIC EXPERIMENT IN THUNDERSTORM ELECTRIFICATION,

Hawaii Univ. at Hilo. Cloud Physics Observatory.
For primary bibliographic entry see Field 2C.
W86-01528

EFFECTS OF DROP SIZE DISTRIBUTION TRUNCATION ON RAINFALL INTEGRAL PARAMETERS AND EMPIRICAL RELATIONS,

Clemson Univ., SC. Dept. of Physics and Astronomy.
C. W. Ulbrich.
Journal of Climate and Applied Meteorology, Vol. 24, No. 6, p 580-590, June, 1985. 9 Fig, 20 Ref. National Science Foundation grant ATM-8120686.

Descriptors: *Rain, *Drop size distribution, *Fluid drops, Statistical analysis, Disdrometers, Numerical analysis.

A description is given of a method of estimating the effects of truncating the raindrop size distribution (DSD) at lower and upper drop diameters D min and D max which assumes that the DSD can be approximated by a gamma distribution (including the exponential distribution). The method is used to investigate the effects of DSD truncation on rainfall integral parameters (e.g., reflectivity factor, liquid water content, etc.) and on empirical relations between pairs of these integral parameters. Tests of the theoretical predictions are performed using a set of drop size data collected with a Joss disdrometer. A brief description is also given of the use of the method to determine DSD truncation effects on precipitation parameters deduced from dual-measurement techniques. (Author's abstract)
W86-01534

FRACTAL PROPERTIES OF RAIN, AND A FRACTAL MODEL,

Etablissement d'Etudes et de Recherches Meteorologiques, Paris (France).
S. Lovejoy, and B. B. Mandelbrot.
Tellus, Vol. 37A, No. 3, p 209-232, May, 1985. 18 Fig, 1 Tab, 36 Ref.

Descriptors: *Fractals, *Rainfall, *Model studies, Simulation, Probability, Statistical studies, Spatial distribution, Temporal distribution, Rainfall distribution.

This paper amplifies upon earlier theories and observations by the authors, advances a probabilistic model of rain fields, and exhibits realistic simulations. The model is also compared with other approaches. The theory of fractals has been in part motivated by the Hurst effect, which is an empirical observation in hydrology and climatology. A fractal is an unsmooth shape that is scaling, that is, where shape appears unchanged when examined by varying magnifications. The study of fractals is characterized by the prevalence of hyperbolically distributed random variables, for which Pr(U > u) varies directly as u to the -alpha where Pr is the probability that the value of the variable exceeds u, and alpha is a positive exponent. Lovejoy established the applicability of fractals in meteorology, by showing that cloud and rain areas project on the Earth along shapes whose boundaries are fractal curves, and that the temporal and spatial structure of rain is rife with hyperbolically distributed features. These observations, as amplified in this paper, set up the challenge of constructing fractal models with the observed properties. The models presented here belong to a very versatile family of random processes devised in Mandelbrot: fractal sums of (simple) pulses, or FSP processes. The simulations to be presented reveal that these processes involve a scaling heirarchy of 'bands', 'fronts', and 'clusters', as well as other complex shapes, none of which had been deliberately incorporated in the process. This very rich morphology and the related statistical distributions exemplify the power of simple fractal models to generate complex structures, and are in accord with the wide diversity of actual rainfall shapes. It is argued that this model already provides a useful context in which the basic statistical properties of the rainfield, including the relationship between the temporal and spatial structure, may be studied. (Author's abstract)
W86-01749

SENSITIVITY OF AN ENERGY BALANCE CLIMATE MODEL WITH PREDICTED SNOWFALL RATES,

National Oceanic and Atmospheric Administration, Princeton, NJ. Geophysical Fluid Dynamics Lab.
K. P. Bowman.
Tellus, Vol. 37A, No. 3, p 233-248, 1985. 10 Fig, 2 Tab, 28 Ref, 1 Append. NSF grant ATM 8106800.

Descriptors: *Climate, *Energy balance, *Model studies, *Snowfall, Snow cover, Ice sheets, Solar radiation, Hydrologic cycle, Temperature, Water vapor, Atmospheric transport.

A two-level zonally-averaged seasonal energy balance model with separate land and ocean temperatures and an explicit surface energy budget is used

to study the effects of the snowfall rate of the extent of snow cover and ice sheets. Sensitivity experiments are performed both with and without ice sheets and with two different snowfall parameterizations. When snowfall rates are prescribed independent of latitude, higher snowfall rates increase the area of snow cover but reduce the sensitivity of the snow line to changes of the solar constant. To eliminate arbitrary assumptions about the snowfall rate, a relationship between the atmospheric transports of water vapor and sensible heat is derived and tested against observations. The relationship obtained is used to predict the meridional transport of water vapor in the model, from which the precipitation and snowfall are calculated. The response of the hydrologic cycle to changes of the solar constant is qualitatively similar to that found in general circulation models. The snow line is more sensitive with the predicted precipitation than with the prescribed precipitation because the predicted precipitation rate increases toward the equator. When ice sheets are included, they are larger than permanent snow cover under the same conditions because the cold surface temperatures at high elevations on the ice sheet inhibit melting. Feedback effects of the ice sheets are small, in part because they are limited to 30% of a latitude circle in this model. (Author's abstract)
W86-01750

GLOBAL STATUS AND TREND OF DESERTIFICATION,

United Nations Environment Programme, Nairobi (Kenya). Desertification Branch.
G. Karrar, and D. Stiles.
Journal of Arid Environments, Vol. 7, No. 4, p 309-312, 1984. 2 Fig.

Descriptors: *Desertification, *Drought, *International commissions, United Nations, Foreign aid, Erosion, Land use, Planning, Rainfall, Irrigation, Developing countries, Political aspects, Organizations.

Drylands are presently under stress to a degree perhaps unprecedented in history. High human and livestock populations growth, chronic drought and bad land-use practices in many areas have resulted in 75% of all the productive land within the world's drylands becoming desertified to some extent. A United Nations Conference on Desertification in 1977 formulated the Plan of Action to Combat Desertification (PACD). On all fronts, desertification has worsened since the conference. Land irretrievably lost to desert continues at 60,000 sq km/yr, while land rendered economically unproductive is showing an increase at 210,000 sq km/yr. Most responsibility for implementing the PACD at the national level rests with governments. UNEP (United National Environment Program) hoped to use the occasion of the 12th Governing Council and the presentation of the Executive Director's report on the General Assessment to stimulate renewed interest in the global problem of desertification. It is a problem which needs immediate, concentrated attention by the world's governments and international organizations. (Baker-IVI)
W86-01855

INCIDENCE OF DROUGHTS AND ITS IMPACT ON FOOD PRODUCTION IN RAJASTHAN,

Central Arid Zone Research Inst., Jodhpur (India).
G. G. S. N. Rao, Y. S. Rama Krishna, B. V. Ramana Rao, and R. S. Purohit.
Annals of the Arid Zone, Vol. 23, No. 4, p 327-334, 1984. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Drought, *Crop yield, *Rajasthan, *India, Monsoons, Millet, Pulses, Rainfall, Aridity index.

Failure of the monsoon rains leading to drought conditions is common in Rajasthan State, India. The incidence and spread of drought over Rajasthan during the years 1972, 1974 and 1979, were analyzed on the basis of departures from the normal aridity index during different months of the southwest monsoon season. District averages of monthly rainfall for all the 26 districts in Rajasthan State were obtained from the daily rainfall records. The average rainfall in the State decreased by 32, 18 and 7% during the drought years 1972, 1974 and 1979, respectively. Consequently 84, 68 and 86% of the total area was affected by drought in the respective years. Productivity of pearlmillet and pulses was considerably affected by drought conditions. The impact of drought on the fall in productivity of these crops is more pronounced in western Rajasthan than in eastern Rajasthan. The decrease in yields during the three drought years varied from 61 to 92% in pearlmillet and 71 to 86% in the pulse crop. The variations in the productivity of the rainfed crops can be explained satisfactorily by the pattern of incidence and the spread of droughts. (Moore-IVI)
W86-01856

2C. Snow, Ice, and Frost

MODELLING ALPINE SNOW ACCUMULATION AND ABLATION USING DAILY CLIMATE OBSERVATIONS,

Canterbury Univ., Christchurch (New Zealand). Dept. of Geography.
R. D. Moore, and I. F. Owens.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 73-83, 1984. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *New Zealand, *Model studies, *Snow, *Ablation, Alpine regions, Air temperature, Mountains, Simulation, Precipitation, Altitude.

Modelled snow storage is compared to data from a snow course in the Craigieburn Range, and the utility and limitations of this approach are assessed for New Zealand conditions and data availability. Low-altitude precipitation measurements appear to provide a good index of high-altitude precipitation when averaged over the accumulation season. Snow storage was reasonably reproduced when temperatures measured at a site above the seasonal snow-line were used. The simulation quality was less satisfactory when low-altitude temperatures were used, because of marked and systematic deviations of the actual from the assumed lapse rate, and the consequent problem of distinguishing rain from snow. If no high altitude temperature measurements are available, the use of observations of storm snow-line elevations to determine the phase of precipitation may improve simulation quality. Application of these approaches should help to overcome lack of data on snow accumulation in mountainous areas of New Zealand. (Baker-IVI)
W86-01385

UNEVEN PATTERN; THE 1982-83 SNOW SEASON,

For primary bibliographic entry see Field 2B.
W86-01428

INTERNATIONAL PERSPECTIVE ON LARGE-SCALE SNOW STUDIES,

Agricultural Research Service, Beltsville, MD. Hydrology Lab.
A. Rango.
Hydrological Sciences Journal, Vol. 30, No. 2, p 225-238, June, 1985. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *International commissions, *Snow, *Large scale studies, *Research priorities, Precipitation, Remote sensing, Policy making, Governmental interrelations, Political aspects.

Because of significant physical differences between snow and other naturally occurring substances, snow is not only a valuable resource but it also has significant large-scale effects on weather, climate and the hydrological cycle. A working group of the IAHS International Comission on Snow and Ice (ICSI) has recently reached certain conclusions regarding these effects. In order to study and model the large-scale effects of snow, the standardization of existing ground observation methods, the exploitation of new technologies such as remote sensing, and the systematic archiving of all data are necessary. Various research efforts and international activities have been identified which, when accomplished, should lead to improved understanding and management of the large-scale effects of seasonal snow cover. An international organization should take the lead in promoting an exchange of ideas, techniques, measurements, research results and management strategies on large-scale snow studies. (Author's abstract)
W86-01446

ROLE OF LIQUID WATER ON AN ICE SURFACE DURING RIMING ELECTRIFICATION - BASIC EXPERIMENT IN THUNDERSTORM ELECTRIFICATION,

Hawaii Univ. at Hilo. Cloud Physics Observatory.
T. Takahashi.
Journal of the Meteorological Society of Japan. Vol. 63, No. 2, p 262-266, April, 1985. 3 Fig, 15 Ref.

Descriptors: *Electrification, *Ice, *Rime, Temperature effects, Clouds, Thunderclouds, Electrical properties, Hail, Snow, Thunderstorms.

Since the surface potential of liquid water on an ice surface is negative, the negative space charge will be enriched in the liquid layer. When this negative charge liquid layer is torn off as ice crystals collide and separate, a positive charge will be measured on rime. The present study examines this phenomenon in the cold room. At warm temperatures or in regions where the cloud water content is very high, graupel (or hail) may be electrified positively if the water film on the ice surface is removed by ice crystals when they collide and separate. If the contact area is 10 micro-m x 100 micro-m, the separated charge during such a process will be on the order of 10 to the minus 5 power esu, which is similar to the order of magnitude observed during riming. At colder temperatures, except in regions where the water content is very high, charge separation will be associated with the defects which form during ice fracture if this occurs in a graupel growth stage. Under hail growth conditions in colder temperatures, hail may be electrified during either dropsplashing or ice crystal contact-separation while liquid water flows over the hail surface. The chemical impurities of water will determine the polarity of the charge which is separated. In the latter case, the detachment of water may not be necessary for charge separation. (Baker-IVI)
W86-01528

SENSITIVITY OF AN ENERGY BALANCE CLIMATE MODEL WITH PREDICTED SNOWFALL RATES,

National Oceanic and Atmospheric Administration, Princeton, NJ. Geophysical Fluid Dynamics Lab.
For primary bibliographic entry see Field 2B.
W86-01750

ICE STORM DAMAGE TO A SOUTHERN WISCONSIN MESIC FOREST,

Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
L. P. Bruederle, and F. W. Stearns.
Bulletin of the Torrey Botanical Club, Vol. 112, No. 2, p 167-175, April-June, 1985. 1 Fig, 4 Tab, 33 Ref.

Descriptors: *Ice storms, *Storm damage, *Forests, *Wisconsin, Litter, Canopy, Wind, Topography, Climate, Slope, Glaze, Elm trees, Ironwood trees.

In 1976, an extensive ice storm struck southern Wisconsin, resulting in substantial damage to the upland forest at the University of Wisconsin-Milwaukee Cedar-Sauk Field Station. Strong northeasterly winds following the storm (80.6 km/hour) exacerbated the damage. A forest fuel sampling technique was modified to measure the volume of macro-litter resulting from the ice storm. The canopy was photographed using both wide-angle and fish-eye lenses to determine the effect upon the overstory. Macro-litter volume was determined to be 19.35 cu m/ha, accounting for a loss of approximately 35% of the canopy. Damage was uneven and was influenced by topographic and climatic

factors; inclination and aspect of slope, as well as wind were found to be of particular importance. Species susceptibility to glaze varied considerably. Susceptibility was quantified by preparing a ratio of the observed macro-litter volume with the expected volume based upon the relative dominance of each species in the stand. Ratio products ranged from 1.55 for Ulmus rubra, the most susceptible species, to 0.17 for Ostrya virginiana. Factors responsible for species susceptibility include growth form, mechanical properties of wood, tree age and degree of decay, and position in the canopy. (Author's abstract)
W86-01760

SAMPLING OF SNOW AND ICE ON LAKES,

Trent Univ., Peterborough (Ontario). Dept. of Geography.
W. P. Adams, and N. T. Roulet.
Arctic, Vol. 37, No. 3, p 270-275, September, 1984. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Ice, *Snow, *Lake ice, *Elizabeth Lake, *Labrador, White ice, Black ice, Lakes, Snow cover, Seasonal variation.

Three years of data were collected on the late winter snow and ice cover of Elizabeth Lake, Labrador, with a view to developing practical and effective sampling procedures for snow and ice on lakes in general. Elizabeth Lake has an area of 11.08 ha, a mean/maximum depth of 8.7 m/27.1 m and a volume of 2.45 x 10 to the 6th power cu m. The variation between years in mean cover values was not large. Mean snow depth varied most between years, and total ice cover the least. Black ice is lake water frozen in situ, while white ice is formed following the slushing of a snow cover. In terms of distribution present on the lake at the time of the surveys, white ice consistently had the highest coefficient of variation, with total ice again having the lowest. The pattern for black ice forms an interesting reversal of the white ice pattern with thinner ice around the margins and downwind. This illustrated that these two types of ice tend to be compensatory. (Baker-IVI)
W86-01788

2D. Evaporation and Transpiration

HYDROLOGY OF MID-ALTITUDE TUSSOCK GRASSLANDS, UPPER WAIPORI CATCHMENT: II - WATER BALANCE, FLOW DURATION AND STORM RUNOFF,

New Zealand Forest Service, Rotorua. Forest Research Inst.
For primary bibliographic entry see Field 2A.
W86-01384

DIFFERENTIAL EVAPO-TRANSPIRATION FROM A CLAY SURFACE AND ITS INFLUENCE ON EQUILIBRIUM POREWATER PRESSURE,

Golder Associates, Maidenhead (England).
For primary bibliographic entry see Field 2G.
W86-01451

ESTIMATION OF EVAPORATION FROM THE NORMALLY 'DRY' LAKE FROME IN SOUTH AUSTRALIA,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison, and C. J. Barnes.
Journal of Hydrology, Vol. 78, No. 3/4, p 229-242, June, 1985. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Lake Frome, *South Australia, *Dry lakes, *Evaporation, Groundwater inflow, Saline water, Deuterium, Recharge.

Lake Frome, situated in northern South Australia, contains water only rarely, the last time being in the period 1973-74. Depth profiles of deuterium composition, expressed as delta-values, have been used to make point estimates of evaporation from the floor of the normally 'dry' Lake Frome. Values from five sites, varying between 90 and 230 mm/yr, have been used to obtain a relatively crude approximation for mean evaporation rate from the lake of 170 mm/yr. This estimate is lower than would be expected at first sight for an almost saturated sediment surface with a water table at about 300 mm in an environment where the evaporation rate from a Class A pan is 3200 mm/yr. Actual evaporation is reduced well below potential because the vapor pressure deficit between the atmosphere and water at the evaporating surface is reduced because this water is saturated with sodium chloride. Because the surface is almost white, it has an albedo much higher than that of a free-water surface. The total evaporative flux from the lake is estimated to be 4.6 x 10 to the 8th power cu m/yr. In periods of no surface water inflow to the lake this represents the groundwater inflow to the lake. Under steady state conditions, and assuming that the surface catchment and the groundwater catchment are identical, this corresponds to a mean recharge flux of about 1 mm/yr over the catchment. (Moore-IVI)
W86-01471

DIFFERENCES IN ANNUAL EVAPORATION BETWEEN GRAZED PASTURE AND EUCALYPTUS SPECIES IN PLANTATIONS ON A SALINE FARM CATCHMENT,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
E. A. N. Greenwood, L. Klein, J. D. Beresford, and G. D. Watson.
Journal of Hydrology, Vol. 78, No. 3/4, p 261-278, June, 1985. 8 Fig, 4 Tab, 5 Ref.

Descriptors: *Evaporation, *Eucalyptus trees, *Pastures, *Australia, Saline seeps, Leaf area, Interception, Stem flow, Land reclamation, Saline farm land.

Daily evaporation (including evaporation from the ground surface) from grazed annual pastures and from five species of Eucalyptus in two farm plantations (in Australia) was measured at regular intervals for a year. Leaf area of trees and pasture, and rainfall interception and stem flow by trees, were also measured. The trees were in their seventh year after germination. The site was a first-order catchment that had developed a saline seep midslope after the felling of the prior forest. One plantation was upslope, the other was immediately above the seep. The work is part of a salinity reclamation study based on increased evaporation through the strategic use of trees. Annual evaporation from pastures was 390 mm regardless of position in the landscape. Annual evaporation from trees upslope was 2300 mm for Eucalyptus maculata and 2700 mm each for E. globulus and E. cladocalyx. Values at midslope were 1600 mm for E. wandoo, 1800 mm for E. leucoxylon and 2200 mm for E. globulus. Expressed as a proportion of annual rainfall (680 mm), annual evaporation was 0.6 for pasture and ranged from 2.4 to 4.0 for trees while interception by trees ranged from 0.16 to 0.36, and stem flow was less than 0.02. Annual evaporation, but not interception, was correlated with leaf area. The application of these findings is discussed. It is concluded that the planting of discrete areas of trees has the evaporation potential to assist in reclamation of saline farm land in the southwest region of Australia and that some species are much more effective than others. (Author's abstract)
W86-01473

SIMPLIFIED PROCEDURE FOR THE EVALUATION OF THE LAKE KINNERET EVAPORATION,

TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
E. Simon, and F. Mero.
Journal of Hydrology, Vol. 78, No. 3/4, p 291-304, June, 1985. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Lake evaporation, *Lake Kinneret, *Israel, Hydrologic budget, Energy balance, Mass transfer, Meteorology, Air temperature, Water temperature, Evaporation.

Actual evaporation losses from lake surfaces can still not be determined by direct measurements. This presents a major problem to the planners, especially in cases as Lake Kinneret (Israel), where evaporation losses represent about 30% of its water budget. A description is given of the various approaches to find an optimal method for the quantitative estimation of evaporation losses from this lake, to enable reliable water-budget calculations and also to serve as a tool for the various water allocation models for long-range planning, now under development. Past experience shows that the best evaporation estimates can be obtained by the energy balance and the mass transfer methods, widely used all over the world. In this case, two micro-meteorological stations were installed on the up-wind western and the down-wind eastern shore of the lake. The big mass of the accumulated data has been carefully analyzed, and served as a basis for the various theoretical and more or less empirical approaches to obtain the desired optimal estimate of lake evaporation losses. Another problem to be solved was to find simpler, more easily obtainable data (as air and water temperatures, etc.), to serve as long-term evaporation estimator, to permit reconstruction of long-term series of Lake Kinneret water balances, to permit optimized use of the available water resources originating from the Jordan River and the direct drainage area of this lake. The various estimation methods, discussed in this paper were calibrated and compared to the now used energy balance method, considered as the most reliable approach for the evaporation measurements. During the process of these analyses, some doubts were raised as to the reliability of frequently used methods for the elusive estimate of evaporation losses. (Author's abstract)
W86-01475

CALCULATING THORNTHWAITE AND MATHER'S ACTUAL EVAPOTRANSPIRATION USING AN APPROXIMATING FUNCTION,

Oak Ridge National Lab., TN. Environmental Sciences Div.
J. Pastor, and W. M. Post.
Canadian Journal of Forest Research, Vol. 14, p 466-467, 1984. 1 Fig, 6 Ref. DOE contract W-7405-eng-26.

Descriptors: *Evapotranspiration, *Water loss, *Soil water, Precipitation, Temperature effects, Water storage.

Soil water storage is related to a maximum storage value (field capacity) and accumulated potential water loss through a simple negative exponential function. This formula summarizes 10 tables from the Thornthwaits and Mather (Publications in Climatology, 10: 183-311, 1957) needed to calculate actual evapotranspiration. Values predicted by this formula and the Thornthwaite and Mather's tabulated values are compared. Discrepancies between tabulated and predicted values occurred largely due to the fact that the equation is a continuous function while the tables are step functions. (Baker-IVI)
W86-01780

2E. Streamflow and Runoff

SOUTHLAND FLOOD OF JANUARY 1984,

Southland Catchment Board, Invercargill (New Zealand).
D. C. Riddell.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 120-129, 1984. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Rainfall, *Southland, *New Zealand, *Waihopai River, *Floods, Storm runoff, Water levels, Probable maximum precipitation, Flood hydrographs, Flood flow.

Nine automatic raingauges and more than 100 manual gauges gave an excellent record of the storm rainfall which caused the floods of January 1984 in Southland and caused extensive damage. River flows and lake levels were recorded at 17 sites. Over the 18 hours which the storm lasted, heavy rainfall was associated with fronts in an extremely deep and humid northwesterly airflow. The estimated probably maximum flood for the

Waihopai River which flows through Invercargill is twice the size of the January 1984 flood which reached 112 times mean flow. Being far larger than any other storm experienced in recent times, the 1984 storm provided an opportunity for assessing the likely probable maximum precipitation for the Invercargill region and particularly for the Waihopai River catchment. Temporal distribution of the January 1984 storm rainfall was similar to that normally assumed for the probable maximum precipitation, so a probable maximum flood hydrograph for the Waihopai River was derived by scaling the ordinates of the January flood hydrograph by the ratio of the probable maximum direct runoff to the January runoff. If 10% of the probable maximum precipitation were retained in storage, a direct runoff of 21 mm would be expected. This is twice the January 1984 flood runoff. With baseflow this would result in a probable maximum peak flow of 580 cu m/sin the Waihopai River, a specific discharge of 3.6 cumecs per square kilometer. (Baker-IVI)
W86-01388

DRAINAGE COEFFICIENTS FOR HEAVY LAND,

Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W86-01431

PROBABILITY-DISTRIBUTED PRINCIPLE AND RUNOFF PRODUCTION AT POINT AND BASIN SCALES,

Institute of Hydrology, Wallingford (England).
R. J. Moore.
Hydrological Sciences Journal, Vol. 30, No. 2, p 273-297, June, 1985. 10 Fig, 33 Ref.

Descriptors: *Statistical analysis, *Runoff forecasting, *Hydrologic models, *Rainfall-runoff models, Infiltration capacity, Storage capacity, Overland flow.

The probability-distributed principle in basin-scale hydrology considers the frequency of occurrence of hydrological variables (model inputs, parameters or elements) of certain magnitudes over the basin without regard to the location of a particular occurrence within the basin. The random assemblage of different parts is considered more important than the relation of the parts, one to another. Rainfall-runoff models based on probability-distributed infiltration capacity and storage capacity concepts, and which generate runoff according to Hortonian and saturation overland flow mechanisms respectively, are distinguished. Two types of probability-distributed storage capacity model are identified, one based on an assumption that storage elements at points in the basin respond independently of their neighbors, and the other where storage elements interact so as to equalize the depth of stored water over the basin. Allowing redistribution of water leads to simplification of the model equations. The probability-distributed principle is also used to represent the process of water translation through the basin. Interpretation of the instantaneous unit hydrograph as a probability density function of translation time is demonstrated and the inverse Gaussian density proposed as a suitable functional form on physical grounds. (Author's abstract)
W86-01449

RIVER RECESSION ANALYSIS IN THE OPERATIONAL MANAGEMENT OF LAKE ABSTRACTION,

S. Walker, and D. Pearson.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 244-253, June, 1985. 7 Fig, 4 Ref.

Descriptors: *Water level fluctuations, *Lakes, *Water management, Mathematical equations, Water level, Forecasting, Stream flow, Rivers.

The need to obtain reliable estimates of the likely changes in stream flow with time has led to a reappraisal of the methods available for analyzing flow data. The need also to include a stochastic component in the description of the way in which such data arise leads to some problems, but the developed techniques have been found to provide a reasonable solution to them. The methods are attractive, as they make no assumptions about the relationship between successive daily flows and hence may be applied in a wide range of situations. Some care is required when analyzing data with a high level of observational noise and for which recession rate varies markedly with flow. The search for more flexible techniques was justified by the analysis of flow data from Windermere and Ullswater. Here, recession rate varied with flow, and the relationship between them was different with and without abstractions. Changes in recession rate with flow were also observed on the river Derwent, though these were of a smaller order than those observed on the rivers controlled by lakes. A comparison between the recession curve for the unregulated flow in the river Derwent and the curves for Windermere and Ullswater in the no-pumping case is presented. The curves for Ullswater and the Derwent are similar, showing a steady quickening of recession rate as flow increases. This is the shape which can be expected for an uncontrolled river. In comparison, the curve for Windermere is much flatter. This is reasonably explained by difference in physical characteristics of the outlets to the lakes. The recession curves for Windermere have been used to construct a diagram showing the number of days for which pumping is likely to be sustained before the flow falls below a prescribed flow level. This is now being used as an aid in the everyday operation of the pumping station, and proves a practical example of the value of obtaining reliable estimates of recession factors for use in the management of lake and river abstraction systems. (Baker-IVI)
W86-01522

TURBULENT FLOWS OVER A WAVY BED,

Delaware Univ., Newark. Ocean Engineering Program.
N. Kobayashi, and O. S. Madsen.
Journal of Geophysical Research, Vol. 90, No. C4, p 7323-7331, July, 1985. 3 Fig, 1 Tab, 24 Ref.

Descriptors: *Turbulent flow, *Wavy beds, *Hydrodynamic models, Model studies, Shear stress, Boundary conditions, Ripples, Hydraulics, Hydrodynamics, Fluid mechanics.

A hydrodynamic model was developed for the calculation of shear stress and pressure along a sinusoidal boundary that is fixed or propagating very slowly in a wide rectangular open or closed channel. The model uses curvilinear coordinates that follow the wavy boundary, and it is similar to that for two-dimensional wavy boundary flows of infinite extent proposed by Benjamin except that the present model takes account of turbulent stresses on the basis of the turbulent eddy viscosity concept employed by Hussain and Reynolds. The compact analytical expressions for the perturbed shear stress and pressure on the wavy boundary are derived for the cases of hydraulically smooth turbulent and fully rough turbulent flows. The developed model is shown to be in good agreement with the experiments conducted by Zilker et al. The developed hydrodynamic model is applied to the problem of the formation of ripples in erodible channels by Kobayashi and Madsen. (Author's abstract)
W86-01537

TRAPEZOIDAL CHANNELS WITH INCREASING DISCHARGE,

Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
R. Guarga, and M. Lara.
Journal of Engineering Mechanics, Vol. 110, No. 7, p 1050-1059, July, 1984. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Trapezoidal channels, *Channel flow, *Stream discharge, Hydraulics, Cross-sections, Numerical analysis, Mathematical equations.

Flow in channels of trapezoidal section has not been treated in general, although it is the most frequent encountered in practice; there has also not been a complete review of the possible cases of flow in a channel of trapezoidal section with increasing flow. Previously, the solution to the problem of increasing discharge in trapezoidal cross sectional channels has been obtained via numerical computation for each particular case. The problem was studied using the classic equation of 'momentum' which is normalized utilizing the coordinates of the singular point. Using linear transformations it is possible to reduce the classic equation for channels with increasing discharge to a universal equation for all the cases of trapezoidal section and non-zero slope. The possible flow cases in a channel with increasing discharge arise from the analysis of this equation. In the case of a channel with zero slope, the exact solution to this problem is obtained by analytical integration of the equation for the adimensional parameters. It was possible to completely analyze different flow regimes that may occur in the channel and also the curves representing the free surface may be classified. (Collier-IVI)
W86-01541

STORMWATER RUNOFF FROM HIGHWAYS,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5B.
W86-01605

NUTRIENT RUNOFF LOSSES AS PREDICTED BY ANNUAL AND MONTHLY SOIL SAMPLING,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5B.
W86-01709

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. R. Richardson, S. R. Abt, and E. V. Richardson.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1133-1147, August, 1985. 8 Fig, 3 Tab, 11 Ref.

Descriptors: *Inflow seepage, *Channels, *Streambeds, Seepage, Hydraulics, Sediment transport, Scour, Fluid dynamics.

A flume study was conducted to identify and analyze the effects of inflow seepage on flow in straight alluvial open channels. The effect of inflow seepage on energy slope, water surface depth, velocity, sediment transport, scour, bed forms, and resistance to flow was investigated. The results of this investigation indicated that inflow seepage increases localized mean channel velocity, energy slope, and stream power in the zone of inflow. The water surface depth decreased for subcritical flow and remained nearly constant for supercritical flow during inflow conditions. Sediment transport was slightly increased when inflow was introduced in the bed. Inflow seepage did not appear to enhance channel scour. Inflow seepage significantly enhanced bed form transformation and the bed roughness. Inflow seepage also caused dunes to become longer, flatter, and move more erratically in the reach where inflow occurred. Inflow seepage could significantly influence the channel hydraulics, stream power, bed form and bed roughness in the localized zone of inflow. (Author's abstract)
W86-01731

DETERMINATION OF RIPPLE GEOMETRY,

Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
M. S Yalin.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1148-1155, August, 1985. 4 Fig, 10 Ref.

Descriptors: *Ripple geometry, *Ripple marks, *Streambeds, Sediment transport, Hydraulics, Fluid mechanics.

Laboratory measurements were carried out on the mobile bed covered by ripples generated by an open channel flow. The bed materials used were

cohesionless and reasonably uniform; the steady-state subcritical flume flow was in equilibrium and it was nearly two-dimensional. In addition to the conventional runs conducted with water, special runs were conducted with a water and glycerine mixture. Using the results of these measurements, as well as the data of other reliable sources, a series of experimental curves were determined which can be used to predict the length and height of ripples. The analysis of the data indicates that the dimensionless quantities related to the geometry of ripples are functions of two dimensionless variables. One of them must be a combination reflecting the intensity of sediment-transporting flow, the other must be an arrangement of parameters characterizing the physical nature and the liquid and solid phases involved. (Author's abstract)
W86-01732

PREDICTION OF 2-D BED TOPOGRAPHY IN RIVERS,

Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W86-01734

COMPARISON OF THE RESULTS OF CALCULATING UNSTEADY FLOW IN THE ENISEI MOUTH STRETCH BY THE FINITE-DIFFERENCE AND FINITE-ELEMENT METHODS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. K. Kantorovich, and T. A. Lysenko.
Water Resources, Vol. 11, No. 4, p 289-293, July-August, 1984. 3 Fig, 2 Tab, 4 Ref. Translated from Vodnye Resursy, No. 4, p 30-34, July-August, 1984.

Descriptors: *Unsteady flow, *Finite element method, *Enisei River, *USSR, Flow, Hydraulics, Waves, Wind, Surges, Computers.

The mouth stretch of the Enisei River (USSR) was investigated between Selivanikha and Baikalovsk, having a length of about 800 km. The upriver propagation of a surge wave forming within the Kara Sea and Enisei Gulf was investigated in this stretch. The formation of the surge is due to the presence of aperiodic fluctuations of the water level in the mouth nearshore zone occurring under the effect of wind and causing a variable backwater. As the initial information for assigning the hydraulic and geometric characteristics of the channel of the Enisei mouth region in the calculations, the data was used of hydrometric and morphometric measures which were preliminarily corrected with consideration of an analysis of the results of a number of calculations of the propagation of surges in 1962, 1963, 1969, 1972, and 1973. Calculation by the finite-difference method was performed on a BESM-6 computer according to a program written in ALPHA-6. Although the computers and translators used are different, an estimate made of the expenditures of computer time permits the conclusion that these expenditures are slightly less for calculation by the finite-element method. The calculations of unsteady flow by Saint Venant equations showed that for such a large scale object as the mouth stretch of the Enisei River the use of the finite-element method leads to some gain in accuracy and expenditures of computer time compared with the finite-difference method. (Baker-IVI)
W86-01802

TEMPERATURE REGIME IN WATER BODIES OF THE VOLGA DELTA UNDER REGULATED RUNOFF CONDITIONS,

Astrakhan Reserve (USSR).
G. V. Rusakov, and A. V. Moskalenko.
Water Resources, Vol. 11, No. 4, p 347-354, July-August, 1984. 4 Tab, 6 Ref. Translated from Vodnye Resursy, No. 4, p 95-99, July-August, 1984.

Descriptors: *Water temperature, *Volga Delta, *USSR, *Runoff, Temperature effects, Weather, Deltas, Hydrological regime, Swamps, Lakes.

Water temperature is one of the important elements of the hydrologic regime which has a considerable effect on natural processes in water bodies of the Volga delta (USSR). The temperature regime of various water bodies of the delta is different and depends on the temperature of the water arriving there from the Volgograd reservoir, general weather conditions of the region, daily variation of the air temperature in the delta, depths of the water body, flowage, and its overgrowth by aquatic vegetation. In the shallow channels crisscrossing the delta the flowage is slightly weaker than in the Volga branches, the water temperature is higher than in the Volga but lower than in the backswamp and delta lakes. Heated water can flow into such shallow channels from the back swamps and delta lakes. The temperature regime of the backswamps and delta lakes in the lower part of the Volga-Aktuba floodplain differs somewhat from the temperature regime of the backswamps and lakes of the lower reaches of the delta. This is related to the fact that in the floodplain flooding of the backswamps and lakes occurs rapidly, primarily with cold surface waters of the Volga; the depths are considerably greater; flowage sets in at the start of their flooding; the current speeds are considerable; owing to the absence of dense aquatic and terrestrial vegetation heating of the water column in them occurs gradually and uniformly from the surface to the bottom. The rise of water temperature in water bodies of the delta after the ice period occurs at different times throughout its territory. As a result of regulating the Volga runoff, considerable changes occurred in the characteristics of the temperature regime of the delta water bodies. An increase of the water temperature in the delta water bodies in the fall-winter period already has an effect on the dynamics of the hydrologic and geomorphologic processes occurring in them. The current state of the thermal regime should be taken into account when planning and conducting measures to increase the biological productivity of the delta water bodies. (Baker-IVI)
W86-01809

FINITE AMPLITUDE WAVES IN STRATIFIED TWO-PHASE FLOW: TRANSITION TO SLUG FLOW,

California Univ., Santa Barbara.
R. Ahmed, and S. Banerjee.
AIChE Journal, Vol. 31, No. 9, p 1480-1487, September, 1985. 8 Fig, 13 Ref. NSF grant CP-81-12667.

Descriptors: *Slug flow, *Two-phase flow, *Mathematical equations, Density, Velocity, Waves, Schrodinger equation, Stratified flow, Wave amplitude.

In horizontal two-phase flow, phases stratify due to density differences if the velocity difference between the phases is small relative to the phase velocities. as the velocity difference between the phases is increases, waves appear on the initially smooth interface but the phases remain distinctly separated. At sufficiently high velocity differences interfacial waves grow rapidly, tending to block the flow, i.e., they are swept up to form slugs. A perturbation technique based on the method of multiple scales is used to solve the system of equations governing finite amplitude waves at the interface between two bounded fluids. This method allows the separation of the system into two parts: the rapidly varying phase of the disturbances, and the slowly varying amplitude. The complex system of equations governing the modulation of the wave amplitude can be reduced to a nonlinear Schrodinger equation. Nonlinear instability is essentially determined by the signs of two coefficients in the Schrodinger equations, leading to an analytically established criterion for the growth of finite-amplitude waves at the interface between two bounded flowing fluids. The predictions made by this study are in reasonable agreement with existing experimental results and appear to provide a theoretical framework for interpreting experiments on transition from stratified to slug flow. (Moore-IVI)
W86-01864

2F. Groundwater

EXPERIMENTAL MEASUREMENT OF CHANNELING OF FLOW IN POROUS MEDIA,

Cold Regions Research and Engineering Lab., Hanover, NH.
J. L. Oliphant, and A. R. Tice.
Soil Science, Vol. 139, No. 5, p 394-399, May, 1985. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Soil water, *Channeling, *Porous media, *Permeability coefficient, Unsaturated flow, Montmorillonite, Clays, Hydraulics, Silt.

By comparing experimental measurements of the hydraulic conductivity and the effective self-diffusivity of water in porous media, a channeling parameter, c, is defined. This parameter measures the degree of division of flow paths in the media, but does not depend on the tortuosity of the paths or surface effects on the viscosity of the water. Values of c are obtained for Na-saturated montmorillonites containing from 0.82 to 7.7 g of water per g of clay and for Fairbanks silt containing from 0.135 to 0.23 g of water per g of silt. Values for the montmorillonites remain relatively close to the theoretically predicted value of 1/3 of all water contents, indicating maximally divided flow paths. Values for the silt vary from 100 to over 2000, indicating highly channeled flow. (Author's abstract)
W86-01419

ELECTRICAL RESISTIVITY FOR ESTIMATING GROUND-WATER RECHARGE,

Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
W. E. Kelly.
Journal of Irrigation and Drainage Engineering, Vol. 11, No. 2, p 177-180, June, 1985. 2 Fig, 7 Ref. NSF grants GK-42130 and ENG 78-19408.

Descriptors: *Groundwater recharge, *Resistivity, *Unsaturated flow, Permeability coefficient, Vadose water, Hydrogeology.

Estimates of recharge rates from surface resistivity measurements should be possible under favorable conditions. Electrical properties of unsaturated soils can be characterized by a form of Archie's law. Differences in resistivity are primarily due to differences in degree of saturation with fine-grained sediments tending to occur in situ at lower resistivities than coarse sediments which occur at lower degress of saturation. On a relative basis, higher transverse resistances would reflect sites more favorable for recharge. Estimates of transverse resistance may be made without interpreting sounding curves in some cases. When sounding curves can be completely interpreted, the resistivity of the vadose zone can be estimated. The resistivity of this layer will be an average transverse resistivity which should correlate with the average hydraulic conductivity of the vadose zone during recharge. Field data under a variety of geohydrological conditions are needed, along with lab work on the electrical properties of unsaturated soils and a study of the geometric effects mentioned. This information would provide a sounder basis for applying the surface resistivity in recharge studies. (Baker-IVI)
W86-01437

THERMAL INFRARED DETECTION OF SUBMARINE SPRINGS ASSOCIATED WITH THE PLYMOUTH LIMESTONE,

Plymouth Polytechnic (England). Dept. of Environmental Sciences.
I. S. Roxburgh.
Hydrological Sciences Journal, Vol. 30, No. 2, p 185-196, June, 1985. 11 Fig, 1 Tab, 15 Ref.

Descriptors: *Infrared imagery, *Submarine springs, *Plymouth Limestone, *Devon, *England, Remote sensing, Springs, Groundwater, Limestone, Coastal aquifers, Geomorphology, Geohydrology.

The Plymouth Limestone is the most westerly of a number of separate carbonate outcrops occurring in South Devon, England. In the absence of land-based springs and in the presence of a groundwater gradient which falls seawards from the Upper Devonian slates to the limestone, it is possible that

groundwater discharge from the Plymouth Limestone is taking place through a number of coastal and submarine springs in Plymouth Sound. Freshwater groundwater within the Plymouth Limestone can be shown to be in hydraulic continuity with the marine waters of Plymouth Sound. Fresh groundwater discharges from the limestone in the form of submarine springs can be detected on the basis of temperature differences between the fresh groundwater and the marine waters using an aircraft-mounted thermal infrared linescanner. Analysis of the thermal data is improved and aided by the use of the GEMS color contouring analysis facility. (Collier-IVI)
W86-01443

APPROPRIATE MONITORING TECHNIQUES USING BOMB TRITIUM AND OTHER GEOCHEMICAL PARAMETERS IN HYDROGEOLOGICAL INVESTIGATIONS,

Anambra State Univ. of Technology, Awka (Nigeria). Water Resources and Environmental Pollution Unit.
B. C. E. Egboka.
Hydrological Sciences Journal, Vol. 30, No. 2, p 207-224, June, 1985. 7 Fig, 3 Tab, 40 Ref.

Descriptors: *Tritium, *Isotope studies, *Geochemistry, *Geohydrology, Water chemistry, Monitoring, Radioisotopes, Groundwater movement, Groundwater dating.

Since the atmospheric nuclear tests in 1953, precipitation has contained concentrations of bomb tritium (H-3) higher than the H-3 naturally deposited prior to 1953; consequently, H-3 has been used to investigate groundwater flow systems. It is a tracer for pre-1953 groundwater. A critical review of earlier uses of bomb tritium spotlights problems in its applications that may result in erroneous interpretations. The old monitoring technique using boreholes causes mixing of groundwaters of different age zones. In this study, the mixing problem is overcome by using modern monitoring devices of multi-level samplers and bundle piezometers that yield groundwater samples of small volumes at closely-spaced intervals. The old method may be used to determine recharge and discharge areas of aquifers and used where pollution poses no serious threat. Otherwise, the major pumpage of the aquifer distorts and reverses flow directions, causes mixing of different waters and may spread the pollutants. The disadvantages of the modern method include its restricted use in shallow aquifers and porous media. Case studies for use of tritium as an identifier were conducted at: an abandoned landfill site at the Canadian Forces Base, Borden, Canada; at the Whiteshell Nuclear Research Establishment, Pinawa, Canada; and at the Greenbrook Well Field in Kitchener, Ontario, Canada. The use of isotopes in hydrological studies in Africa is discussed. (Collier-IVI)
W86-01445

DECIPHERING HYDROLOGICAL SYSTEMS BY MEANS OF GEOCHEMICAL PROCESSES,

Geological Survey, Reston, VA.
B. B. Hanshaw, and W. Back.
Hydrological Sciences Journal, Vol. 30, No. 2, p 257-271, June, 1985. 1 Fig, 42 Ref.

Descriptors: *Geochemistry, *Geohydrology, *Groundwater, *Physicochemical characteristics, Carbonate rocks, Aquifers, Saline-freshwater interfaces, Calcite.

The distribution of permeability and chemical character of groundwater in carbonate aquifers is significantly influenced by the many diagenetic processes and reactions that occur in the early development of these rocks. Many of these diagenetic processes occur in the transition zone formed as the carbonate sediments emerge from the marine environment and become fresh-water aquifers. Analyses of trace elements and isotopes indicate that calcite cements and dolomites are formed in this groundwater mixing zone. Reverse reactions such as mineral dissolution and dedolomitization occur in carbonate aquifer systems. The geochemical reactivity of the fresh-water/salt-water mixing zone results from the nonlinearity of geochemical parameters as a function of ionic strength and causes extensive dissolution in coastal carbonate rocks. Interpretation of geochemical reactions and isotopic composition of groundwater provides a method to determine hydrological parameters such as porosity, hydraulic conductivity, and groundwater flow rates. This geochemical method is largely independent of the more conventional approach of determining these parameters by an evaluation of physical properties of aquifer systems. (Author's abstract)
W86-01448

WATER FLOW AND SWELLING PRESSURE IN NON-SATURATED BENTONITE-BASED CLAY BARRIERS,

Luleaa Univ. (Sweden).
L. Borgesson.
Engineering Geology, Vol. 21, No. 3/4, p 229-237, June, 1985. 9 Fig, 5 Ref.

Descriptors: *Bentonite, *Groundwater barriers, *Swelling pressure, Permeability, Water flow, Barriers, Groundwater management, Groundwater pollution, Model studies.

Experiments were devised to determine the water uptake of 10 and 20% bentonite-sand mixtures and of 100% pure bentonite. The swelling pressure situation in an unsaturated clay barrier is very complex especially when the degree of saturation varies through the barrier, and when the access to water is restricted. A piece of bentonite can be highly saturated, and yet it will not exert any pressure on a surrounding stiff material, if it has no further access to water, and if it has been allowed to swell enough to transfer the pressure to something that might be seen as a negative pore pressure. It is necesary to find the influence of the degree of saturation on the swelling pressure in a small clay element, to be able to estimate the pressure in a more complex situation. The swelling pressure reaches a peak value after a relatively short time and then approaches a slightly smaller constant value. The peak value is probably due to either released elastic stresses in the sample, or to the fact that the degree of saturation is very high near the water inlet at the beginning of the test, before the water content is equalized. An equation is derived which serves as a useful model to describe water flow, if there is no temperature gradient. The water diffusion constant in this equation must be determined using the correct initial water content. The model gives better results if the material is partly saturated, than if it is dry. The swelling pressure is a linear function of the degree of saturation. (Baker-IVI)
W86-01455

CARBONATE CHEMISTRY OF RECENT CHALK GROUNDWATER IN A PART OF EAST ANGLIA, U.K.,

Birmingham Univ. (England). Dept. of Geological Sciences.
J. A. Heathcote.
Journal of Hydrology, Vol. 78, No. 3/4, p 215-227, June, 1985. 2 Fig, 3 Tab, 28 Ref.

Descriptors: *Groundwater, *Carbonates, *Chalk Aquifer, *England, Aquifers, Alkalinity, Hydrogen ion concentration, Carbon radioisotopes, Carbon dioxide, Dissolution, Chemical properties.

An example of apparent open-system dissolution is described from a region where a limestone aquifer is recharged through thick calcareous soils developed on till. Groundwaters in the area have higher alkalinities and lower pH-values than are generally reported for carbonate terrains, apparently as a consequence of open-system dissolution. However, limited C-13 isotope data are incompatible with this conclusion, indicating that exchange with the gas phase does not control the isotope chemistry and therefore that the system is isotopically closed. This paradox can be resolved if the dynamics of the system are considered; it is shown that back-diffusion of gas from the solution to the gas reservoir is prevented and therefore isotopic equilibrium between gas and solution is not achieved. Isotope data also show that limited transfer of carbon between soil water and soil calcite occurs. (Author's abstract)
W86-01470

ESTIMATING INTERFACE ADVANCE DUE TO ABRUPT CHANGES IN REPLENISHMENT IN UNCONFINED COASTAL AQUIFERS,

Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.
L. T. Isaacs.
Journal of Hydrology, Vol. 78, No. 3/4, p 279-289, June, 1985. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Coastal aquifers, *Saline-freshwater interfaces, *Replenishment, Dimensional analysis, Saline water wedge, Mathematical equations, Aquifers.

Dimensional analysis is used to establish a functional relationship between the interface toe position and the other parameters for a one-dimensional, unconfined, coastal aquifer subjected to a rapid decrease in replenishment. Non-dimensional curves for the motion of the toe of the salt-water wedge for some cases are presented. The curves were developed from accurate numerical solutions of the equations for motion of the interface and can be used for reliable estimates of the response of interfaces under the conditions assumed for the analyses. An approximate formula for the rate of movement of the toe is derived for the special case when replenishment reduces to zero. (Author's abstract)
W86-01474

INVESTIGATION OF THE RELATION BETWEEN FISSURE FLOW AND DEGREE OF CONTACT AREA BY AN ELECTRIC ANALOGUE MODEL,

Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
G.-A. Tselentis.
Journal of Hydrology, Vol. 78, No. 3/4, p 325-330, June, 1985. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Geological fractures, *Analog models, *Geohydrology, Groundwater movement, Contact area, Model studies, Flow rate.

Fissures in rock masses are a common feature in the near-surface layers of the Earth's crust, and in many situation they form the primary conduits for water movement. The hydraulic behavior of these fissure systems is very important to many geotechnical activities such as pumping, where it is important to know how the hydraulic properties of the fissure will change under conditions of increasing effective stress and thus increasing contact area. The degree of contact area in a fissure plane is a function of the rock stress across the plane and the elastic properties of the rock surface. A knowledge of the relation between fissure flow rate and the contact area of a fissure is very important, especially when dealing with soft rocks. An electrically conductive paper analogue was used to simulate fluid flow through a partially closed fissure and the flow rate for various degrees of contract area was estimated. The existence of contact areas across a fissure results in a decrease of flow rate and this decrease is a function of the contact area between the rock surfaces. (Moore-IVI)
W86-01477

STUDY OF THE HYDROGEOPHYSICAL PROPERTIES OF FISSURED AQUIFERS USING A DOUBLE POROSITY MODEL,

Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
G.-A. Tselentis.
Journal of Hydrology, Vol. 78, No. 3/4, p 331-344, June, 1985. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Geological fractures, *Aquifers, *Geophysics, *Porosity, Permeability coefficient, Geophysical formation logs, Hydraulic properties, Electrical properties, Cementation factor.

The purpose of this paper is to examine to what extent the hydrogeophysical properties of fissured aquifers can be derived from geophysical logs alone. To do this a theoretical double porosity model based on a tortuosity-free, parallel conduc-

tion path assumption is introduced and is used to establish possible relations between geophysical parameters that can be measured from conventional geophysical formation logs and the hydraulic characteristics of the aquifer. The relation between the formation's cementation factor and the electrical properties of the water and the solid particles of the formation is investigated and the results are applied for three different types of geologies. Finally an expression for assessing the aquifers hydraulic conductivity from parameters measured from geophysical formation logs is derived. (Author's abstract)
W86-01478

NUMERICAL MODEL OF COMPACTION-DRIVEN GROUNDWATER FLOW AND HEAT TRANSFER AND ITS APPLICATION TO THE PALEOHYDROLOGY OF INTRACRATONIC SEDIMENTARY BASINS,

Illinois Univ. at Urbana-Champaign. Dept. of Geology.
C. M. Bethke.
Journal of Geophysical Research, Vol. 90, No. B8, p 6817-6828, July, 1985. 8 Fig, 1 Tab, 84 Ref, 3 Append.

Descriptors: *Mathematical models, *Groundwater movement, *Heat transfer, *Paleohydrology, *Sedimentary basins, Aquifers, Geothermal gradient, Aquathermal pressuring, Conduction, Hydraulic properties.

A new numerical method allows calculation of compaction-driven groundwater flow and associated heat transfer in evolving sedimentary basins. The model is formulated in Lagrangian coordinates and considers two-dimensional flow in heterogeneous, anisotropic, and accreting domains. Both the continuity of the deforming medium and aquathermal pressuring are explicitly taken into account. A calculation of compaction-driven flow during evolution of an idealized intracratonic sedimentary basin including a basal aquifer predicts slow groundwater movement over long time periods. Fluids in shallow sediments tend to move upward toward the sedimentation surface, and deeper fluids move laterally. The hydraulic potential gradient with depth reverses itself near the basal aquifer, and fluids in this area have a tendency to migrate obliquely into stratigraphically lower sediments. Only small excess pressures develop, suggesting that intracratonic basins are not subject to overpressuring during their evolutions. Owing to the small fluid velocities, heat transfer is conduction-dominated, and the geothermal gradient is not disturbed. Variational studies show that excess hydraulic potentials, but not fluid velocities, depend on assumptions of permeability and that both excess potentials and velocities scale with sedimentation rate. Aquathermal pressuring is found to account for $< 1\%$ of the excess potential developed during compaction. These results cast doubt on roles of compaction-driven flow within intracratonic basins in processes of secondary petroleum migration, osmotic concentration of sedimentary brines, and formation of Mississippi Valley-type ore deposits. Results might also be combined with chemical models to investigate the relationship of compaction flow to cementation in sediments. (Author's abstract)
W86-01485

GROUNDWATER AT HOME AND ABROAD,

Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 271-283, June, 1985. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Aquifer properties, *Model studies, Groundwater movement, Saline water intrusion, Groundwater recharge, Hydrochemistry, Great Britain, India, Wells, Boreholes, Groundwater management.

Several groundwater situations are considered in Britain and the Indian Subcontinent. Particular attention is given to the differing types of wells and boreholes, the estimation of recharge, and the important features of aquifers. A discussion is also presented of problems that have arisen during exploitation of groundwater including over exploitation, waterlogging and saline intrusion. As no two aquifers are alike, the approach must be varied for each. Although routine field investigations are needed for each study, there are usually certain key features that need to be identified before an adequate understanding can be gained. Identifying the key features is usually the difficult part of the study. In the Lower Mersey Sandstone aquifer it was important to identify the following consideration: before significant abstraction occurred there were many active springs; the actual recharge was less than the potential recharge due to the influence of the drift cover; the ingress of saline water from the Mersey Estuary allowed fresh water to be released for abstraction; hydrochemical information usually reflected conditions in the aquifer several hyundreds of years ago. For the Mehsana area aquifer the following features appear to be significant: only small quantities of water can move laterally through the aquifer; significant verical flow is occurring through the clay layers; and leakage through the beds of canals and water courses is likely to produce a significant increase in the recharge. In a regional groundwater study it becomes important to attempt to fit together the various aspects throughout the study. (Baker-IVI)
W86-01524

HYDROGEOPHYSICAL MODEL FOR RELATIONS BETWEEN ELECTRICAL AND HYDRAULIC PROPERTIES OF AQUIFERS,

Geofyzika N.E., Geologicka, Barrandov (Czechoslovakia).
O. Mazac, W. E. Kelly, and I. Landa.
Journal of Hydrology, Vol. 79, No. 1/2, p 1-19, 1985. 12 Fig, 1 Tab, 38 Ref.

Descriptors: *Aquifer characteristics, *Hydraulic properties, *Electrical properties, Groundwater, Model studies, Hydrologic models, Groundwater flow.

Factors affecting relations between the geoelectric and hydraulic properties of aquifers are considered. The reliability of relations between electrical and hydraulic aquifer parameters depends primarily on two factors: the character of the material-level relationship; and the mutual relation between the direction of groundwater flow, layering and the hydrogeophysical conditions in the aquifer. The sources of errors in determining the basic geoelectric and hydraulic parameters in a set of measurements were analyzed. The necessity of applying a statistical criterion for determining the minimum number of parametric points was stressed. Both direct and inverse material-level relationships can exist depending on the rock type and the character of the hydraulic conductivity. Inverse relationships can be expected when porosity controls variations in hydraulic conductivity and other factors such as grain size, sorting, and clay content are relatively constant. Direct relationships appear to be controlled by inverse correlations between grain size and porosity or inverse correlations between clay content and hydraulic conductivity. A general hydrogeophysical model was used to demonstrate that at the aquifer scale a variety of relations may be expected. (Baker-IVI)
W86-01653

IDENTIFICATION OF PARAMETERS IN UNCONFINED AQUIFERS,

Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
K. Sridharan, R. Ramaswamy, and N. S. Lakshmana Rao.
Journal of Hydrology, Vol. 79, No. 1/2, p 73-81, July, 1985. 5 Fig, 13 Ref.

Descriptors: *Aquifers, *Pumping tests, *Parameter identification, Optimization, Permeability coefficient, Storage, Specific yield, Sensitivity analysis, Least squares method.

A method is presented for identification of parameters in unconfined aquifers from pumping tests, based on the optimization of the objective function using the least squares approach. Four parameters are to be evaluated, namely: the hydraulic conductivity in the radial and the vertical directions, the storage coefficient and the specific yield. The sensitivity analysis technique is used for solving the optimization problem. Besides eliminating the subjectivity involved in the graphical procedure, the method takes into account the field data at all time intervals without classifying them into small and large time intervals and does not use the approximation that the ratio of the storage coefficient to the specific yield tends to zero. Two illustrative examples are presented and it is found that the parameter estimates from the computational and graphical procedures differ fairly significantly. (Author's abstract)
W86-01657

222RN CONCENTRATIONS AND VARIATIONS IN UNCONFINED GROUNDWATER,

Kyoto Univ., Osaka (Japan). Research Reactor Inst.
For primary bibliographic entry see Field 2K.
W86-01658

EFFECT OF INCOMPLETE RECOVERY PRIOR TO A PUMP TEST IN A LARGE-DIAMETER WELL,

National Geophysical Research Inst., Hyderabad (India).
C. P. Gupta, and V. S. Singh.
Journal of Hydrology, Vol. 79, No. 1/2, p·141-144, July, 1985. 3 Fig, 2 Ref.

Descriptors: *Wells, *Pumping tests, Aquifer characteristics, Water supply development, India, Water level.

In order to have a quick appraisal of the potential of an aquifer for meeting the irrigation needs of small farms and for supplying drinking water in the hard rock terrains of South India, short duration pump tests are carried out. A reliable estimate of hydrogeologic parameters was obtained through a pump test provided the recovery rate prior to the test is fed into a numerical model used for the interpretation of the data. In order to account for the effect of incomplete recovery it is necessary to observe not only the water level variations prior to the onset of pumping but also during the post pumping phase until the recovery is nearly complete for a correct interpretation of pump test data to be made. An appreciable aquifer response is observed only during recovery. The data on the recovery phase of the pump test are, therefore, necessary for the data analysis using the numerical method. Particularly the later portion of the recovery phase is more important, as the effect of pre-pumping incomplete recovery is pronounced in the latter portion only. (Baker-IVI)
W86-01664

MEASUREMENT OF GROUNDWATER RECHARGE ON EASTERN LONG ISLAND, NEW YORK, U.S.A.,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
T. S. Steenhuis, C. D. Jackson, S. K. J. Kung, and W. Brutsaert.
Journal of Hydrology, Vol. 79, No. 1/2, p 145-169, July, 1985. 9 Fig, 6 Tab, 27 Ref.

Descriptors: *Groundwater recharge, *Long Island, *New York, Evaporation, Hydrologic budget, Darcys law, Mathematical equations, Precipitation, Seasonal variation, Vadose zone.

Two methods were tested for their suitability to provide improved estimates of recharge in the region of eastern Long Island (New York). The two methods tested consist, first, of measuring recharge with a direct application of Darcy's law in the vadose zone and, second, of calculating recharge by closure of the hydrologic budget equation with evaporation computed from micrometeorologic data. The recharge figure, now in general use, of 50% of the annual precipitation is a long-term average at best. The measurements of recharge, which were performed during a three-

year period, showed that the vertical flux past the 1 m depth was strongly dependent on both the time of the year and the precipitation amount. In late fall, winter and early spring a high percentage of the precipitation became recharge. During the summer months there was a small net upward movement of water past the 1 m depth. Precipitation during these months did not contribute to the annual recharge. It may be concluded from these measurements that in order to estimate recharge, special attention should be given to precipitation during the winter months. A better estimate for annual recharge than the current 50% of annual precipitation might be to take approximately 75-90% of the precipitation from October 15 until May 15. The two methods used for estimating recharge were labor intensive and required experienced technicians. Currently, one method cannot be recommended above the other. Both methods give a good estimate during the year except for the winter. The closure method using micrometeorological data gives a slightly higher estimate than the direct measurement method based on Darcy's law. (Author's abstract)
W86-01665

GROUNDWATER PROTECTION IN SAN FRANCISCO BAY AREA,

California Regional Water Quality Control Board, Oakland.
For primary bibliographic entry see Field 5G.
W86-01724

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-01731

SIMULATION OF TWO-FLUID RESPONSE IN VICINITY OF RECOVERY WELLS,

Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
G. P. Lennon.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1156-1168, August, 1985. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Recovery wells, *Dense fluids, *Aquifers, *Groundwater pollution, Boundary conditions, Geohydrology, Wells, Saline-freshwater interfaces, Density.

A dense fluid in an unconfined aquifer is usually removed by pumping a recovery well screened in the region of the aquifer occupied by the fluid. For many problems, the transition zone separating the dense fluid from the overlying water can be modeled as a sharp interface. When the pumping begins, the interface is drawn downward, allowing water to enter the well. The recovery process is improved if a second well is drilled and screened in the zone occupied by the water. The simultaneous pumping of water tends to cause the interface to move upward, allowing the dense fluid to be recovered at an increased rate without water entering the recovery well. The boundary integral equation method (BIEM) is used to solve the problem of the response of a dense fluid near a recovery well in a ground-water aquifer. The axisymmetric problems considered here are time-dependent and involve a nonlinear boundary condition along the free surface, as well as a nonlinear, moving interfacial boundary. The entire boundary, including the moving boundaries, are discretized into axisymmetric finite elements for evaluating the required boundary integrations. Numerical examples include pumping both fluids simultaneously as well as separately. The model is used to illustrate the design of a recovery system for the efficient removal of the dense fluid. (Author's abstract)
W86-01733

ANALYSIS OF SOME LABORATORY TRACER RUNS IN NATURAL FISSURES,

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
L. Moreno, I. Neretnieks, and T. Eriksen.
Water Resources Research, Vol. 21, No. 7, p 951-958, July, 1985. 11 Fig, 5 Tab, 12 Ref.

Descriptors: *Geological fractures, *Tracers, *Model studies, Advections, Dispersion, Diffusion, Sorption, Hydrodynamics, Residence time, Solute transport, Dispersivity.

Tracer tests in natural fissures performed in the laboratory are analyzed by means of fitting two different models. In the experiments, sorbing and nonsorbing tracers were injected into a natural fissure running parallel to the axis of a drill core. The models take into account advection, dispersion, diffusion into the rock matrix, and sorption onto the surface of the fissure and on the microfissures inside the matrix. For the second mechanism, one of the models considers hydrodynamic dispersion, while the other model assumes channeling dispersion. The models take into account time delays in the inlet and outlet channels. The dispersion characteristics and water residence time were determined from the experiments with nonsorbing tracers. Surface and volume sorption coefficients and data on diffusion into the rock matrix were determined for the sorbing tracers. The results are compared with values independently determined in the laboratory. Good agreement was obtained using either model. When these models are used for prediction of tracer transport over larger distances, the results will depend on the model The model with channeling dispersion will show a greater dispersion than the model with hydrodynamic dispersion, assuming constant dispersivity. (Author's abstract)
W86-01767

COMPONENTS OF FLOW RESULTING FROM ABSTRACTION IN A TWO-LAYERED CONFINED AQUIFER WITH NO CROSS FLOW,

Institute of Hydrology, Wallingford (England).
R. S. Wikramaratna.
Water Resources Research, Vol. 21, No. 7, p 985-989, July, 1985. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Wells, *Well storage, *Confined aquifers, Artesian wells, Pumping, Well screens, Well casings, Mathematical equations, Groundwater movement, Transmissivity.

The problem of abstraction from a well penetrating a two-layered confined aquifer, each layer being independently homogeneous, isotropic, and artesian, is considered. Three components of the total abstraction are identified: the concentration from well storage and contributions from flow in each of the aquifer layers. Analytical expressions were derived for the three components; the expressions were evaluated numerically for different parameter sets in order to investigate the transient variation in the relative importance of the components. In the initial stages of pumping, well bore storage is the dominant factor, but the contribution falls effectively to zero as abstraction progresses. The length of time during which well bore storage provides a significant proportion of the total flow is dependent on the aquifer parameters as well as on the screen and casing radius. Reduction of the screen radius results in increased drawdown and a small increase in the importance of well bore storage during the early stages of pumping. In all cases, after a sufficiently long time of pumping, the aquifer flow contribution are divided in the same proportion as the transmissivities of the two layers. (Moore-IVI)
W86-01770

MULTIVARIATE ANALYSIS AND INTERPRETATION OF THE HYDROCHEMISTRY OF A DOLOMITIC REEF AQUIFER, NORTHERN ITALY,

Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
E. Seyhan, A. A. van de Griend, and G. B. Engelen.
Water Resources Research, Vol 21, No. 7, p 1010-1024, July, 1985. 12 Fig, 4 Tab, 32 Ref.

Descriptors: *Multivariate analysis, *Hydrochemistry, *Dolomite aquifers, *Italy, Hydrogeology, Isotopes, Groundwater, Chemical properties, Aquifers, Environmental tracers.

Regionalization based on multivariate statistical analyses of hydrochemical data and environmental isotopes proved most successful in differentiating groundwater of different hydrogeological origins within the Sasso Lungo dolomitic mountain stock, Northern Italy. The approach used chemical and isotopic data to evaluate hydrologic properties normally determined by more traditional techniques. From field and laboratory studies of 19 hydrochemical variables measured at 46 sampling points, three distinct groups of water types were differentiated, in close agreement with hydrogeological evidence, namely, (1) pure Sciliar dolomite water, (2) water from volcanic deposits, and (3) mixed water from Sciliar dolomite and volcanic deposits. Environmental isotopes are used to support hydrogeological observations and the hydrochemical analyses and also to provide valuable additional information for futher distinction between hydrogeological subsystems. The data show that the dolomite aquifer discharges from two main subsystems: (1) relatively young, shallow to moderately deep waters in the central part of the reef stock and (2) older groundwater discharging at the rims of the reef. (Author's abstract)
W86-01773

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA; 1. THE NONREACTIVE CASE,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. A. Sudicky, R. W. Gillham, and E. O. Frind.
Water Resources Research, Vol. 21, No. 7, p 1035-1041, July, 1985. 3 Fig, 22 Ref.

Descriptors: *Porous media, *Solute transport, *Stratified media, Tracers, Simulation, Diffusion, Dispersion, Aquifers, Sand, Silt, Model studies.

The migration of a nonreactive solute in layered porous media was studied under controlled laboratory conditions by injecting a tracer into a thin sand layer bounded by silt layers. The experimental results show a delay in the breakthrough of the tracer in the effluent of the permeable sand layer along with a substantial decrease in concentrations after a 1-m travel distance. The strongly dispersed and skewed shape of the breakthrough curves for the layered system is in contrast to the symmetric and weakly dispersed concentration patterns typically associated with homogeneous media. Because of the tailing of the breakthrough measurements, a departure from classical Fickian transport is apparent. Simulations of the experiments demonstrate that these effects are the result of a transient redistribution of the tracer across the strata by transverse molecular diffusion and that local longitudinal dispersion is only of secondary importance as a spreading process in such systems. These findings are consistent with recent theoretical descriptions of dispersion in stratified aquifers. (Author's abstract)
W86-01775

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA 2. THE REACTIVE CASE,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. C. Starr, R. W. Gillham, and E. A. Sudicky.
Water Resources Research, Vol. 21, No. 7, p 1043-1050, July, 1985. 7 Fig, 13 Ref.

Descriptors: *Solute transport, *Porous media, *Stratified media, Simulation, Mathematical models, Strontium radioisotopes, Tracers, Sand, Silt, Advection, Diffusion, Retardation.

Laboratory experiments and mathematical simulations were used to investigate the transport of a reactive solute, Sr-85, through a sand layer located between two silt layers. The experimental results showed breakthrough curves that were similar in form to those reported in the preceeding paper for a nonreactive solute, but were delayed in the time of appearance, had a lower peak concentration, and were more highly dispersed. A mathematical model that accounts for longitudinal advection in the sand layer, transverse diffusion in the silt layers, and retardation in both the sand and silt

layers was used to simulate the experimental results. With a trial-and-error adjustment of the retardation coefficients, the mathematical model gave a good representation of the experimental data; however, different parameter values were required in order to simulate breakthrough curves measured at different values of the pore-water velocity in the sand. The use of measured retardation parameters in the model produced a much better fit to the data compared to that which was obtained when retardation was neglected. Nevertheless, significant discrepancies existed between the measured and simulated results, with the discrepancies becoming greater at lower velocities. In view of the excellent agreement between measured and simulated results obtained in part 1 for nonreactive solutes, the less satisfactory agreement obtained here suggests that there is some physical or chemical aspect of the retardation process that is not adequately represented in the model. (Author's abstract)
W86-01776

FORMATION OF USEFUL GROUNDWATER RESOURCES IN THE SOUTHWESTERN PART OF THE MOSCOW ARTESIAN BASIN UNDER INTENSE WITHDRAWAL CONDITIONS,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
B. V. Borevskii, V. A. Polyakov, and L. A. Subbotina.
Water Resources, Vol. 11, No. 4, p 293-303, July-August, 1984. 4 Fig, 2 Tab, 11 Ref. Translated from Vodnye Resursy, No. 4, p 35-47, July-August, 1984.

Descriptors: *Mesozoic-Cenozoic Aquifer, *Leakage, *Groundwater movement, *Moscow, *USSR, Artesian basin, Selective withdrawal, Hydrogeology, Groundwater depletion.

The presence of leakage from the Mesozoic-Cenozoic aquifer complex into the Upper Devonian complex through the Neocomian-Jurassic clay stratum was established from the data of hydrodynamic, hydrochemical, hydrogeothermal, and isotropic investigations. A quantitative estimate made on the ES-1022 digital computer of all main sources of formation of useful resources with the existing withdrawal was given and it was proved that more than half of withdrawal is provided by leakage from the Mesozoic-Cenozoic aquifer complex. Useful groundwater resources were estimated up to the year 2000, and a quantitative estimate of the sources of their formation was given for this period with different variants of withdrawal. The possibility of not only keeping the existing withdrawal up to 2000 but also of its substantial increase (by almost 2-fold) by locating new intakes in the west, near the Sechcha channel, along the Desna valley, was proved. Such investigations can be recommended when conducting works under anlogous hydrogeological conditions to study the conditions of formation and to estimate useful groundwater resources. (Baker-IV)
W86-01803

EVALUATION OF THE EFFECTIVENESS OF ITERATIVE METHODS FOR MODELING GROUNDWATER FLOW ON DIGITAL COMPUTERS,

Moscow State Univ. (USSR).
L. K. Gokhberg, N. A. Mossakovskaya, and A. A. Roshal.
Water Resources, Vol. 11, No. 4, p 316-324, July-August, 1984. 5 Fig, 10 Ref. Translated from Vodnye Resursy, No. 4, p 61-69, July-August, 1984.

Descriptors: *Computers, *Model studies, *Groundwater movement, Mathematical models, Costs, Algorithms, Hydrogeology.

Numerical modeling methods on digital computers in recent years have been introduced in hydrogeological investigations. A wide range of methods is recommended for use and is being used. At the same time, the effectiveness of using various methods is insufficiently elucidated in the literature. Among the most important characteristics of the numerical method from the standpoint of effectiveness of its technical application on digital computers are use of computer time and the size of the working field of the main storage. The computer experiments conducted on the test problems showed that with respect to computation time, the Seidel method is slightly inferior to the block iteration method, winning, however, in simplicity of the algorithm. (Baker-IVI)
W86-01805

INVESTIGATION OF THE HYDRODYNAMIC PROBLEMS OF SEEPAGE AND CONVECTIVE DIFFUSION IN INHOMOGENEOUS AND ANISOTROPIC POROUS MEDIA,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. G. Khublaryan, O. M. Churmaev, and I. O. Yushmanov.
Water Resources, Vol. 11, No. 3, p 185-191, May-June, 1984. 5 Fig, 16 Ref. Translated from Vodnye Resursy, No. 3, p 23-29, 1984.

Descriptors: *Groundwater level, *Seepage, *Diffusion, *Hydrodynamics, Porous media, Convection, Anisotropy, Mathematical equations.

The problem of predicting the groundwater level is becoming ever more urgent in connection with the increasing anthropogenic impact on rivers and subsurface waters. Transfer of part of the runoff from one river basin to another and the creation of reservoirs and other hydraulic structrues is leading to a change in the paramters of flow which in turn causes a change in the groundwater level of adjacent territories. Few investigations have been performed in which fluid flow in inhomogeneous media is studied. This work is a further development of the hydrodynamic problem of seepage and convective diffusion for the case of inhomogeneous and anisotropic media. Examples are given which demonstrate how important the characteristics of a porous medium are. Schematization and assumption of physicochemical paramters as constant are not always valid. (Baker-IV)
W86-01818

FLOW OF A WELL IN AN INHOMOGENEOUS LAYERED ARTESIAN AQUIFER,

N. N. Lapshin.
Water Resources, Vol. 11, No. 3, p 192-203, May-June, 1984. 2 Fig, 12 Ref. Translated from Vodnye Resursy, No. 3, p 30-43, May-June, 1984.

Descriptors: *Aquifer characteristics, *Wells, Water flow, Groundwater movement, Artesian wells, Permeability, Flow rate, Water table, Hydrogeology.

Inhomogeneous layered media with complete consideration of two-dimensionality in the section of the groundwater flow in each of the layers composing the aquifer were studied theoretically. An artesian aquifer is examined which consists of two zones of different permeability. The length of the filter of the pumping well amounts to only part of the thickness of one of the layers of the two-layer aquifer. The main hydrogeologic parameters of a two-layer aquifer to be determined when conducting experimental seepage flow studies are the total value of transmissivity T and pressure conductivity factor, as well as the permeability coefficients of the layers composing the aquifer. It is necessary to determine these indices considering the main properties of groundwater flow during pumping in inhomogeneous aquifers. Flow imperfection of wells due to partial penetration in an inhomogeneous two-layer aquifer is determined to a considerable extent by the pressure conductivity factor. (Baker-IVI)
W86-01819

ESTIMATION OF SAFE GROUNDWATER YIELD WITH CONSIDERATION OF CYCLIC VARIATION OF THE WATER WITHDRAWAL RATE,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
S. Ya. Kontsebovskii, and E. I. Minkin.
Water Resources, Vol. 11, No. 3, p 204-217, May-June, 1984. 2 Fig, 4 Tab, 4 Ref. Translated from Vodyne Resursy, No. 3, p 44-59, May-June, 1984.

Descriptors: *Drawdown, *Groundwater, Water level, Mathematical equations, Safe yield, Water management, Irrigation water.

The existing methods of calculating the drawdown of the level (head) of groundwaters with periodic withdrawal are based on representing the withdrawal graph in the form of several steps. Random variations in the times of flushing, water spreading, and crop irrigations result in the form of the average long-term graph of the variation of ground water withdrawal for irrigation being rather smooth. The value of the lag depends on the relationship of the values of the maxima of withdrawal and duration of the time interval between them. The lags between the peak values of withdrawal and drawdown, which under certain conditions reach several months, can have a substantial effect on estimating the safe yield for irrigation. The value of the permissible drawdown assigned on the basis of thickness of the aquifer is not an exactly determined constant, but varies within certain limits. Consideration of the displacement of the peak values of drawdown with respect to the peak of withdrawal when estimating the safe yield can be expressed in an increase of the calculated values of the permissible drawdown to its upper limit. In certain cases, this value can probably be greater, taking into account that a brief drop of the level below the permissible value will occur in a period when the rate of withdrawal is substantially less than the peak value and probable disconnection of part of the wells will not lead to so substantial a complication of the water management situation as would occur at the height of crop irrigation. (Baker-IVI)
W86-01820

USES AND ABUSES OF WASTEWATER INJECTION WELLS IN HAWAII,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
F. L. Peterson, and J. A. Oberdorfer.
Pacific Science, Vol. 39, No. 2, p 230-240, 1985. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Injection wells, *Wastewater disposal, *Hawaii, Domestic wastewater, Well clogging, Geohydrology, Nitrogen gas, Injection well capacity, Particulate matter, Microorganisms.

During the past two decades in Hawaii, more than 500 injection wells for the disposal of domestic sewage wastewater have been constructed and operated. Thus far, contamination of potable groundwater supplies has not been a problem. Many of the injection wells, however, have not performed as designed, and aquifer clogging and reduced injection capacity have produced numerous well failures resulting in public health, legal, and financial problems. Factors most commonly responsible for the well problems have been unfavorable hydrogeology, underdesign of injection well capacity, poor effluent quality, and lack of injection well maintenance. Detailed study of clogging mechanisms in the immediate vicinity of injection wells suggests that binding of pore spaces by nitrogen gas is the most important cause of aquifer clogging. Other clogging mechanisms also operating are filtration of solid particles and growth of microorganisms. (Author's abstract)
W86-01884

GROUND-WATER RESOURCES OF TOWNER COUNTY, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
P. G. Randich, and R. L. Kuzniar.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. North Dakota State Water Commission County Ground-Water Studies 36 and North Dakota Geological Survey Bulletin 79, Part III. 26 p, 5 fig, 3 tab, 51 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, Transmissivity, Recharge, Water use, Chemical properties, Potential yield, Storage, Towner County, North Dakota.

Large quantities of water can be obtained from glacial-drift aquifers in Towner County, North Carolina. Glacial-drift aquifers occur as saturated sand and gravel deposits that range in thickness from 4 to 287 feet. These aquifers underlie about 550 square miles and contain approximately 2.8 million acre-feet of available ground water. Potential well yields range from 5 to 1,500 gallons per minute. The most extensive and productive is the Spiritwood aquifer system. Chemical quality of the water varies greatly, but the dominant cations are sodium and calcium and the dominant anions are sulfate and bicarbonate. The Pierre aquifer consists of a fractured siliceous shale that ranges from 25 to 400 feet in thickness in the upper part of the Pierre Shale. The Pierre aquifer underlies all of Towner County. Wells developed in the aquifer generally yield less than 10 gallons per minute. The chemical quality of the water in the Pierre also is highly variable. The dominant cation is sodium and the dominant anion generally is chloride. The rural population and most communities in Towner County depend on ground water as a source of supply. (USGS)
W86-01917

LEACHING STUDY OF OIL SHALE IN KENTUCKY WITH A SECTION ON HYDROLOGIC RECONNAISSANCE OF THE OIL SHALE OUTCROP IN KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01918

2G. Water In Soils

NON-DARCIAN WATER FLOW IN PEAT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond, and J. C. Goldman.
Journal of Ecology, Vol. 73, No. 2, p 579-584, July, 1985. 1 Fig, 14 Ref.

Descriptors: *Peat, *Permeability coefficient, *Seepage, Soil water, Flow discharge, Pore pressure, Darcys law, Interstitial water.

Dramatic changes in the apparent hydraulic conductivity of peat observed by several investigators during seepage-tube and auger hole tests in both recharge and depletion modes can be explained by the large elastic storativity of peat, which renders steady-state analytical methods inappropriate. Such observations alone are not inconsistent with Darcian peat behavior. A lesser degree of non-Darcian peat behavior suggested by constant head steady state experiments may be explainable in part by vertical effective stress and compressibility effects. Results of in situ conductivity tests in mires can also be affected by other factors, such as local alterations of vertical effective stress by the weight of observers. The three-dimensional, heterogeneous nature of the situation in the field further complicates analysis; for example, where large horizontal gradients are imposed on the peat by a seepage-tube test, local changes in peat-pore geometry due to changes of horizontal stresses may also occur. The accurate measurement and interpretation of peat hydraulic conductivity remains an extremely difficult problem. Darcy's Law is seen to be appropriate for use in upper unhumified or slightly humified peats. Even in humified peats under natural conditions of constant pore-water chemistry, small hydraulic gradients, and fairly constant effective stress, the existing data may not be inconsistent with the satisfactory application of Darcy's Law. Field measurement methods which provide steady state condition and minimal alteration of effective stresses are likely to provide the most accurate information for hydrologic models. It is suggested that the minimum practicable alteration of pore pressure be a criterion for the design of methods to measure peat hydraulic conductivity under field conditions. (Baker-IVI)
W86-01359

EXPERIMENTAL MEASUREMENT OF CHANNELING OF FLOW IN POROUS MEDIA,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2F.
W86-01419

CHARACTERIZATION OF PORE SIZE DISTRIBUTIONS WITHIN SOILS BY MERCURY INTRUSION AND WATER-RELEASE METHODS,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
K. R. Olson.
Soil Science, Vol. 139, No. 5, p 400-404, May, 1985. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Soil water, *Pore size, *Pores, *Pore water, *Mercury intrusion method, *Water release method, Roots, Sand, Clay, Soil properties.

Soil pore size distributions for undisturbed, oven-dried peds were measured and interpreted using mercury intrusion porosimetry. The pore size distributions were compared with those calculated from moisture release data. A correlation between water retention difference by water-release methods and water storage pore volumes (50 to 0.5 microns) by mercury intrusion was established with an R squared = 0.58 over a variety of soil texture and bulk density ranges. Most of the variation occurred for soil samples high in either sand or clay. In addition, root-restricting class limits were developed based on volume of root size pores (200 to 10 microns) within oven-dried peds that were large enough to permit root tip and root hair penetration. (Author's abstract)
W86-01420

SLEEVE AND CASING LYSIMETERS FOR SOIL PORE WATER SAMPLING,
Wisconsin Univ.-Madison. Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W86-01422

DESIGN OF A SENSITIVE AND PRACTICAL CLOSED-TOP INFILTROMETER,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
R. S. Malik, S. K. Sharma, and J. S. Dhankar.
Soil Science, Vol. 139, No. 5, p 452-457, May, 1985. 1 Fig, 5 Tab, 14 Ref.

Descriptors: *Infiltrometers, *Infiltration, *Soil water, Soil types, Moisture meters, Measuring instruments, Water depth.

A two-piece, closed-top infiltrometer with a 10-cm diameter was designed which measures infiltration under constant and naturally occurring low surface water head. Field tests were conducted in cultivated sandy and fine loamy soils with varying ring size, depth, and surface water head conditions. Mean cumulative infiltrations obtained with this infiltrometer are not significantly different from those with an open-top, falling-head infiltrometer at all times. Measurements with the designed infiltrometer are more reproducible, and hence fewer infiltration runs are needed to characterize the average infiltration parameters of a given area. The mean and coefficient of variation in cumulative infiltration of 60 min are 13.88 and 8.29% in sandy soil, respectively. The corresponding values for an open-top, falling-head infiltrometer are 13.56 and 17.55%, respectively. The designed infiltrometer does not present parallax and floating material problems. The time lag in taking zero time reading is reduced from 6.3 to 2.4 s. The sensitivity of the designed infiltrometer is 0.025 cm; that of a conventional infiltrometer is 0.1 cm. It is more practical, in general, and for remote areas of short water supply, in particular. Mean cumulative infiltration did not differ significantly with increasing ring size from 10- to 30-cm diameter. The coefficient of variation decreased at all times with the increase in size. The optimum outer ring depth was 10 cm, which was equal to the inner ring depth. The cumulative infiltration increased with increase in surface water head at all times, especially when it is increased in the higher range from 5 to 10 cm. (Author's abstract)
W86-01423

NOTE: THE RELATION BETWEEN DESORPTIVITY AND SOIL-WATER DIFFUSIVITY,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, M. Vauclin, R. Haverkamp, and I. Lisle.
Soil Science, Vol. 139, No. 5, p 458-461, May, 1985. 1 Fig, 14 Ref.

Descriptors: *Desorptivity, *Soil water, *Diffusivity, *Desorption, Sorptivity, Drainage, Infiltration.

In the absence of gravity, the amount of water removed by desorption from a soil with uniform initial water content and constant suction at the surface is proportional to 1/2. The coefficient of proportionality is called desorptivity, by analogy with sorptivity, for the infiltration of water. A formula was derived relating desorptivity to soil-water diffusivity. The accuracy of the formula is illustrated with numerical, theoretical, and experimental examples. Desorptivity is shown to be much smaller than sorptivity, and this difference explains why gravity effects are normally important much earlier for drainage than for infiltration. (Author's abstract)
W86-01424

NOTE ON THE USE OF A SIMPLE NUMERICAL MODEL FOR VERTICAL, UNSATURATED FLUID FLOW,
Warren Spring Lab., Stevenage (England).
J. M. Kirby.
Soil Science, Vol. 139, No. 5, p 462-467, May, 1985. 11 Fig, 6 Ref.

Descriptors: *Numerical models, *Vertical flow, *Unsaturated flow, *Soil water, *Model studies, Permeability coefficient, Soil water suction, Drainage, Clays, Soil types, Soil properties, Data interpretation.

The simulation of vertical fluid flow in unsaturated cells usually starts with a form of the vertical water transport equation. The strong nonlinearity of the equation creates difficulties in its solution. Numerical techniques require small time and length steps to obtain a stable and accurate solution. A previously published simple numerical model overcame these difficulties but was applied only to soils that are not too dry; the model was later extended to cover dry soils. The previously published model uses an exponential approximation for the unsaturated conductivity to derive a simple expression for vertical, unsaturated fluid flow and the later work makes use of several exponential segments to approximate the unsaturated conductivity, which extends the method to a wider range of soils and moisture contents. However, this leads to a difficulty in the solution and can create a discontinuity in the predicted moisture content-depth profile. A method is demonstrated for removing this difficulty and the resulting discontinuity and the method is applied to two examples of drainage problems and to infiltration into Yolo light clay. The method yields accurate results for both types of problems and the accuracy is retained even with large time and depth steps. It should be realized that the accuracy depends upon the approximation of the unsaturated conductivity and suction data; a poor choice can give very misleading results. The choice of approximations is straightforward when the data for suction and log (permeability) fall in straight lines. When the data are in the form of a continuous curve, however, several approximations will be needed and must be chosen such that the data are approximated well in the suction region of most interest in the solution. (Collier-IVI)
W86-01425

CALDEP: A REGIONAL MODEL FOR SOIL CACO3 (CALICHE) DEPOSITION IN SOUTHWESTERN DESERTS,
San Diego State Univ., CA. Systems Ecology Research Group.

G. M. Marion, W. H. Schlesinger, and P. J. Fonteyn.
Soil Science, Vol. 139, No. 5, p 468-481, May, 1985. 11 Fig, 2 Tab, 44 Ref. NSF grant BRS 8212466.

Descriptors: *Geochemistry, *Calcium carbonate deposition, *Desert soils, *Soils, *Model studies, *Caliche, Soil types, Evapotranspiration, Hydrologic cycle, Soil water.

A regional model for CaCO3 deposition in desert soils of the southwestern United States was developed and validated. There were five major components in the simulation model: a stochastic precipitation model, an evapotranspiration model, chemical thermodynamic relationships, soil parameterization, and a soil water and CaCO3 flux model. For the present climate, a cold-dry Pleistocene climate, and a cool-wet (summer) Pleistocene climate, the model predicted a shallower depth for the calcic horizon than was found in field soils. However, the model was compatible with field soils if one assumed that most pedogenic carbonate formed during a cool-wet (winter) Pleistocene climate. The model was highly sensitive to the frequency of extreme precipitation events and to soil water-holding capacity. The biotic factor played an important role in CaCO3 deposition through its control of soil CO2 concentrations and evapotranspiration rates. The range in predicted CaCO3 deposition rates agreed with the rates for most field studies (1 to 5 g/sq m/yr); also, the model predicted an increasing rate of CaCO3 deposition with increasing precipitation, which agreed with field studies. The model is a valuable research tool for evaluating the role of state factors on soil CaCO3 deposition. (Author's abstract)
W86-01426

DRAINAGE COEFFICIENTS FOR HEAVY LAND,

Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
L. K. Smedema.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 101-112, June, 1985. 6 Fig, 3 Tab, 7 Ref, 1 Append.

Descriptors: *Drainage, *Heavy land, *Soil properties, *Surface drainage, *Netherlands, *Yugoslavia, *Tanzania, *Soil density, Rainfall, Percolation, Clays, Basin clays, Soil types, Permeability coefficient.

Drainage of heavy land is largely governed by the fact that the hydraulic conductivity (K-value) of the subsoil is generally too low (often $K<0.01$ m/day) to permit ready percolation of excess rain water to lower depths. Under these conditions, drainage discharge predominantly takes the form of 'shallow drainage' - lateral interflow through the more permeable toplayer and overland flow. Evidence is presented that this type of 'shallow drainage' discharge can be described by the linear reservoir type rainfall-discharge model. According to this model, the discharge at any time, t, is linearly dependent on the current dynamic storage and the excess rain which has not yet been discharged at time t. Results were evaluated by comparison with other methods of deriving drainage coefficients and with commonly used design standards. Case studies were made of a Netherlands drainage basin clay land with mixed farming, of a Yugoslavian drainage of basin clay with mostly arable farming (maize and wheat), and of a Tanzanian drainage of sugarcane fields on heavy basin clay land. The proposed method yields values of the correct order of magnitude and is based on a physical model of the drainage processes involved, making it universally applicable. (Collier-IVI)
W86-01431

LOW GRADIENT PERMEABILITY MEASUREMENTS IN A TRIAXIAL SYSTEM,

Geological Survey, Denver, CO.
H. W. Olsen, R. W. Nichols, and T. L. Rice.
Geotechnique, Vol. 35, No. 2, p 145-157, June 1985. 15 Fig, 2 Tab, 20 Ref.

Descriptors: *Permeability, *Triaxial systems, *Flow-pump method, Soil properties, Soil types, Sand, Clay, Silt, Soil water, Unsaturated zone.

Permeability measurements were conducted with the flow-pump method on sand, sandy silt and silty clay specimens in a conventional triaxial system by introducing and withdrawing water at known constant flow rates into the base of a specimen with a flow-pump, and by monitoring the head difference induced across the length of the specimen with a sensititive differential pressure transducer. The results show that the previously reported advantages of the flow-pump method, compared with conventional constant head and falling head methods, were realized for permeability measurements in conventional triaxial equipment. These advantages are that direct flow rate measurements are avoided together with the associated errors that arise from the effects of contaminants on capillary menisci and the long periods of time involved in flow rate measurements; permeability measurements can be obtained much more rapidly and at substantially smaller gradients; errors from the small intercept in the otherwise linear flow rate versus hydraulic gradient relationship, and also from seepage-induced permeability changes, can easily be recognized and avoided or minimized. The results further show that the initial transient response of a specimen that precedes the steady state condition needed for a permeability measurement can require a substantial period of time. In this study the response times varied from a fraction of a minute for a sand specimen to more than 200 minutes for a silty clay specimen. Errors in permeability measurements from this transient response can easily be avoided with the flow-pump method but not with constant head and falling head methods. (Author's abstract)
W86-01450

DIFFERENTIAL EVAPO-TRANSPIRATION FROM A CLAY SURFACE AND ITS INFLUENCE ON EQUILIBRIUM POREWATER PRESSURE,

Golder Associates, Maidenhead (England).
R. E. Gibson, M. H. Goldsworthy, and A. M. Chandler.
Geotechnique, Vol. 35, No. 2, p 181-191, June, 1985. 5 Fig, 6 Tab, 7 Ref.

Descriptors: *Evapotranspiration, *Porewater pressure, *Clay, *Groundwater movement, Settlement, Soil water, Evaporation, Transpiration.

The derivation is presented of expressions resulting from a steady state groundwater flow approach to determining the porewater pressure changes caused by modification of the rate of evapo-transpiration over limited areas of the ground surface. Solutions to the expressions have been computed for positions throughout the soil layer for a variety of shapes and sizes of affected area. The tabulated results may be used to estimate the effects for a wide range of conditions by making use of the principle of superposition. Case histories are presented in which observations of porewater pressure changes and of ground movement are compared with the values derived from the tabulated results. (Author's abstract)
W86-01451

WATER FLOW AND SWELLING PRESSURE IN NON-SATURATED BENTONITE-BASED CLAY BARRIERS,

Luleaa Univ. (Sweden).
For primary bibliographic entry see Field 2F.
W86-01455

OBSERVATIONS OF THE BEHAVIOUR OF LARGE CORES OF SOIL DURING DRAINAGE, AND THE CALCULATION OF HYDRAULIC CONDUCTIVITY,

Oxford Univ. (England). Dept. of Agricultural and Forest Science.
W. R. Kneale.
Journal of Soil Science, Vol. 36, No. 2, p 163-171, June, 1985. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Permeability coefficient, *Drainage, *Soil water. Matric potential, Macropore channels, Interstitial water, Air entry.

This paper reports observations on the behavior of large cores of undisturbed clay-loam soil during the drainage of water under an imposed step in potential. Rates of outflow and the matric potential at various points in the core were recorded during drainage. The volumes of 'macropore-channels' (large, continuous voids) were estimated to be 0.005 cu m/cu m in a subsoil sample, and 0.026 cu m/cu m in a topsoil sample from arable land. The calculated values of hydraulic conductivity were found to vary with the size of the step in potential imposed on the sample at the start of each drainage experiment. The available evidence suggested that the apparent K/Psi m relationship was influenced by the rate that air could enter the soil to replace water during drainage. The degree of restriction on air movement was affected by the initial drainage behavior, and this varied with the imposed step in potential. (Author's abstract)
W86-01467

NITROGEN MINERALIZATION IN A SEQUENCE OF HYDROMORPHIC SOILS IN A VALLEY IN THE HIGH SEMOIS (BELGIUM) (MINERALISATION DE L'AZOTE DANS UNE SEQUENCE DE SOLS HYDROMORPHES DE LA VALLEE DE LA HAUTE SEMOIS (BELGIQUE)),

Universite Libre de Bruxelles (Belgium). Lab. de Botanique Systematique et d'Ecologie.
F. Baillon, J. Herbauts, and M. Tanghe.
Acta Ecologica, Vol. 6, No. 2, p 183-192, 1985. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Nitrogen, *Mineralization, *Hydromorphic soils, *Semois, *Belgium, Humic soils, Water table, Nitrification, Vegetation, Soil water.

In the alluvial plain of the Semois (Belgium), both in situ and in vitro, nitrogen availability of humic layers was studied in relation with the yearly fluctuations of the water-table in a sequence of more or less hydromorphic soils. The fluctuations of the water-table were measured using a sequence of 15 piezometers disposed throughout a transect overlying successively a peaty grassland with Molinia caerulea, a tall-herb community with Filipendula ulmaria and a reed-bed with Phalaris arundinacea. Results show that, during the vegetation period, nitrogen mineralization is almost not affected by the degree of hydromorphy of the humic layers: nitrogen mineralization rates are not significantly different in the 3 studied sites and in every case nitrification is the dominant process. (Author's abstract)
W86-01510

COMPARATIVE WATER RELATIONS OF ADJACENT CALIFORNIA SHRUB AND GRASSLAND COMMUNITIES,

Pepperdine Univ., Malibu, CA. Natural Science Div.
For primary bibliographic entry see Field 2I.
W86-01602

ANALYSIS OF SOLUTE BREAKTHROUGH CURVES TO PREDICT WATER REDISTRIBUTION DURING UNSTEADY FLOW THROUGH UNDISTURBED STRUCTURED CLAY SOIL,

Oxford Univ. (England). Soil Science Lab.
R. E. White.
Journal of Hydrology, Vol. 79, No. 1/2, p 21-35, July, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Unsteady flow, *Clay, *Model studies, Solute transport, Soil water, Mixing, Diffusion, Interstitial water, Bypass flow, Structured soils.

Solutions of 5 or 10 mM CaCl2 were applied at constant rates of 7-14 mm/hr to the surface of large (23-cm dia. x 20-24 cm long) undisturbed cores of cracking clay soil. Cl- breakthrough was analyzed assuming a log-normal distribution of solute travel times. The resultant transfer function model (TFM) fitted the data well for moist or

prewetted cores (volumetric water content theta sub i from 0.35 to 0.49) but was inadequate for very dry cores (theta sub i approximately = 0.30) at the higher input rates. When extensive bypass flow occurred in the soil, the probability density function of solute travel times was not well represented by a log-normal distribution. The breakthrough data were also analyzed using a mixing model which postulated convective mixing of applied solution with resident soil water to form a mobile miscible volume, and diffusion of solute between the miscible and immiscible volumes of soil water. This model was used to predict the miscible volume and its change with time during unsteady flow through each core. The time-weighted average fractional miscible volume theta' sub m derived from the mixing model was in close agreement with theta sub m, calculated as the input water flux divided by the mean pore-water velocity given by the TFM. An essential feature of any model of solute transport in structured soils is the recognition of two domains of different flow characteristics which is some cases give rise to a log-normal distribution of pore-water velocities. (Author's abstract)
W86-01654

MODEL FOR NITRATE LEACHING IN UNDISTURBED STRUCTURED CLAY SOIL DURING UNSTEADY FLOW,

Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 5B.
W86-01655

SCALING THE EXPONENTIAL SOIL-WATER DIFFUSIVITY FOR SOILS FROM GHANA,

Ghana Univ., Legon. Dept. of Soil Science.
K. B. Laryea, and S. Abbenney-Mickson.
Journal of Hydrology, Vol. 79, No. 1/2, p 95-106, July, 1985. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Soil water, *Diffusivity, *Ghana, Infiltration, Mathematical equations, Soil type, Soil physical properties, Wetting.

Horizontal infiltration experiments were conducted on laboratory packed columns of six tropical soils chosen from two different ecological zones of Ghana (the coastal savannah and the forest regions). Calculated soil-water diffusivities of these soils were then fitted with an exponential regression equation to determine the values of the 'Universal' constants, alpha, gamma and beta. The scaling procedures suggested in the literature appear to be applicable to soils from Ghana. The constants alpha, beta and gamma vary according to the type of soil, sodium absorption ratio, and the scaling technique used to obtain the dimensionless soil-water diffusivity. Values obtained for alpha, gamma, and beta for these soils did not agree with those previously suggested, thus negating the proposed universality concept. The shape factor delta for the wetting profile appears to be around 0.90. (Moore-IVI)
W86-01659

INFLUENCE OF CYLINDRICAL MACROPORES ON STEADY-STATE INFILTRATION IN A SOIL UNDER PASTURE,

Sydney Univ. (Australia). Dept. of Soil Science.
K. R. J. Smettem, and N. Collis-George.
Journal of Hydrology, Vol. 79, No. 1/2, p 107-114, July, 1985. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Infiltration, *Macropores, *Pastures, Permeability coefficient, Infiltrometers, Steady-state infiltration.

Steady-state infiltration rates in a soil under native pasture were predicted from independent measurements of macropore volume fluxes and soil matrix hydraulic conductivity (K(sat)). K(sat) was measured by two methods which give slightly different results but were lower than areally averaged macropore fluxes. The predicted steady-state infiltration rates were compared with data obtained from cylinder infiltrometer measurements and agreement was excellent, indicating that steady-state infiltration was controlled primarily by the size and number of macropores within an infiltrometer ring. (Author's abstract)
W86-01660

PREDICTION OF STEADY-STATE PONDED INFILTRATION DISTRIBUTIONS IN A SOIL WITH VERTICAL MACROPORES,

Sydney Univ. (Australia). Dept. of Soil Science.
K. R. J. Smettem, and N. Collis-George.
Journal of Hydrology, Vol. 79, No. 1/2, p 115-122, July, 1985. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Infiltration, *Macropores, *Ponding, Simulation, Infiltrometers, Soil water, Permeability coefficient, Mathematical models, Soil properties.

A Monte Carlo simulation is used to predict the distributions of steady-state infiltration rate values for different infiltrometer ring sizes in a soil with vertical macropores. The simulation requires functional characterization of flow in soil macropores, coupled with a knowledge of macropore spatial dispersion. An additional option includes soil matrix hydraulic conductivity K(sat) which is assumed to be normally distributed with a known mean and standard deviation. The model was checked against measured data for two different ring sizes (0.071 and 0.0022 sq m) and good agreement was obtained. It is shown that in soil with vertical transmission macropores, the distribution of steady-state infiltration rate values becomes increasingly skewed as ring size is decreased, unless K(sat) is of sufficient magnitude to mask the macropore contribution. A method for determining the probability of a sensor with a known horizontal cross-sectional soil contact area intercepting at least one macropore is also presented. (Author's abstract)
W86-01661

LEACHING FRACTION BEYOND DEPTH X, CAUSED BY PERCOLATION OF A SOIL PROFILE WITH AN INITIAL SALT ACCMULATION AT ITS SURFACE,

Central Soil Salinity Research Inst., Karnal (India).
S. K. Gupta, D. Ramadurgaiah, and W. H. Van Der Molen.
Journal of Hydrology, Vol. 79, p 123-126, 1985. 1 Ref.

Descriptors: *Leaching, *Soil water, *Path of pollutants, *Percolation, Saline soils, Salts, Solute transport.

In many saline soils, large amounts of soluble substances are accumulated at the surface by capillary rise followed by evaporation. If such a soil is leached by rainfall or by application of irrigation water, these accumulated salts will move downward. By sampling the soil after a certain time, the concentration depth relation is obtained which can be used to find the parameters describing the leaching process. A characteristic for the progress made in leaching is the fraction of solute that moved beyond a certain depth x at the moment of sampling. An expression is derived for the leaching of a profile with a superficial accumulation of soluble substances. Use has been made of existing analytical solutions, now adapted to a Dirac delta function input of solute. With the concentration profile obtained, a formula follows for the fraction of solute leached beyond depth x at a given time t. (Baker-IVI)
W86-01662

OPERATIONAL RANGES FOR SUCTION LYSIMETERS,

Kaman Tempo, Santa Barbara, CA.
L. G. Everett, and L. G. McMillion.
Ground Water Monitoring Review, Vol. 5, No. 3, p 51-60, 1985. 12 Fig, 36 Ref. EPA contract 68-03-3090.

Descriptors: *Suction lysimeters, *Lysimeters, *Monitoring, *Aeration zone, Vadose water, Land treatment, Waste disposal, Soil water.

Four questions relative to suction lysimeter performance have been raised by operators of land treatment systems. These questions deal with plugging of the porous segments of the lysimeters, soil suction operational ranges, adsorption onto and screening by the materials comprising the various lysimeter parts, and loss of volatile organics under negative pressures. The physical operation of a lysimeter, the characteristics of the lysimeters tested (high- and low-flow lysimeters with porous ceramic cups and lysimeters with porous PTFE (polytetrafluoroethylene) cups, and procedures followed in preparing them for testing are all described and the results of experiments dealing with the first two questions - plugging and operational ranges - are discussed. The intake rate of suction lysimeters placed in the vadose zone, in most types of soils, will initially drop off rapidly, but will stabilize after about 15 liters of moisture have been drawn through the porous cups. Packing a crystalline silica flour slurry around the cups of PTFE lysimeters negates most of the plugging associated with finer particles in soils. The effective operating range of ceramic lysimeters is between 0 and 60 centibars of suction independent of the use of silica flour. The operating range of PTFE lysimeters without silica flour is extremely narrow, but with the use of silica flour is extended to about 7 centibars of suction. The testing program indicates that all lysimeters should be checked for leaks using pressure techniques before field installation and that lysimeters have 'dead' spaces, or reservoirs of from 34 to 80 mL of moisture that cannot be extracted from the cups, which must be taken into account when determining moisture collection rates. Information gathered in the test program is planned for inclusion in an EPA guidance document entitled 'Unsaturated Zone Monitoring at Hazardous Waste Land Treatment Units'. (Author's abstract)
W86-01697

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,

Woodward-Clyde Consultants, Santa Ana, CA.
For primary bibliographic entry see Field 7B.
W86-01701

REDISTRIBUTION OF BROMIDE BY RAINFALL INFILTRATION INTO A CECIL SANDY LOAM LANDSCAPE,

Agricultural Research Service, Watkinsville, GA.
For primary bibliographic entry see Field 5B.
W86-01716

EFFECTS OF TEMPERATURE, RAINFALL AND SOIL MOISTURE ON SOIL RESPIRATION AND LITTER DECOMPOSITION IN A SUB-TROPICAL HUMID FOREST ECOSYSTEM,

North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
J. Singh.
Acta Botanica Indica, Vol. 12, p 167-173, 1984. 3 Fig, 1 Tab, 26 Ref.

Descriptors: *Lailad, *India, *Forests, *Soil respiration, *Decomposition, *Litter, *Rainfall, *Soil water, Carbon dioxide, Nutrients, Climate, Seasonal variation, Temperature effects, Subtropic zone, Leaching.

The study was conducted at Lailad, in a mixed sub-tropical humid 50 yr old forest ecosystem developed subsequent to slash and burn agriculture in north eastern India. Carbon dioxide production was highly correlated with temperature, rainfall and soil moisture. Seasonal climatic conditions during the present study seem to play an important role in controlling the decomposition rates. The highest decomposition rates during rainy season indicated to the favorable effect of the availability of suitable temperature and moisture conditions on the activity of decomposers for leaching of water soluble substances. The low temperature and moisture conditions during winter had an unfavorable effect on the activity of decomposers resulting in lower rates of decomposition. The differences in weight loss in different species can be explained by considering the variation of water soluble components and the physical nature of the plant materials. (Baker-IVI)
W86-01759

STABILITY ANALYSIS OF WATER MOVEMENT IN UNSATURATED POROUS MATERIALS; 3. EXPERIMENTAL STUDIES,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
G. A. Diment, and K. K. Watson.
Water Resources Research, Vol. 21, No. 7, p 979-984, July, 1985. 5 Fig, 11 Ref.

Descriptors: *Porous media, *Soil water, *Infiltration, Particle size, Water content, Wetting front, Frontal instability, Hydrodynamics.

In the first paper of this series a detailed theory was presented in which the principles of hydrodynamic stability analysis were used to develop a linear perturbation equation for vertical water movement with nonsharp fronts. The second paper of the series discussed the application of this analysis to the stability of several soil water systems, some of which were potentially unstable. These included redistribution following infiltration, infiltration into a scale heterogeneous medium, and infiltration into a fine-over-coarse stratified profile. Although instability was expected for these systems and a noticeable trend toward instability was present, the numerical results did not predict the occurrence of such a condition. There was evidence to suggest that small amounts of initial water could have a significant effect on the damping out of instabilities that would occur under dry initial conditions. The present paper studies the effect of initial water content and grain size on wetting front instability by using a series of simple experiments. Results are presented for redistribution following infiltration for three porous materials, initially in a dry condition, and for three wetting depths prior to the onset of the redistribution phase. In addition, for the coarsest of these porous materials, a similar series of infiltration-redistribution experiments is conducted with varying amounts of initial water present. Results are also presented for the effect of initial water content of infiltration into a stratified profile. The experiments show quite clearly that even small amounts of initial water have a strongly inhibiting effect on the development of frontal instability patterns. (Author's abstract)
W86-01769

KINEMATIC WAVE APPROXIMATION TO INFILTRATION INTO SOILS WITH SORBING MACROPORES,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
P. F. Germann, and K. Beven.
Water Resources Research, Vol. 21, No. 7, p 990-996, July, 1985. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Kinematic wave theory, *Infiltration, *Macropores, Soil water, Mathematical models, Sorption, Capillarity, Gravity flow, Wetting front, Soil hydraulic properties.

Soil macropores, such as dessication cracks and channels formed by roots and soil animals, are important pathways for water and solutes. Macropore flow is approached in this study by kinematic wave theory, including a sink function with regard to macropore flow due to sorption by the surrounding soil matrix. Infiltration into soils with macropores is treated as two-domain flow. The first domain is the soil matrix, in which water is subjected to capillarity, and infiltration is approached by Philip's sorptivity concept. The second domain is the soil macropore system in which water moves only under gravity and flow is approached by kinematic wave theory. The two-domain flow model is then applied to infiltration into a block of undisturbed soil containing macropores. There is faily good agreement between the modeled and the observed hydrograph. Only 18 trials were needed to match the modeled cumulative drainage to the observed one. It is assumed in the model that a uniform macropore system exists through which the wetting front may move as a piston. A multitude of flow paths each of them having its own macropore flow properties might prove to be a more realistic approach to macropore flow. This may account for the dispersion of the wetting and draining fronts. The dispersion may also account for the deviation of the modeled for the observed peak, because faster responding macropores were already drained at the time the model predicted the peak. (Moore-IVI)
W86-01771

DISCRIMINATION OF SOIL PHYSICAL PARAMETERS, THERMAL INERTIA, AND SOIL MOISTURE FROM DIURNAL SURFACE TEMPERATURE FLUCTUATIONS,

Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
A. A. van de Griend, P. J. Camillo, and R. J. Gurney.
Water Resources Research, Vol. 21, No. 7, p 997-1009, July, 1985. 12 Fig, 1 Tab, 41 Ref. NASA contract NAS5-23450.

Descriptors: *Soil physical properties, *Soil water, *Thermal inertia, *Soil temperature, Model studies, Remote sensing, Soil surface temperature, Heat flux, Transpiration.

A coupled heat and moisture flux model was used to study the influence of soil physical parameters and moisture content on diurnal surface temperature fluctuations. The study was performed for a grass cover under summer and autumn conditions for four soil types, ranging from sand to clay. The results show that it may be possible to use the daily maximum and minimum surface temperature measurements to discriminate several soil physical characteristics, including soil moisture. Further, ignoring the lower boundary heat flux, as is usually done in thermal inertia mapping but which can vary substantially in relation to different hydrological recharge and discharge areas, may lead to significant errors in the interpretation of soil moisture, thermal inertia, and transpiration. (Author's abstract)
W86-01772

APPROXIMATE ANALYSIS OF THE BOREHOLE PERMEAMETER IN UNSATURATED SOIL,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research, Vol 21, No. 7, p 1025-1033, July, 1985. 10 Fig, 1 Tab, 21 Ref.

Descriptors: *Borehole permeameters, *Mathematical models, *Unsaturated flow, Permeameters, Unsaturated zone, Soil water, Permeability coefficient, Capillarity, Saturated zone.

An approximate analysis of the steady constant-head uncased borehole permeameter in homogeneous unsaturated soil is presented. A bulb-shaped region of saturated soil, the 'saturated bulb,' adjoins the water-filled length of the hole. The problem is solved by matching approximate models of the 'inner' saturated flow within the bulb and of the 'outer' flow in surrounding unsaturated soil. The quasilinear analysis, with sorptive number alpha characterizing the capillary properties of the soil, is applied to the outer saturated flow. Certain approximations made are geometrical, and other simplify the physics by treating gravity and capillarity as separable. The results agree well with the limited body of relevant detailed numerical solutions, and the model is consistent also with saturated flow results and formulae. In general, the capillary properties of the soil cannot be ignored: for a borehole of radius 0.05 m, the error committed in ignoring capillarity increases from 2.8 to 280% as alpha decreases from 10 to 0.1/m. The concepts and methods (the saturated bulb, use of the quasilinear analysis, matching inner and outer flows) apply to a range of steady mixed saturated-unsaturated flow systems with water applied under positive hydrostatic pressure to an initially unsaturated soil mass. The study leads to some doubt about the practicality of using the borehole permeameter to measure saturated hydraulic conductivity in the absence of an independent determination of alpha. (Author's abstract)
W86-01774

SUMMER SOIL MOISTURE CONTENT AND THE WATER TABLE IN A FORESTED WETLAND PEAT,

Toronto Univ. (Ontario). Dept. of Geography.
D. S. Munro.
Canadian Journal of Forest Research, Vol. 14, No. 3, p 331-335, June, 1984. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Soil water, *Water table, *Peat, *Wetlands, Beverly Swamp, Ontario, Soil moisture deficiency, Storage capacity, Swamps.

Soil samples were collected from the peat of the Beverly Swamp (Ontario), at weekly intervals, over three successive summers. The samples were analyzed to determine the distribution of soil moisture within the peat above the water table. A calculation scheme for the soil moisture deficit is defined and utilized to describe the behavior of the soil moisture regime over time. Linear regressions of soil moisture deficit against water table level are found to be statistically strong, but the slopes of the regressions change significantly from one summer to the next. Therefore, it is concluded that the position of the water table is not necessarily consistant indicator of storage capacity in wetlands. (Author's abstract)
W86-01779

EFFECT OF ENTRAPPED AIR ON WATER PERMEABILITY OF SOILS (THEORY AND EXPERIMENT),

Kiev State Univ. (USSR).
B. A. Faibishenko.
Water Resources, Vol. 11, No. 4, p 304-315, July-August, 1985. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Soil moisture, *Permeability coefficient, *Entrapped air, Unsaturated soils, Aeration, Water table, Model studies, Computers, Percolation.

The permeability of soils can be substantially affected by entrapped air, which remains in unsaturated soils of the zone of aeration and in quasi-saturated soils of the aquifer, reducing their permeability coefficient by 100 times and more. A model incorporating a system of equations should be used to predict water transport with consideration of entrapped air with a computer. For drainage conditions it is advisable to use in the zone of seasonal water table fluctuations in hydrogeological calculation the permeability coefficient and function K determined at the maximum possible volume of entrapped air for the investigated soils. Processes for moisture transport and percolation in the case of complete saturation and in a quasi-saturated state are described by one differential equation, the parameters of which vary for a different degree and character of soil saturation. During intake of water in monoliths under lab conditions and in rings and pits under field conditions the general character of variation of soil permeability with time is the same. Field methods can be used for determining the permeability coefficient of soils only with monitoring of the volume of entrapped air and spatial dynamics of water in soils. For practical purposes a combined approach can be recommended, which calls for: a field experiment - water intake tests in a pit for establishing the regularities of formation of the flow under natural conditions; a laboratory experiment - experiments on monoliths for determining the permeability coefficient as a function of the volume of entrapped air and hydrophysical properties of the soils and a computational experiment on a computer using a model for substantiating the necessary amount of field and lab works and for selecting and evaluating the correspondence of the mathematical model used to the natural process of percolation and moisture transport. (Baker-IVI)
W86-01804

ESTIMATION OF THE DEGREE OF DRAINAGE OF A TERRITORY,

Industrial and Scientific-Research Inst. for Engineering Surveys in Construction, Moscow (USSR).
V. V. Vedernikov, and E. S. Dzektser.
Water Resources, Vol. 11, No. 3, p 217-223, May-

June, 1984. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 3, p 60-67, May-June, 1984.

Descriptors: *Drainage, *Mapping, *Hydrogeology, Groundwater, Hydrology, Mathematical equations, Geomorphology, Climate.

The degree of drainage of a territory is one of the most important complex hydrogeologic characteristics. The construction of hydrogeologic maps with zones of various degrees of drainage is widely used in reclamation engineering. An estimation of the degree of drainage of territories is important for planning cities, industrial complexes, routes of oil and gas pipelines or when developing areas for industrial and civil construction. The degree of drainage of a territory depends on a whole set of conditions: geomorphologic, hydrogeologic, geologic, and hydrologic-climatic. The proposed method, based on quantitative drainage criteria, broadens the limits of applicability of existing methods in view of the comparatively greater detail of the natural conditions of the investigated territories and possibilities for future use. (Baker-IVI)
W86-01821

COMPARISON OF THREE FIELD METHODS FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. M. Lee, W. D. Reynolds, D. E. Elrick, and B. E. Clothier.
Canadian Journal of Soil Science, Vol. 65, p 563-573, August, 1985. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Permeability coefficient, *Permeameters, Measuring instruments, Sand, Loam, Clay, Macropores, Air entrapment, Soil type, Statistical studies.

The saturated hydraulic conductivity, Ks, was measured on a loamy sand, a fine sandy loam, a silt loam and a clay at four 100-sq m-area sites in southern Ontario. Twenty measurements of Ks, were obtained by each of three different measurement techniques at each of the four sites. The techniques included: (1) the air-entry permeameter method; (2) the constant head well permeameter method using the Guelph Permeameter; and (3) the falling-head permeameter method applied to small soil cores. The Ks data were found to be better described by the log-normal frequency distribution than by the normal frequency distribution. Statistical comparison of the mean Ks values (Ks) indicated significant differences between some or all of the methods within each site. This site-method interaction was interpreted in terms of the influence of macropores and air entrapment on each of the measurement techniques. The measured Ks values ranged over an order of magnitude on the sand, one to two orders of magnitude on the loams, and three orders of magnitude on the clay. The Ks estimates averaged over the three methods were: 0.00003 m/s for the sand; 0.000002 m/s for the loams and 0.0000001 m/s for the clay. Although all techniques were able to discriminate between the three soil types, the best choice of method for any particular situation appears dependent on the required type and accuracy of the Ks measurement, soil type, and the various practical constraints on the investigation. (Author's abstract)
W86-01909

2H. Lakes

POSSIBILITIES OF OBTAINING ZOOPLANKTON FROM THE RIVER PLONIA TO FEED YOUNG FISH,

Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrozoology.
B. Szlauer.
Acta Hydrobiologia, Vol. 25/26, No. 2, p 165-171, 1983/1984. 3 Tab, 12 Ref.

Descriptors: *Fish food, *Zooplankton, *River Plonia, *Poland, Fish, Aquaculture.

Little information is available on the occurrence of zooplankton at some distance from the outflows of rivers from lakes. A test method was proposed to elaborate on this problem which would allow the size of expected catches of zooplankton in a river to be estimated. Two samping sites were chosen close to road bridges. Site I was 10 km from the outflow of the River Plonia from Lake Miedwie in a straight line. Site II was 18 km from this lake. The mean zooplankton flow at Sites I and II was respectively 74.86 and 57.88 kg wet weight per 24 hrs, ranging from 500 kg per 24 hr in May (Site I) to 0.32 kg/24 hr in August (Site II). During the period of demand for zooplankton, December to May, the zooplankton flow at Site I amounted to 23 310 kg. This was sufficient live food for the rearing of approximately 4000 kg of fry. The results of this study indicate it is possible to catch zooplankton in rivers flowing from lakes. This zooplankton may be caught even at a great distance from the lake, in those places most suitable from the point of view of their utilization. However, the catches may be abundant at such distant sites only in the period from November until May. (Baker-IVI)
W86-01320

EFFECT OF BIOTIC AND ABIOTIC FACTORS ON THE OCCURRENCE OF PLANKTONIC ROTIFERS (ROTATORIA) IN THE PLAWNIOWICE DUZE RESERVOIR (UPPER SILESIA, POLAND),

Silesian Univ., Katowice (Poland). Dept. of Zoology.
I. Bielanska-Grajner.
Acta Hydrobiologia, Vol. 25/26, No. 2, p 173-180, 1983/1984. 3 Fig, 26 Ref.

Descriptors: *Phytoplankton, *Reservoirs, *Plawniowice Duze Reservoir, *Poland, *Rotifers, Dissolved oxygen, Water temperature, Primary productivity, Population dynamics, Phytoplankton.

The Plawniowice Duze Reservoir lies in the Forest Protective Belt in the Upper Silesia Industrial Region of Poland. It was constructed by flooding a sand pit heading with waters from the Toszecki stream, a tributary of the River Klodnica. Filling was completed in 1975. The area of the reservoir is about 285 ha, with a maximum depth of 16 m, and a mean depth of 11 m. The Plawniowice Duze reservoir is a lowland, extremely limnic dam reservoir. The lake hollow is characterized by the absence of asymmetry typical for dam reservoirs. A hydrobiological investigation was carried out in the reservoir, which demonstrated a dependence between the occurrence of pelagic rotifers and phytoplankton appearing in the water body. The rotifers occurred in greater numbers at the same depths as the phytoplankton. A dependence was also noted between the vertical distibution of rotifers and the water temperature and the amount of dissolved oxygen in the water. (Baker-IVI)
W86-01321

EFFECTS OF ANNUAL DRAINING ON WATER QUALITY AND PRODUCTION OF CHANNEL CATFISH IN PONDS,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 8I.
W86-01322

APPROACH TO THE RESTORATION OF AQUATIC VEGETATION IN THE XIHU LAKE OF HANGZHOU, WITH REFERENCE TO THE WATER QUALITY PROBLEM (IN CHINESE),

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W86-01324

HABITAT REQUIREMENTS AND BIOINDICATOR VALUE OF THE MAIN COMMUNITIES OF AQUATIC VEGETATION IN NORTH-EAST POLAND,

Warsaw Univ. (Poland). Dept .of Phytogeography.
S. Klosowski.
Polskie Archiwum Hydrobiologii, Vol. 32, No 1, p 7-29, 1985. 6 Fig, 3 Tab, 37 Ref.

Descriptors: *Bioindicators, *Poland, *Aquatic vegetation, *Macrophytes, *Habitats, Pondweed, Indicators, Aquatic habitats, Nutrients.

Comparison of the phytosociological data as well as of the physical and chemical properties of water and substrate of the phytocenoses of five aquatic communities - Potamogetonetum perfoliati, P. lucentis, P. natantis, Nupharo-Nymphaeetum albae and Hydrocharitetum morsus-ranae - indicates that the properties of the habitat evidently influence phytosociological differentiation of the communities. The substrate and water represent two, in a great measure independent, habitat components whose importance for the various communities is different. Nearly each aquatic vegetation community, singled out on the grounds of floristic dominance, exhibits some indicator value. With respect to aquatic habitat, the greatest bioindicator value is displayed by Potamogetonetum natantis which is indicative of waters relatively poor in nutrients (mesotrophic water). (Author's abstract)
W86-01326

SEASONAL OBSERVATIONS OF HETEROTROPHIC ACTIVITY AND ACTIVE BACTERIAL NUMBER IN LAKE CONSTANCE,

Shinshu Univ., Matsumoto (Japan). School of Allied Medical Sciences.
K. Kato.
Archive fur Hydrobiologie, Suppl. 66, No. 3, p 309-319, May, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Seasonal variation, *Primary productivity, *Bacteria, *Lake Constance, Heterotrophic bacteria, Temperature effects, Phytoplankton, Eutrophication.

In situ experiments were conducted during 1982 to study factors regulating bacterial numbers and their heterotrophic activities in Lake Constance. Seasonal changes of heterotrophic activity and substrate-active bacterial number were determined using carbon-14 labeled glucose for samples taken from 2 m depths in the large mesotrophic lake. Glucose-active bacterial number fluctuated from 0.75 to 22000000 cells/ml and it amounted to between 3.5-46% of the total bacteria present which varied between 2.1 and 9800000 cells/ml. Vmax was low in April and increased rapidly, parallel to the spring bloom of phytoplankton. Turnover time of labeled glucose decreased from around 2 months (1336 h) to the order of days (182 h) in April and remained nearly constant at the level of a few days until 29 November when the numbers of turnover time and Vmax were 434 hr and 0.013 micro-g C/l/h, respectively. A close correlation was observed between Vmax and glucose-active bacterial number. Data show that both Vmax and specific Vmax were correlated with temperature. Bacterial response to labeled glucose did not show significant relations to primary productivity. (Baker-IVI)
W86-01329

SEDIMENT RESUSPENSION AND CURRENTS IN LAKE MANITOBA,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
B. C. Kenney.
Journal of Great Lakes Research, Vol. 11, No. 2, p 85-96, 1985. 7 Fig, 5 Tab, 18 Ref.

Descriptors: *Lake Manitoba, *Manitoba, *Suspended sediments, *Water currents, Sediments, Phosphorus, Nutrients, Stratification, Wind, Lakes.

Lake Manitoba is exposed to high prairie winds that produce both surface waves and turbulent lake currents. Large amounts of sediment are resuspended in the water column of the prairie lake. A device has been designed to collect samples of resuspended sediments in gram quantities at various depths without a fair weather bias. Although not thermally stratified, the currents measured in very shallow water in Lake Manitoba were frequently composed of a surface flow directly driven by the wind separated from a bottom layer by a large directional skew at the interface. The vertical mass distribution of resuspended sediment reflected the two layer characteristics of the lake currents.

The particle size distribution of the suspended sediment was also sharply layered with sand in the upper layer and silt in the lower. The resuspended sediments form a large phosphorus pool that is potentially available to support the immense algal blooms observed in prairie great lakes. (Baker-IVI)
W86-01341

CURRENTS AND TEMPERATURES IN GREEN BAY, LAKE MICHIGAN,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. S. Miller, and J. H. Saylor.
Journal of Great Lakes Research, Vol. 11, No. 2, p 97-109, 1985. 8 Fig, 1 Tab, 18 Ref.

Descriptors: *Water currents, *Water temperature, *Green Bay, *Lake Michigan, Lakes, Water circulation, Water level, Thermal statification, Stratification, Waves.

Current and water temperature recordings made during 1977 constitute the first long term data set of this type from Green Bay. Anticlockwise water movements hypothesized from earlier indirect data were also indicated in the current data. Cool water flows southward along the western shore while warmer water returns in the eastern part of the bay. This cyclonic pattern is disrupted and reversed during northeasterly winds. An unexpected discovery was the large and consistent water volume transfer through Porte des Morts Passage and Rock Island Passage. Measurements showed the upper half of the water column egressing from the bay while cold hypolimnetic lake water entered the bay in the lower half. This intruding cold water, with an estimated flow rate of 3,300 cu m/sec during summer, supplies cool water well into the middle bay southward of Chambers Island. This cold-water inflow is not an infrequent episodic phenomenon, nor is the flow seasonally dependent. Flushing is enhanced dramatically by the infusion of additional water. Periodic components are present in all currents and are highly coherent with water level fluctuations. Currents through the mouth associated with water level oscillations at the bay head illustrated that the phase was constant within the frequency band of the semidiurnal tidal wave and co-oscillating 9 hr wave, contrary to model predictions. In addition, the phase of currents across the mouth was near zero for these oscillating components, suggesting that the modeled bottom friction may require adjustments. Three dimensional models capable of treating stratification and lake bay interactions are necessary to adequately model dynamic processes in Green Bay. (Baker-IVI)
W86-01342

PHYTOPLANKTON DISTRIBUTION IN SAGINAW BAY,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer, and E. Theriot.
Journal of Great Lakes Research, Vol. 11, No 2, p 132-142, 1985. 9 Fig, 5 Tab, 19 Ref.

Descriptors: *Phytoplankton, *Distribution, *Saginaw Bay, *Michigan, Great Lakes, Lake Huron, Multivariate analysis, Algae, Diatoms, Eutrophication, Population dynamics, Chlorophyta.

Saginaw Bay is located on the western side of Lake Huron, extending in a southwesterly direction from the lake into the lower peninsula of Michigan. Average conditions were measured in the phytoplankton assemblage in Saginaw Bay in order to examine movement of phytoplankton populations developing in the bay. Phytoplankton assemblage variation was also discussed in relation to proposed models of Saginaw Bay phytoplankton. Samples taken in the spring were numerically dominated by diatoms. However, green algae then took over for a brief period of dominance from July through October when diatoms again became the dominant taxonomic group. Cluster analysis indicated the bay could be effectively divided into two regions in regard to phytoplankton assemblages. The inner bay was typified by algal species with a Saginaw River origin and/or species typical of eutrophic waters in the Great Lakes. The outer region was typified in part by species of open Lake Huron. Unique phytoplankton assemblages were noted in Wild Fowl Bay and the area to the southwest of Oak Point. These areas are not well integrated with the rest of the bay. A possible strong nearshore effect was noted on transport of Saginaw Bay populations to Lake Huron. The nearshore effect modifies the effect of Saginaw River on the phytoplankton of the Saginaw Bay-Lake Huron system. (Baker-IVI)
W86-01345

TIME-DEPENDENT SOLUTION OF MULTI-SEGMENT MASS BALANCE MODELS OF CONTAMINANTS IN THE GREAT LAKES,

Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 5B.
W86-01350

PARTITIONING OF HEAVY METALS (FE, MN, CD, PB, CU, ZN, CO, NI AND AS) AND P INTO SELECTIVE CHEMICAL FRACTIONS IN SEDIMENTS FROM LAKE KOJIMA (IN JAPANESE),

For primary bibliographic entry see Field 5B.
W86-01362

POPULATION DYNAMICS OF THE DEVILS HOLE PUPFISH,

Michigan Univ., Ann Arbor. School of Natural Resources.
B. Chernoff.
Environmental Biology of Fishes, Vol. 13, No. 2, p 139-147, 1985. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Population dynamics, *Devils Hole, *Nevada, *Pupfish, Model studies, Fish, Model studies, Mortality, Simulation, Water level, Seasonal variation.

A model is constructed to simulate fluctuations in monthly population sizes of the Devils Hole pupfish between January 1973 and August 1976. The strength of the proposed conceptual model is that is allows focusing on the relationship between population size and various biological and environmental factors. The model is shown to be capable of accurately predicting the population size over a 44 month period when several sources of mortality were included. The model was unable to project the long term effect of constant water-level management. The model should not be considered as an end in itself but rather as a valuable heuristic tool which can shed light on areas of needed research. A variety of biological parameters are estimated, and adult mortality is partitioned into natural and environmentally-dependent components. The simulations capture the seasonal fluctuations in population size, and only seven predicted population sizes differ from those observed by 20% or more. The model is used to make testable predictions about the life history of this species and interactions of the parameters are discussed. (Baker-IVI)
W86-01364

MIXED LAYER DYNAMICS IN A LAKE EXPOSED TO A SPATIALLY VARIABLE WIND FIELD,

Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. Imberger, and G. Parker.
Limnology and Oceanography, Vol. 30, No. 3, p 473-488, May, 1985. 17 Fig, 1 Tab, 18 Ref. Australian Water Resources Council project 80/119.

Descriptors: *Lakes, *Mixing, *Wind velocity, Lake circulation, Water circulation, Salinity, Density, Water temperature.

The formation of frontal structures in the surface mixed layer near the entrance of an embayment in a medium-sized lake were described with field measurements. The observed evolution of the fronts was interpreted in terms of three well defined dynamical regimes. The first, differential heating, is defined as the variable heat capture due to decreased surface heat losses and warmer surface water in the sheltered embayments. The second, variable deepening of the mixed layer, is induced by a sudden increase in wind speed in the open central areas of the lake, with only minimal mixing in the sheltered part of the lake. The third is the horizontal gravitational motion driven by the horizontal density gradients set up by the active deepening of the mixed layer in the exposed parts of the lake. Although detailed wind data were not available, observations of the temperature and salinity fields show the existence of fronts in lakes and strongly suggest the importance of the above mechanisms in determining the horizontal variability of these fields in the surface mixed layer of medium-sized lakes. (Author's abstract)
W86-01412

EFFECTS OF PH AND PLANT SOURCE ON LIGNOCELLULOSE BIODEGRADATION RATES IN TWO WETLAND ECOSYSTEMS, THE OKEFENOKEE SWAMP AND A GEORGIA SALT MARSH,

Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 2L.
W86-01413

EXPERIMENTAL MANIPULATION OF NUTRIENTS AND WATER IN A FRESHWATER MARSH: EFFECTS ON BIOMASS, DECOMPOSITION, AND NUTRIENT ACCUMULATION,

Manitoba Univ., Winnipeg. Dept. of Botany.
For primary bibliographic entry see Field 5D.
W86-01414

PHOSPHORUS LIMITATION OF LOTIC PERIPHYTON GROWTH RATES: AN INTERSITE COMPARISON USING CONTINUOUS-FLOW TROUGHS (THOMAS RIVER SYSTEM, BRITISH COLUMBIA),

National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
M. L. Bothwell.
Limnology and Oceanography, Vol. 30, No. 3, p 527-542, May, 1985. 3 Fig, 7 Tab, 72 Ref.

Descriptors: *Phosphorus, *Limiting nutrients, *Periphyton, *Thomas River System, *British Columbia, Nitrogen, Nutrients, Growth, Biomass, Algae, Chemical composition.

Periphyton growth rates and relative degrees of phosphorus deficiency were compared with onsite, continuous-flow troughs in three parts of the Thompson River system. Soluble reactive phosphorus (SRP) in the lower Thompson, North Thompson, and South Thompson Rivers averaged 3.4, 1.1, and 0.7 micro-g/liter. Several physiological and chemical composition parameters ranked the degree of P deficiency in the rivers in the same sequence as did SRP. Among these were alkaline phosphatase activity, V sub max for (P-32)O4(3-) uptake, and cellular N:organic P, Chl a:ATP, C:ATP, and C:organic P. Specific growth rates (mu) estimated by biomass accrual and by (C-14)O2 uptake usually, but not always, indicated higher mu with greater availability of P. However, relative specific growth rates (mu:mu sub max) consistently reflected the influence of P limitation. As assessed from N:organic P and by application of the Droop and Goldman-Carpenter equations, mu:mu sub max was 0.8-0.9 at the lower Thompson, 0.3-0.6 at the North Thompson, and 0.0-0.3 at the South Thompson sites. Hence, periphyton growth rates in the lower Thompson River were near the maximum set by temperature and light at ambient SRP of only 3-4 micro-g/liter. Evidence of P-limited growth rates in the South Thompson and North Thompson Rivers was found at temperatures approaching 0 C. (Author's abstract)
W86-01416

FACTORS CONTROLLING PHOSPHORUS LIMITATION IN STREAM SEDIMENTS,

State Univ. of New York Coll. at Cortland. Dept. of Biological Sciences.
R. L. Klotz.
Limnology and Oceanography, Vol. 30, No. 3, p

543-553, May, 1985. 5 Fig, 6 Tab, 30 Ref.

Descriptors: *Phosphorus, *Limiting nutrients, *Stream sediments, *Sediments, *New York, Microorganisms, Benthos, Alkaline phosphatase activity, Forest watersheds, Agricultural watersheds.

Factors influencing the phosphorus limitation of benthic microorganisms were determined for four streams (two agricultural and two forested) in central New York State over an annual cycle. Phosphorus limitation was measured biweekly as specific alkaline phosphatase activity (APA) of sediment samples. Analysis of variance showed the forested streams (sites 2 and 4) to have significantly different sediment APA from the agricultural streams (sites 1 and 3), the higher APA for the forested sites indicating greater phosphorus limitation. Stream total reactive phosphorus concentrations showed no relationship with watershed type, with mean annual values of 10.5 and 6.0 micro-g/liter for agricultural sites 1 and 3 and 4.1 and 9.6 for forested sites 2 and 4. With all sites grouped together, sediment APA had a low correlation with stream water phosphate ($r = 0.184$, $n = 73$). Phosphorus sorption isotherms showed sediments from agricultural streams to have higher phosphate sorption indices than forested sites and to sorb rapidly large amounts of phosphorus. This resulted in higher available phosphorus content for the agricultural sediments and lower sediment APA. (Author's abstract)
W86-01417

DISTRIBUTION AND CHARACTERISTICS OF CARBOXYPEPTIDASE ACTIVITY IN POND, RIVER, AND SEAWATERS, IN THE VICINITY OF TOKYO,

Tokyo Univ. (Japan). Dept. of Chemistry.
S. Hashimoto, K. Fujiwara, K. Fuwa, and T. Saino.
Limnology and Oceanography, Vol. 30, No. 3, p 631-645, May, 1985. 10 Fig, 4 Tab, 29 Ref. Ministry of Science, Culture and Education (Japan) grant-in-aid 58540349.

Descriptors: *Carboxypeptidase, *Ponds, *Rivers, *Seawater, *Tokyo Bay, *Japan, *Enzymes, Chlorophyll, Proteins, Water chemistry, Peptides, Organic carbon.

Enzymatic hydrolysis of the peptide bond between glycine and tryptophan was measured in river water, pond water, and seawater near Tokyo. Enzymatic activities were in the range between 0.1 and 3 mU/liter, 10-50% of the activity was due to cell-free (dissolved) enzymes (1 mU expresses the rate of hydrolyzing substrate at 1 nM/min at 25 C). According to gel permeation chromatography, the dissolved activity included several macromolecules with molecular weights between 30,000 and 500,000 daltons. The horizontal and vertical distributions of this activity were measured in Tokyo Bay and the open sea, where an appreciable amount was detected even at 1,400-m depth. Among various factors investigated (including pH, salinity, water, temperature, metal ions, and phosphorus concentrations), total organic carbon, particulate organic carbon, and especially chlorophyll a were positively correlated to the enzymatic activity in Tokyo Bay. The slope of regressions of chlorophyll a on carboxypeptidase activity for individual sampling points showed that the activity per unit of chlorophyll a increased when the sampling station was closer to the open sea. Although whole protein molecules are not decomposed in the dissolved state, small peptides may be degraded by the free dissolved enzymes. (Author's abstract)
W86-01418

ANNUAL LOSSES OF IRON FROM MOORLAND SOILS AND THEIR RELATION TO FREE IRON CONTENTS,

Stirling Univ. (Scotland). Dept. of Environmental Science.
I. C. Grieve.
Journal of Soil Science, Vol. 36, No. 2, p 307-312, June 1985. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Iron, *Moorland soils, *Soils, Chemical composition, Metals, Organic matter, Soil properties.

The temporal pattern of iron loss from a moorland catchment was investigated by intensive stream sampling. The field site was a 51 ha area of moorland in the Ochil Hills near Stirling, Scotland, drained by a small tributary of the Allan Water. Filtered water samples were used for the determination of dissolved iron by atomic absorption spectrophotometry and of dissolved organic matter by dichromate oxidation. Losses of iron from the catchment were calculated as the product of discharge and iron concentration, summed over time. The total loss in 1 year was 2.11 kg/ha of Fe, with a pronounced autumn maximum. Iron concentrations in stream water were strongly correlated with dissolved organic matter content, but again with seasonal variation. The autumn maximum for Fe losses relates to the flushing of DOM during autumn rewetting of the catchment. However, the DOM/Fe ratio indicates maximum iron transport per unit mass of DOM in the winter. Free iron content measured on a number of soils in the catchment ranged from 3.1 to 8.7 kg/sq m. Assuming soil development over 10,000 years, predicted loss of iron from the catchment is comparable in quantity to the amounts of free iron in soils. (Collier-IVI)
W86-01468

EFFECT OF SUSPENDED SOLIDS ON THE GROWTH OF APICAL TIPS OF GAMETOPHYTE PLANTS OF LEMANEA AND ON CARPOSPORE GERMINATION AND SUBSEQUENT COLONISATION,

University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 5C.
W86-01498

INTER- AND INTRA-HABITAT DISTRIBUTION OF LEECHES IN A EUTROPHIC ENGLISH LAKE,

Liverpool Univ. (England). Dept. of Zoology.
S. M. L. Randall, S. M. Spelling, and J. O. Young.
Archiv fur Hydrobiologie, Vol. 103, No. 4, p 419-444, June, 1985. 12 Fig, 9 Tab, 35 Ref.

Descriptors: *Leeches, *Ecological distribution, *Eutrophic lakes, *England, Habitats, Substrate, Reproduction, Biomass, Water depth, Migration.

In an eutrophic English lake, Erpobdella octoculata, Glossiphonia complanata and Helobdella stagnalis had their maximum abundance in waters of less than 1 m in depth. H. stagnalis was numerically dominant on stones, on plants and in detritus. E. octoculata had a greater relative abundance than G. complanata on plants and in detritus. For any one species, weight-structure and breeding activity were similar for populations living on stones and in beds of vegetation. Leeches showed no preference for stones of a particular size or texture. For each of the species, density and biomass were less but mean weight and the proportion of breeding animals were greater on stones than in the underlying subtratum. There was some evidence for a movement of leeches into the deeper littoral waters in the winter. (Author's abstract)
W86-01499

RESPONSES OF PHYTOPLANKTON IN LAKE JACARETINGA TO ENRICHMENT WITH NITROGEN AND PHOSPHORUS IN CONCENTRATIONS SIMILAR TO THOSE OF THE RIVER SOLIMOES (AMAZON, BRAZIL),

Universidade Estadual Paulista, Botucatu (Brazil). Inst. Basico de Biologia Medica e Agricola.
R. Henry, K. Hino, J. G. Tundisi, and J. S. B. Ribeiro.
Archiv fur Hydrobiologie, Vol 103, No. 4, p 453-477, June, 1985. 14 Fig, 4 Tab, 40 Ref. NSF grant BSR-800.3203.

Descriptors: *Phytoplankton, *Nitrogen, *Phosphorus, *Lake Jacaretinga, *River Solimoes, *Brazil, Zooplankton, Productivity, Nitrates, Chlorophyll, Decomposition, Bacteria.

The Amazon valley presents a large diversity of aquatic environments, all formed by water flowing from the Andes through the River Solimoes. The water inflow from the river Solimoes into the adjacent lakes (Lake Jacaretinga for example) affects strongly the ecology and productivity of the lacustrine systems. An in situ enrichment experiment was conducted in Lake Jacaretinga (Brazil) in January 1982 to assess the possible stimulation of phytoplankton growth by nutrients (nitrates or phosphates). Phosphate enrichment (with or without nitrate) did not cause statistically changes in the chlorophyll production. There was a significant increase in biomass (chlorophyll a) and photosynthetic activity after only two days incubation due to nitrate addition. On day four, a decrease in chlorophyll and primary productivity occurred. This reduction was explained as a function of predation by zooplankton. On day six of incubation, an increase in productivity was observed, due probably to ammonia excretion by zooplankton and decomposition action by bacteria. The inflow of river water into the lake at high water (April to September) results in a rich load of nutrients as well as an increase of the water levels in the lake. (Moore-IVI)
W86-01500

GAMMARIDS IN STREAMS OF NORTHEASTERN BAVARIA, F. R. G. I. PREDICTION OF THEIR GENERAL OCCURRENCE BY SELECTED HYDROCHEMICAL VARIABLES,

Fachhochschule Weihenstephan, Freising (Germany, F.R.). Fachbereich Landespflege.
E. Schrimpff, and F. Foeckler.
Archiv fur Hydrobiologie, Vol. 103, No. 4, p 479-495, June, 1985. 3 Fig, 7 Tab, 21 Ref.

Descriptors: *Gammarus, *Ecological distribution, *Bavaria, *Germany (Federal Republic), Calcium, Magnesium, Hydrogen ion concentration, Water chemistry, Geology, Crustaceans.

Northeastern Bavaria (Federal Republic of Germany) belongs to the distribution area of the two Gammarus species: G. fossarum and G. roeseli, but a geographical area of about 3000 sq km is not populated by gammarids. To determine if natural conditions or anthropogenic influences cause this, 143 stream sections within 15 selected streams in Northeastern Bavaria were checked for the presence of Gammarus, temperature, pH and electric conductivity. Water samples were analyzed for Ca, Mg, K, Cl(-), NO3(-), PO4(3-), Fe, Zn, total hardness and organic matter. The occurrence of gammarids in this area is restricted to the well buffered streams of the scarplands. Gammarids avoid the acidic waters, poor in ions, of the ancient earthblock area and of the ferrugineous sandstone areas within the scarplands. Mg, Ca, and pH were the hydrochemical parameters most efficient for discrimination between the occurrence and nonoccurrence of gammarids. A simple discriminatory model built up on these variables yields 96% correct predictions within Northeastern Bavaria. The model was less efficient when applied in other areas. (Moore-IVI)
W86-01501

LOWLAND HARDWOOD WETLAND INVERTEBRATE COMMUNITY AND PRODUCTION IN MISSOURI,

1027 Second St., Morgan City, LA, 70380.
D. C. White.
Archiv fur Hydrobiologie, Vol. 103, No. 4, p 509-533, June, 1985. 1 Fig, 13 Tab, 40 Ref.

Descriptors: *Wetlands, *Invertebrates, *Productivity, *Missouri, Isopods, Amphipods, Clams, Drought tolerance, Dissolved oxygen, Mixing, Climate.

The invertebrate community and production on 3 lowland hardwood wetland sites in southeastern Missouri, were studied in the winter of 1979-1980. The 1 managed and 2 naturally flooded sites varied in the initiation date of winter flooding. The invertebrate community was classified according to strategies for drought toleration and period or recruitment to the community. The dominance of

permanent residents (isopods, amphipods and fingernail clams) indicated that lowland hardwood wetlands retain sufficient moisture during the dry period to support animals with limited drought tolerance. Comparisons of isopod growth on the 3 sites indicated that duration of the hydroperiod was the most important factor affecting production. The relatively low production of isopods, amphipods and fingernail clams on lowland hardwood wetlands is related to limited dissolved oxygen, poor water mixing and a short, cold growing season. (Author's abstract)
W86-01502

SPY POND DIAGNOSTIC-FEASIBILITY STUDY: RECOMMENDATIONS FOR RESTORING A LAKE IMPACTED BY URBAN STORMWATER RUNOFF,

Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
E. W. Chesebrough, and C. L. Duerring.
Northeastern Environmental Science, Vol. 3, No. 2, p 59-66, 1984. 4 Fig, 1 Tab, 19 Ref.

Descriptors: *Spy Pond, *Arlington, *Massachusetts, *Eutrophic lakes, *Ponds, Lake restoration, Water pollution effects, Lakes, Water quality, Urban runoff, Oxygenation, Aluminum salts.

A diagnostic study was performed on Spy Pond in Arlington, Massachusetts from March 1980 to April 1981 by the Massachusetts Division of Water Pollution Control. This lake was found to be highly eutrophic based on high inlake nutrient concentrations, anaerobic hypolimnion during summer stratification, successive algae blooms, and dense aquatic macrophyte growth in littoral areas. Forty storm drains are known to deliver urban stormwater runoff to the lake and this was found to be a major source of nutrients. A feasibility study further examined and confirmed these results. A cost-effective restoration project was developed that incorporates the following components: importation of 1 mgd of groundwater, periodic use of an aluminum salt to seal the sediments, an oxygen diffuser to enhance circulation, and a diversion chamber at the major storm drain/inlet to direct inflows into three separate waste streams. (Author's abstract)
W86-01550

NUTRIENT CYCLING AND ECOSYSTEM BEHAVIOUR IN A SALT-WATER LAKE,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
I. De Vries, and C. F. Hopstaken.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 221-245, December, 1984. 6 Fig, 4 Tab, 46 Ref.

Descriptors: *Cycling nutrients, *Ecosystems, *Lakes, *Lake Grevelingen, *Netherlands, Water resources development, Flood control, Environmental effects.

A nutrient balance model is developed to describe and evaluate the relations between carbon cycling and nutrient dynamics in saline Lake Grevelingen, a former estuary in the SW-part of the Netherlands. Calculations indicate nutrient limitation of planktonic and benthic microalgae by reversible storage of more than 75% of the available silicon and nitrogen in bottom detritus. Mobilization from the bottom is the main nutrient source during summer. Uptake by benthic micro-algae strongly reduces the nutrient flux from shallow bottoms at that time. Uptake of nutrients from the overlaying water by benthic micro-algae during spring can explain the observed decrease of the dissolved silicon concentration in the absence of planktonic diatoms. The planktonic primary production depends on the balance between storage of nutrients in bottom detritus, mineralization, and uptake by benthic microalgae. Denitrification is considered to be a key process in the nitrogen balance, compensating the nitrogen load, and thus crucial in consolidating the mesotrophic properties of the lake. Factors probably influencing denitrification and hence controlling or promoting eutrophication in shallow marine ecosystem, like the oxygen concentration in the sediment and the suspension feed in bottom fauna community, are discussed. The observed gradual concentration decrease of silicon at an increasing nitrogen concentration, combined with a shift in phytoplankton from diatoms to flagellates, is explained by irreversible fixation of a small fraction of silicon in diatom tests, combined with a high resolution rate of the labile silicon fraction in detritus. (Baker-IVI)
W86-01569

PHYTOPLANKTON PRIMARY PRODUCTION IN BRACKISH LAKE GREVELINGEN (SW NETHERLANDS) DURING 1976-1981,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
F. Vegter, and P. R. M. de Visscher.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 246-259, December, 1984. 3 Fig, 4 Tab, 33 Ref.

Descriptors: *Water resources development, *Flood control, *Environmental effects, *Phytoplankton, *Primary productivity, *Lake Grevelingen, *Netherlands, Carbon, Nutrients, Temperature effects, Water temperature, Light intensity, Chlorophyll.

Phytoplankton primary production in brackish Lake Grevelingen was studied from 1976 to 1981, inclusive, in connection with a number of environmental parameters. An evident tendency of increasing primary production from 1978 (90 g C/sq m/a) to 1981 (225 g C/sq m/a) has been shown, following a change in the hydrological regime of the lake in 1978, viz. the opening of a sluice between the lake and the North Sea. Especially increased nitrate concentrations may be responsible for the enhanced production. Primary production was triggered almost every year at the end of February with prevailing light conditions of 0.002-0.004 J/sq cm/s in the water column. Annual production data from Lake Grevelingen are comparable with literature values, measured in eutrophicated coastal areas. (Baker-IVI)
W86-01570

CHANGES OF SEDIMENT DISTRIBUTION PATTERNS IN LAKE GREVELINGEN, AN ENCLOSED ESTUARY IN THE SW NETHERLANDS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. Kelderman, J. Nieuwenhuize, A. M. Meerman-Van de Repe, and J. M. Van Liere.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 273-285, December, 1984. 8 Fig, 1 Tab, 29 Ref.

Descriptors: *Lake sediments, *Lake Grevelingen, *Netherlands, Environmental effects, Sedimentation, Sediment transport, Sediments, Particle size, Distribution.

Some basic sediment parameters from samples of 0 to 3 cm sediment depth were investigated at 430 stations in the recently formed Lake Grevelingen, to elucidate the history of sediment deposition in Lake Grevelingen and the former Grevelingen estuary. A geographical trend exists for the sediment median grain size, with increasing median grain size values towards the eastern part of the lake. This trend has been caused by sediment distribution processes under the former ebb and flood currents in the Grevelingen estuary. After enclosure of the estuary in 1971, much of the fine grained sediment material has been transported towards the deeper gullies. A reflection of this may be seen in the recent sediment maps for mud content and organic carbon content of the upper 0-3 cm sediment layer in Lake Grevelingen. (Baker-IVI)
W86-01571

SEDIMENT-WATER EXCHANGE IN LAKE GREVELINGEN UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. Kelderman.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 286-311, December, 1984. 11 Fig, 3 Tab, 69 Ref.

Descriptors: *Lake sediments, *Lake Grevelingen, *Netherlands, Sediments, Nutrients, Water temperature, Phosphates, Turbulence, Silicates, Resuspension, Model studies.

The impact of various environmental factors on the phosphate and silicate sediment-water exchange in Lake Grevelingen has been investigated in a series of laboratory experiments under aerobic conditions. Silicate mobilization from the sediment showed a strong temperature dependence, with fluxes ranging from 5 mg Si/sq m/day at 5 C to 85 mg Si/sq m/day at 20 C. Phosphate mobilization fluxes ranged from 0.5 to 11 PO4-P/sq m/day at 5 and at 20 C respectively. The phosphate exchange fluxes showed a significantly linear negative correlation with the phosphate concentrations in the overlying water, in accordance with Fick's first law of diffusion. High P accumulation rates into the sediment were especially found at low water temperatures. Resuspension of the upper sediment layer was shown to enhance these P accumulation rates even more. Based on the results for four different sediment types, general relationships have been derived for the phosphate sediment water exchange as a function of water temperature and phosphate concentration in Lake Grevelingen. The results have successfully been applied in a simulation model for the phosphate concentration in Lake Grevelingen over the years 1974 through 1977. (Baker-IVI)
W86-01572

NUTRIENT CONCENTRATIONS IN THE INTERSTITIAL WATER OF LAKE GREVELINGEN SEDIMENT: EFFECTS OF SEDIMENT REDISTRIBUTION AND BENTHIC PRIMARY PRODUCTION PROCESSES,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. Kelderman.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 312-326, December, 1984. 7 Fig, 2 Tab, 75 Ref.

Descriptors: *Netherlands, *Lake Grevelingen, *Sediments, *Nutrients, *Interstitial water, Benthos, Primary productivity, Oxygen, Sedimentation, Ammonia, Nitrates, Phosphorus, Silicates, Water depth.

Interstitial water characteristics are a useful indicator for the various diagenetic processes in the sediment. Nutrient concentrations in the interstitial water were periodically investigated at 24 permanent stations in Lake Grevelingen, a recently enclosed estuary in the Netherlands. At the deeper stations (>7 m) in the lake, phosphate and silicate pore water concentration generally reach maximum values in the 0-3 cm sediment zone (typically 50 and 400 microgat/l respectively). These maxima are caused by the mineralization of reactive sediment material, that is continuously being redistributed towards the deeper areas in the lake. At the shallow stations (<7 m) local phosphate and silicate porewater maxima are often found in the top 0-1 or even 0-.5 cm layer. It is probable that mineralization of microphytobenthos cells plays a dominant role here. This implies that a light dependent nutrient depletion in the upper mm, or less, of the sediment must have occurred; an effect that could not be detected with the present interstitial water sampling technique, but has indirectly been shown to take place at a field station with high microphytobenthos primary production rates. Highly significant seasonal trends were found for the P, Si and NH4-N pore water concentration in the top layer at the deeper stations. Seasonal variations at the shallow station were virtually absent; light regime, and not temperature, may be the dominant factor here. (Baker-IVI)
W86-01573

CARBON FIXATION AND CHLOROPHYLL IN BOTTOM SEDIMENTS OF BRACKISH LAKE GREVELINGEN, THE NETHERLANDS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. H. Nienhuis, and B. H. H. De Bree.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 337-359, December, 1984. 5 Fig, 6 Tab, 44 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Lake sediments, *Carbon fixation, Chlorophyll, Bottom sediments, Pigments, Particulates, Organic carbon, Primary productivity, Benthos.

Chlorophyll a concentrations in the upper 10 cm (sliced per cm) of Lake Grevelingen (Netherlands) sediments are given for the years 1977-1980. Chlorophyll a in the upper cm of the bottom varied between 20-400 mg/sq m. Average values in 1-3 m deep sandy and silty-sandy stations amounted to 67.5-82.2 mg/sq m in the upper cm. A 7 m deep silty station contained on an average 42.7 mg/sq m chlorophyll a in the upper cm of the sediment. Both within year and year to year variations were large. A restricted number of phaeopigment data for 1977 revealed an average phaeopigment chlorophyll a ratio of 0.03 (sand) to 0.39 (silt). Particulate organic carbon (POC) measured in 1977 and 1978 in the top cm of the sediment showed annual average values ranging between 0.2 and 0.7% of sediment dry weight. C-14 fixation data in the light, as measured in a lab incubator, are given for 1979 and 1980, with highest values during summer and lower values in winter. Integrated annual values give average C-14 fixation estimates per station ranging between 47 and 71 g C/sq m/a, with a variation coefficient of 35 to 49% of the mean. Average C-14 dark fixation values varied between 13 and 27% of average light fixation values. An arbitrarily and tentatively derived net microphytobenthos primary production estimate for entire Lake Grevelingen amounts to 35 g C/sq m for 1979 and 32 g C/sq m for 1980. The relationship between POC and chlorophyll a concentration was sometimes significant; between annual chlorophyll a concentration and light fixation values it was not. The C-14 and the oxygen exchange methods both have serious drawbacks when applied to benthic systems. (Baker-IVI)
W86-01574

DYNAMICS, MIGRATION AND GROWTH OF NASSARIUS RETICULATUS (MOLLUSCA: PROSOBRANCHIA) COLONIZING SALINE LAKE GREVELINGEN (SW NETHERLANDS),

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
R. H. D. Lambeck.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 395-417, December, 1984. 13 Fig, 3 Tab, 17 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Snails, *Biomass, Growth rates, Population dynamics, Lakes, Migration.

The marine snail Nassarius reticulatus colonized Lake Grevelingen (Netherlands) after its creation in 1971. A population explosion took place in 1976. Dynamics, growth and biomass development were studied during 1976 and 1977. One generation a year was observed, with 1976 settlement around August 1. Densities at a 12 m deep station were mostly below 10/sq m, at two shallow (1 m) stations numbers increased to 40 to 60 sq m, as a result of immigration. Numbers at two 3 m stations, with peak values of 200 sq m, showed a cyclic pattern with a minimum in July 1977 due to migratory movements. Biomass increased over the period of investigation. The lowest maximum biomass was found at 12 m (0.16 g ADW/sq m) and the highest of 5.0 g at a 3 m station. In this survey the dominant 1976 year class showed a gradual decline from about 300 ind/sq m between 2 and 35 m to about 60/sq m in water deeper than 10 m. Growth rates were also depth dependent. Within the range of 2 to 25 m juveniles born in 1976 showed a maximum mean size of 6.8 mm after one growing season at 5 to 6 m depth against only 3.5 mm in deep water. Highest mean values after 2 growing seasons, vix. 16 mm, were reached at the 1 m deep stations, which figure might be inflated by size dependent immigration. Growth was poor (8 mm) at the 12 m station. Growth rates are similar to Swedish observations, but were reached at 10 to 50 times higher densities in Lake Grevelingen. (Baker-IVI)
W86-01575

LONG-TERM EVOLUTION OF THE MEIOFAUNA AT A SANDY STATION IN LAKE GREVELINGEN, THE NETHERLANDS,

Ghent Rijksuniversiteit (Belgium). Zoology Inst.
K. A. Willems, Y. Sharma, C. Heip, and A. J. J. Sandee.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 418-433, December, 1984. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Population dynamics, *Nematodes, *Copepods, Crustaceans, Species diversity, Species composition, Biomass, Vertical distribution.

Data on density, diversity and species number of harpacticoids and nematodes from a 3 m deep station in Lake Grevelingen are reported over the period 1975-1980. Vertical distribution of both copepod and nematode densities are added. Over the 6 year period 95 species of nematodes and 26 species of harpacticoids have been identified. Neither diversity nor species number of harpacticoids changed significantly over the period. Nematode diversity and species number showed considerable changes, and especially the species composition evolved drastically over the years. The changes in feeding types among nematodes are discussed. Densities of both copepods and nematodes changed substantially over the 6 year period. Concurrent with a significant rise of the redox discontinuity layer from more than 20 cm sediment depth to less than 5 cm, the interstitial copepod fauna disappeared almost completely. The changes in vertical distribution of nematode densities were less pronounced though substantial. (Baker-IVI)
W86-01576

DENSITY, GROWTH AND ANNUAL FOOD CONSUMPTION OF PLAICE (PLEURONECTES PLATESSA L.) AND FLOUNDER (PLATICHTHYS FELSUS (L.)) IN LAKE GREVELINGEN, THE NETHERLANDS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
G. Doornbos, and F. Twisk.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 434-456, December, 1984. 6 Fig, 7 Tab, 34 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Population dynamics, *Fish, Plaice, Flounder, Saline lakes, Growth, Fish food.

Within the scope of a carbon budget study in the 108 sq km saline Lake Grevelingen, investigations on the plaice and flounder populations were made during October 1979 to December 1981. Both populations were dominated by the 1979 year class that presumably entered the lake as larvae in the year the Brouwerssluice, which opens to the North Sea, was operative the whole year round. Due to high summer temperatures in the lake, juvenile plaice attained a mean length of 13.0 cm and a fresh weight of 27.4 g at the end of their first growing season. Total stock of plaice, excluding year class 1981, was estimated at an average of 1.3 million over 1980 and at 0.6 million fish over 1981. About 56% of the plaice food consisted of polychaetes, mainly consisting of in 1980 Arenicola marina (41%) and in 1981 A. marine (15%), Nereidae (15%) and Nephtys hombergii (11%). Total food consumption of the plaice population, excluding year class 1981, in 1980 and 1981 was estimated at 1.68 g and 1.41 g ash-free dry weight (ADW)/sq m/a. Annual consumption of O-group 1981 plaice was assessed at about 0.06 g ADW. The corresponding consumption of the flounder population was 1.14 g and 0.44 ADW, respectively. (Baker-IVI)
W86-01577

CARBON MINERALIZATION IN THE WATER OF LAKE GREVELINGEN (THE NETHERLANDS), AS MEASURED WITH THE OXYGEN CONSUMPTION METHOD,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. Goossens, R. S. Minnaar, and H. Verplanke.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 480-491, December, 1984. 4 Fig, 2 Tab, 37 Ref.

Descriptors: *Carbon, *Mineralization, *Lake Grevelingen, *Netherlands, Lakes, Oxygen consumption, Oxygen levels, Solar radiation.

The carbon mineralization rate in the water of Lake Grevelingen (Netherlands) was estimated by measuring the Oxygen Consumption Rate (OCR) of water samples from August 1980 until August 1981. Carbon respiration amounted to 305 g C/sq m/a. The water temperatures and the numbers of bacteria were also measured. Rapid and substantial changes in the oxygen consumption rate were observed. Regression analysis of OCR with a set of environmental parameters showed a particular high correlation of OCR with the summation of solar irradiance during 5 days preceding the day of sampling. Path analysis showed that the influence of solar irradiance on OCR was not primarily a temperature effect. The observed discrepancy between the estimate for the amount of carbon produced and mineralized in the water layer of the lake is discussed. (Baker-IVI)
W86-01578

MINERALIZATION OF ORGANIC CARBON ON AND IN THE SEDIMENT OF LAKE GREVELINGEN,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. J. Lindeboom, H. A. J. De Klerk, and A. J. J. Sandee.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 492-510, 1984. 4 Fig, 3 Tab, 43 Ref.

Descriptors: *Lake Grevelingen, *Netherlands, *Mineralization, *Organic carbon, *Lake sediments, Saline lakes, Aquatic plants, Aquatic animals, Biomass, Diffusion, Bioturbation, Dissolved oxygen, Temperature.

Sediments play an important role in the biological activity in shallow aquatic environments. They function as major sinks or sources of inorganic and organic substrates for both primary production and mineralization in the water column and in the sediment. A study was made of mineralization on and in the sediments as a part of a research project on the carbon cycle in saline Lake Grevelingen (Netherlands). The oxygen uptake was measured using the bell jar method at 6 sampling stations. Applying a C over O2 conversion factor of 0.29, it was calculated that 330 g/sq m is mineralized in the sediment of the lake annually. Based on biomass estimates of the macroflora and fauna inside the bell jars and a regression analysis, the contribution of these organisms to the carbon mineralization rate was calculated to 70 and 95 g/sq m/a, respectively. The effect of oxygen gradients and apparent diffusion coefficients upon the oxygen uptake rate was studied with microelectrodes. This indicated that bioturbation is a major factor influencing the oxygen uptake rate. A good correlation was found between this rate and temperature. (Moore-IVI)
W86-01579

CARBON BALANCE OF A SALINE LAKE (LAKE GREVELINGEN, THE NETHERLANDS),

Waterloopkundig Lab. te Delft (Netherlands).
I. De Vries.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 511-528, 1984. 1 Fig, 4 Tab, 35 Ref.

Descriptors: *Carbon balance, *Saline lakes, *Lake Grevelingen, *Netherlands, Lakes, Carbon, Model studies, Ecosystems, Phytoplankton, Aquatic animals, Primary productivity, Food chains.

Lake Grevelingen is a former estuary in the Netherlands which was isolated by enclosing dams for the influences of the rivers Rhine and Meuse since 1964 and from the influence of the North Sea since

1971. The connection with the North Sea was partly reestablished in 1978. An annual gross carbon balance is presented for Lake Greveingen. Planktonic primary production is the main source of organic material, with an estimated contribution of at least 60%. From a comparison of the carbon balance with oxygen consumption measurements, the efficiency of the planktonic auto- and microheterotrophic community in producing particulate organic material is estimated at 44%. This is a high value compared to efficiencies of deeper coastal waters in the western English Channel and off the Belgian coast (2.34%). The pelagic and benthic compartment of the lake are tightly coupled by the filtering activity of benthic macrofauna, causing a high grazing pressure on phytoplankton (estimated at 55% of net production) and a transport of suspended organic particles to the sediment by deposition of feces and pseudofeces, exceeding passive sinking with a factor 3 to 4. In agreement with new data on the western Wadden Sea, the role of the benthic small foodweb in consuming primary organic matter is probably limited. (Baker-IVI)
W86-01580

SURVIVAL STRATEGIES OF INVERTEBRATES IN DISTURBED AQUATIC HABITATS,

Toronto Univ. (Ontario). Dept. of Zoology.
R. J. Mackay.
Journal of the Minnesota Academy of Science, Vol. 50, No. 3, p 28-30. 10 Ref.

Descriptors: *Invertebrates, *Benthos, *Aquatic habitats, Ecology, Ecological effects, Drought, Aquatic environment, Life cycles, Particulates, Water pollution effects.

Aquatic invertebrates face two main types of disturbances to their habitat: One is a change in the amount of water surrounding them as in a flood or drought; the other is a change in the physical or chemical quality of the water such as unusual or unnatural introductions of particulate or dissolved substances from the surrounding land. Aquatic invertebrates survive disturbance by moving to a refuge or alternative habitat or by having resistant or specially protected stages in the life cycle. Some invertebrates are able to exploit the richer and more available food materials that may result from disturbance. Sometimes the potential for regeneration or recolonization is so high that the loss of individuals is counteracted by the influx of colonizers from unaffected neighboring habitats. Most species in disturbed aquatic habitats are efficient colonizers; they combine one or more survival strategies with high powers of dispersal, rapid growth rates, and characteristics of ecological generalists. Some ecological generalists may even be somewhat flexible in their life cycles and be able to produce young at several times in the year. This characteristic is not seen in all invertebrates in snow-melt pools where the life cycles in some species must be precisely timed if the appropriate stage is to coincide with drought. But even in these pools, some generalists can rapidly take advantage of an early flood or a late drought. Given these characteristics of efficient colonizers, it is not surprising that the earliest newcomers after disturbance in aquatic habitats are insects. Their great powers of dispersal, regeneration, and tolerance make them remarkably resilient in the face of any kind of disaster, whether natural or deliberate. (Collier-IVI)
W86-01581

ESTIMATING THE POPULATION DYNAMICS OF COHO SALMON (ONCORHYNCHUS KISUTCH) USING POOLED TIME-SERIES AND CROSS-SECTIONAL DATA,

Rhode Island Univ., Kingston. Dept. of Resource Economics.
J. L. Anderson, and J. E. Wilen.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 459-467, March, 1985. 6 Tab, 16 Ref.

Descriptors: *Population dynamics, *Salmon, *Statistical analysis, *Washington, *Oregon, *California, *Columbia River, Fish management, Fish populations, Populations, Model studies.

The population dynamics of natural and hatchery coho salmon (Oncorhynchus kisutch) were estimated for three regions, (1) Washington coastal, (2) Columbia River region, and (3) Oregon/California coastal, using pooled time-series and cross-sectional data. Two functional forms were compacted: the Beverton-Holt and Ricker models. Both models yielded very similar results. In both cases, we found that the natural coho stock recruitment is significantly affected by parent stock level (positive), parent stock density (negative), river flow (positive), and hatchery smolt release (negative). The significant factors affecting hatchery coho salmon were smolt release level (positive), smolt release density (negative), and upwelling (positive). (Author's abstract)
W86-01585

WATER CIRCULATION IN SMALL ARCTIC LAKES IN WINTER,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
H. E. Welch, and M. A. Bergmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 506-520, March, 1985. 13 Fig, 12 Ref.

Descriptors: *Water circulation, *Arctic zone, *Lakes, *Winter, *Saqvaqjuac, *Northwest Territories, Mixing, Salinity, Stratification, Seasonal variation, Thermodynamics.

Dye experiments and detailed measurements of conductance and temperature in small lakes at Saqvaqjuac (63 degrees 39' N, 90 degrees 39' W, Northwest Territories) showed how water circulated in midwater. Stored heat returning from the sediments warms adjacent water, which then sinks downslope. Water immediately beneath the ice moves laterally shoreward, picking up cryoconcentrated salts and sinking downslope. Displacement of deep waters upward at the lake center is postulated as completing the circulation. Rates of water movement are on the order of 10 m/d in 2- to 10-ha lakes. This type of winter circulation is expected to be ubiquitous throughout the arctic. (Author's abstract)
W86-01586

WINTER RESPIRATION OF LAKES AT SAQVAQJUAC, N.W.T.,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
H. E. Welch, and M. A. Bergman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 521-528, March, 1985. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Northwest Territories, *Saqvaqjuac, *Lakes, *Respiration, *Winter, Arctic zone, Plankton, Carbon radioisotopes, Methane, Water pollution effects.

Winter oxygen consumption rates at 64 degrees N latitude were measured for 11 lake years. They ranged from 0.131 to 0.306 g O2/sq m/d. They were not correlated with lake depth, in contrast with the winter respiration rates of temperate lakes. We suggest that this difference results from lower summer temperatures and a lower proportion of planktonic respiration in arctic as compared with temperature lakes. C-14 estimates of annual photosynthesis were generally lower than estimated annual respiration, and the C-14-measured photosynthesis beneath the ice in winter was generally too low to account for the actual amounts of oxygen evolved by photosynthesis. In one lake a 50% increase in annual production resulted in an increase of only 19% in winter respiration, suggesting that lake respiration is an integrative process that averages out production over a period of years. Addition of methane gas to simulate a gas pipeline break to a lake resulted in an immediate 67% increase in lake respiration rate. (Author's abstract)
W86-01587

WATER TEMPERATURE AS THE PRIMARY INFLUENCE ON TIMING OF SEAWARD MIGRATIONS OF ATLANTIC SALMON (SALMO SALAR) SMOLTS,

Direktoratet for Vilt og Ferskvannsfisk, Sandnes (Norway). Forskningsstasjion for Ferskvannsfisk.
B. Jonsson, and J. Ruud-Hansen.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 593-595, March, 1985. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Water temperature, *Salmon, *Fish migration, *Norway, *Imsa River, *Smolts, Lunar cycle, Water flow, Rivers, Migration, Animal behavior.

Using multiple regression models the correlation of water temperature, water flow, cloudiness, and lunar cycle with the timing of the yearly descent of Atlantic salmon (Salmo salar) smolts in the Norwegian Imsa River, 1976-83 was tested. Water temperature between 9 April and 16 May explained 91, 95, and 89% of the yearly variation in date of 25, 50, and 75% cumulative smolt descent, respectively. The regression models were not very sensitive to variations of which date recording of the temperature was started and stopped. The start of the yearly smolt run was not triggered by a specific water temperature or a specific number of degree-days, but was controlled by a combination of temperature increase and temperature level in the river during spring. There was no significant correlation between smolt descent and any of the other environmental variables tested. (Author's abstract)
W86-01589

METHOD FOR MEASURING HORIZONTAL TRANSPORT OF ORGANIC CARBON OVER SEDIMENTS,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
J. Grant.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 595-602, March, 1985. 3 Fig, 24 Ref.

Descriptors: *Organic carbon, *Sediments, *Nutrient transport, Sand, Beaches, Benthos, Deposition.

Prewashed, precombusted sand from a sheltered beach in Nova Scotia was returned to the beach at low tide in metal pans. Hourly sampling of pans during high tide was used to assess gross deposition of organic carbon to the bed, with sampling at successive low tides to derive net deposition rate. Resuspension was considered to be the difference between gross and net deposition. Short-term burial of carbon was measured by vertically sectioning pan samples. The results indicate that due to resuspension, the rate of net deposition over 2d (11 g C/sq m/h) was only 42% of the rate of gross deposition that occurred during a single high tide. The method is useful because it can resolve the short-term particle fluxes that may be trophically important to benthic communities. (Author's abstract)
W86-01590

RESULTS OF OHIO RIVER MACROINVERTEBRATE SAMPLING FOR 1975-1981,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 5C.
W86-01591

SURVEY OF THE FRESHWATER MUSSEL FAUNA OF THE KANAWHA RIVER SEPTEMBER 1981-SEPTEMBER 1982,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. E. Schmidt, and M. A. Zeto.
Proceedings of the West Virginia Academy of Sciences, Vol. 55, No. 2/3/4, p 72-75, 1983. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Mussels, *Kanawha River, *West Virginia, Species composition, Aquatic population, Rivers, Benthos.

Freshwater mussels (naiads) were collected from the Kanawha River, West Virginia, at several locations between Winfield and Falls View as part of a statewide survey to identify naiad populations.

Sampling took place during the Fall of 1981 and the Fall of 1982 when the river was low and clear. Naiad populations were sampled with a 10-foot dovetail mussel brail and sight/hand collecting. Nineteen species of naiads and the asiatic clam Corbicula sp. were collected. The majority (18 species) were collected in the seven-mile stretch of the Kanawha River downstream of Kanawha Falls. Two species - Cyprogenia stegaria and Obliquaria reflexa are very rare in West Virginia. Only Corbicula sp. and one naiad species, Anodonta g. grandis, were collected downstream of Charleston. No endangered species were collected, although a population of Lampsilis abrupta (= orbiculata) is known to occur downstream of Kanawha Falls near Deepwater. (Author's abstract)
W86-01592

AQUATIC VEGETATION OF A NATURAL MARL LAKE IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Anatomy.
R. Bartgis.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 92-101, 1983. 2 Fig, 2 Tab, 24 Ref.

Descriptors: *Aquatic vegetation, *Marl lakes, *West Virginia, *Lake Louise, *Jefferson County, Mosses, Pondweed, Elodea, Duckweed, Species composition.

Lake Louise is a 14.5 m deep natural marl lake in Jefferson County, West Virginia. The aquatic vegetation of the lake occurs primarily in four concentric zones associated with increasing water depth. Each zone is characterized by a distinct plant community. In July 1982 the percent cover of each vascular and bryophytic species was recorded for each community. Dominant macrophytic species in these communities included the emergents Sparganium eurycarpum, and Nasturtium officinale and Veronica anagallis-aquatica in the two shallowest zones, respectively; Potamogeton spp. in an intermediate zone; and Elodea canadensis in the deepest zone. In addition, a fifth separate community dominated by Potamogeton crispus has developed in a small cove of the Lake. Within a community, vertical stratification also occurred. For example, the floating thalloid Lemna minor often formed a prominent surface layer. The flora of Lake Louise is similar to that of marl lakes in the glaciated northeastern United States. Community structure, such as species richness and number of dominants, was generally less complex at Lake Louise than in the northern lakes. (Author's abstract)
W86-01594

LIFE HISTORY AND ECOLOGY OF THE ALDERFLY, SIALIS AEQUALIS BANKS, FROM FLATFOOT CREEK, MASON COUNTY, WEST VIRGINIA,

West Virginia Dept. of Natural Resources, Charleston.
R. W. Gatewod, and D. C. Tarter.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 102-113, 1983. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Flatfoot Creek, *Mason County, *West Virginia, *Alderflies, *Ecology, Hydrogen ion concentration, Water quality, Larvae, Growth stages.

The alderfly Sialis aequalis Banks, from Flatfoot Creek, Mason County, West Virginia, was studied relative to its life history and ecology between April 1978 and May 1979, and its low pH tolerance experimentally estimated in the laboratory. Larvae were collected along the stream margins from a substrate of vegetative debris, mud, and silt. Larvae were detritivorous in their feeding habits, despite the high food potential of their habitat. Their diet was infrequently supplemented with chironomids and other dipterans. Length frequency distributions for larvae indicated one size class for the population, and thus a univoltine life cycle. Growth rate, based upon mean head capsule width, was optimal during the first month of the larval stage (May-June). No increase in head capsule width was observed in February and March, the final months of the larval stage. Pupation in the laboratory was variable in duration, ranging from 10 to 22 days. In the field, pupation began in late March and concluded 4 to 5 weeks later. Adults were first observed in late April, and none were sighted after May 10. Ovarian eggs of adult females ranged in number from 402 to 818, $\bar{x} = 657$. Mean egg length and width were 0.23 and 0.61 mm, respectively. The 96-hour median tolerance limit for low pH for S. aequalis larvae was 2.3.
W86-01595

RESERVOIR FISHERY RESEARCH NEEDS AND PRIORITIES,

Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 8I.
W86-01598

ASSESSING HABITATS USED BY WARM-WATER STREAM FISHES,

Illinois Natural History Survey, Champaign.
R. W. Larimore, and D. D. Garrels.
Fisheries, Vol. 10, No. 2, p 10-16, March/April, 1985. 8 Fig, 2 Tab, 10 Ref.

Descriptors: *Aquatic habitats, *Fish populations, *Streams, Habitats, Monitoring, Radiotelemetry, Animal behavior, Ecology, Fish behavior.

Five methods were developed for locating and identifying an undisturbed, free-swimming, stream fish. These methods used (1) color-coded tags, (2) fixed electrodes, (3) optical measurements, (4) night collections, and (5) radiotelemetry. They permitted observations of most kinds of fishes, at any time of day or night, during any season (including under ice), and from streams of different sizes. Although no one method was equally useful in all situations, the methods were evaluated according to their effectiveness in determining habitat preferences of different fish species under various stream conditions. The importance of precision in locating a fish and its habitat was emphasized by the finding of significant differences in physical measurements over extremely small areas. (Author's abstract)
W86-01599

MANAGEMENT OF LACUSTRINE FISHERIES IN THE TROPICS,

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
For primary bibliographic entry see Field 8I.
W86-01600

EFFECT OF TEMPERATURE ON THE GROWTH OF PLANKTONIC LARVAE OF TELLINA TENUIS DA COSTA,

Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5C.
W86-01603

CALCIUM CHEMISTRY AND DEPOSITION IN IONICALLY ENRICHED ONONDAGA LAKE, NEW YORK,

Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W86-01618

GROWTH OF SUBMERSED MACROPHYTE COMMUNITIES IN THE ST. CLAIR - DETROIT RIVER SYSTEM BETWEEN LAKE HURON AND LAKE ERIE,

Fish and Wildlife Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. W. Schloesser, T. A. Edsall, and B. A. Manny.
Canadian Journal of Botany, Vol. 63, No. 6, p 1061-1065, June, 1985. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Macrophytes, *Plant growth, *Aquatic plants, *St. Clair River, *Detroit River, Submerged plants, Biomass, Seasonal variation, Rivers, Overwintering, Dominance, Succession, Great Lakes.

Growth of submersed aquatic macrophytes was determined from observation and on the basis of biomass of samples collected from April to November 1978 at seven study sites in a major river system of the Great Lakes, the St. Clair - Detroit river system between Lake Huron and Lake Erie. Growth usually began between April and June, peaked between July and October, and decreased by late November. Maximum biomass at six of the seven sites (118-427 g dry weight/sq m) was similar or greater than that reported in other rivers at similar latitudes. Seasonal growth of the abundant taxa followed one of three seasonal patterns at each study site: one dominant taxon grew alone; codominant taxa grew sympatrically without species succession; and codominant taxa grew sympatrically with species succession. Differences in growth and seasonal succession of some taxa were apparently caused by the presence of absence of overwintering plant material, competition, and life-cycle differences. (Author's abstract)
W86-01629

SIMPLE METHOD TO ESTIMATE LAKE PHOSPHORUS CONCENTRATIONS RESULTING FROM NATURAL, BACKGROUND, LOADINGS,

Pavia Univ. (Italy). Ist. di Entomologia Agraria.
M. Vighi, and G. Chiaudani.
Water Research, Vol. 19, No. 8, p 987-991, 1985. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Phosphorus, *Lakes, *Morphoedaphic index, Water depth, Alkalinity, Conductivity, Water quality control, Lake restoration, Eutrophication, Trophic levels.

The relation of mean total phosphorus concentrations to morphoedaphic index (calculated as the ratio between the mean depth and alkalinity or the conductivity) has been examined for a large, diverse, widely distributed group of lakes. A highly significant correlation was found in lakes practically not affected by anthropogenic input of phosphorus. As a consequence the phosphorus concentration in a lake resulting from natural, background loading could be calculated on the basis of the morphoedaphic index. The evaluation of natural phosphorus concentration allows the prediction of the maximum extent to which actual phosphorus concentrations could be reduced in culturally eutrophied lakes by eliminating the anthropogenic inputs and to calculate 'permissible' loadings necessary to achieve natural trophic conditions that will not necessarily correspond to oligotrophy. (Author's abstract)
W86-01640

DIAGENETIC REMOBILIZATION OF MANGANESE, IRON, COPPER AND LEAD IN ANOXIC SEDIMENT OF A FRESHWATER POND,

Central Research Inst. of Electric Power Industry, Tokyo (Japan).
M. Sakata.
Water Research, Vol. 19, No. 8, p 1033-1038, 1985. 3 Fig, 27 Ref.

Descriptors: *Manganese, *Iron, *Copper, *Lead, *Sediments, Ponds, Reservoirs, Interstitial water, Anoxic conditions, Remobilization, Fate of pollutants, Heavy metals.

The diagenetic remobilization of manganese, iron, copper and lead in anoxic sediment of a freshwater pond, T Reservoir, Japan has been examined in an in situ submerged chamber system, through interstitial water and sediment analyses. Manganese was released continuously from the sediment into the overlying water during the experiment, whereas iron was released from the sediment abruptly after the 2nd day of the experiment. Steep vertical concentration gradients of manganese and iron were observed in the interstitial water. The release of manganese and iron from the sediment is due to the dissolution of ferro-manganese oxides and hydroxides in the surface sediment under anoxic conditions. In contrast to manganese and iron, copper and lead were not released from the sediment during the experiment, and their concentrations in the interstitial water were not significantly different from the values of the overlying water. The

results show that the diagenetic remobilization of copper and lead in the sediment is negligibly small. It is likely that copper and lead are fixed into the sediment by some process other than the formation of sulfides. (Author's abstract)
W86-01646

GEOCHEMICAL MASS BALANCE OF A VOLCANIC CRATER LAKE IN AUSTRALIA,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
L. M. Ramamurthy, H. H. Veeh, and J. W. Holmes.
Journal of Hydrology, Vol. 79, No. 1/2, p 127-139, July, 1985. 5 Fig, 6 Tab, 12 Ref.

Descriptors: *Blue Lake, *South Australia, *Crater lakes, *Chemical composition, *Geochemistry, Groundwater, Uranium, Calcium, Sodium, Chlorides, Nitrates, Water quality control, Conjunctive use, Lakes.

Blue Lake in the southeast of South Australia is the largest of a group of four volcanic crater lakes in the regions. It has a surface area of approximately 600,000 sq m, an average depth of 70 m, and is the main source of reticulated water supply to a city with a population of about 20,000 inhabitants. Nitrate concentrations have been rising steadily over the years. The recharge regime of Blue Lake was determined by using the environmental tracers U and Ca (partly precipitated in the sediments) and Na and Cl (conserved in the lake's waters). The geochemical mass balances allowed best estimates of the water budget to be derived. These are: inflow rate from groundwater of 5,000,000 cu m/yr; the outflow rate into the groundwater is therefore about 1,000,000 cu m/yr, because the measured pumping rate is 4,000,000 cu m/yr. The unconfined, Gambier limestone aquifer contributes 85% to the inflow and receives 100% of the outflow. The lower-lying aquifer (Dilwyn Formation fluviatile sediments) contributes 15% to the inflow. Since the unconfined aquifer is the main source of recharge to the lake, the problem of increasing nitrate concentrations of the lake water could be ameliorated by initiating conservation measures to restrict further pollution of the water table aquifer. The confined aquifer in the region could be exploited further to supplement the drinking water requirements of the region, since the composition of Blue Lake itself would not be adversely affected as a consequence. (Moore-IVI)
W86-01663

METHOD FOR LOCATING SEDIMENT ANOMALIES IN LAKEBEDS THAT CAN BE CAUSED BY GROUNDWATER FLOW,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
D. R. Lee.
Journal of Hydrology, Vol. 79. No. 1/2, p 187-193, July, 1985. 3 Fig, 13 Ref.

Descriptors: *Groundwater movement, *Measuring instruments, *Lake beds, Temperature, Conductivity, Seepage, Lake sediments, Groundwater inflow.

Underwater discharges of groundwater should be characterized not only by anomalous temperature distributions but also by water interface of lakes. Location of inflows by detecting such anomalies may be effective where groundwater inflow areas can be inferred from other geologic or hydraulic information, such as areas of lakes that lie over fracture or fault zones. A device was designed to be dragged along lakebeds for locating such anomalies in sediment temperature or chemistry. The drag was a density balanced probe containing temperature transducers and an electrical conductivity cell. The drag was used successfully to detect an artificially created seepage area in soft bottom sediment below 8 m of lake water. The drag has been designed for in-situ, continuous, horizontal profiles of the absolute temperature of sediment, the temperature difference between sediment and overlying water, and the electrical conductivity of sediment. (Baker-IVI)
W86-01667

ESTIMATING ALGAL AVAILABLE PHOSPHORUS IN SUSPENDED SEDIMENTS BY CHEMICAL EXTRACTION,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5A.
W86-01714

SIMULTANEOUS IN-STREAM NITROGEN AND D.O. BALANCING,

Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
J. J. Warwick, and A. J. McDonnell.
Journal of Environmental Engineering, Vol. 111, No. 4, p 401-416, August, 1985. 3 Fig, 4 Tab, 39 Ref.

Descriptors: *Nitrogen, *Dissolved oxygen, *Water analysis, *Model studies, Nutrients, Water quality, Ammonia, Nitrates, Nitrites.

A one-dimensional, pseudo unsteady state, water quality model (Simultaneous Nitrogen and Oxygen Analysis Program - SNOAP) was developed to simultaneously solve both nitrogen and dissolved oxygen mass balance equations. Expressions are derived to estimate ammonia-N exsolution, bacterial ammonia-N uptake, and aquatic plant ammonia-N assimilation in terms of standard water quality indices. The SNOAP model calculates hourly values for all nitrogen species reaction rates (including nitrification and denitrification) based on observed in-stream variation of organic-N, ammonia-N, nitrite-N, nitrate-N, dissolved oxygen, temperature, and pH. An iterative solution algorithm is required to simultaneously solve the nitrogen and dissolved oxygen mass balance equations. This iterative approach is stable and results in relatively quick convergence. Erroneous values of observed nitrogen species or dissolved oxygen variation, or both, may result in an impossible situation for simultaneous nitrogen and dissolved oxygen mass balance solution. This nonconvergence feature is a significant attribute, in that is allows for a systematic screening of measured water quality data. (Author's abstract)
W86-01722

NITROGEN ACCOUNTABILITY FOR FERTILE STREAMS,

Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
J. J. Warwick, and A. J. McDonnell.
Journal of Environmental Engineering, Vol. 111, No. 4, p 417-430, August, 1985. 6 Fig, 7 Tab, 12 Ref.

Descriptors: *Nitrogen, *Streams, *Dissolved oxygen, *Water quality, *Model studies, Denitrification, Ammonia, Water pollution effects, Wastewater.

The Stream Nitrogen and Oxygen Analysis Program (SNOAP) is a one-dimensional, pseudo unsteady state, water quality model, which simultaneously solves both nitrogen and dissolved oxygen mass balance equations. The SNOAP model was successfully calibrated and verified for three, independent, data intensive water quality surveys. The modeled stream system was unsteady due to significant upstream impact from wastewater treatment plant effluent discharges. Denitrification was found to be the dominant total nitrogen sink. Average denitrification rates calculated by the SNOAP model range from 22.0-43.6 mg-N/sq m/hr. The computed values compared quite favorably with measured laboratory sediment denitrification rates which ranged from 28.2-39.2 mg-N/sq m/hr. In addition, the rate of ammonia-N decay was found to be the most accurate nitrogen species estimator of in-stream nitrification rates. (Author's abstract)
W86-01723

ATTENUATION VERSUS TRANSPARENCY,

Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 5A.
W86-01725

SUMMER SOIL MOISTURE CONTENT AND THE WATER TABLE IN A FORESTED WETLAND PEAT,

Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2G.
W86-01779

TRITIUM IN NATURAL WATERS OF MOLDAVIA AND A HYDROGEOLOGICAL INTERPRETATION OF THE RESULTS OF ITS DETERMINATION,

Akademiya Nauk Moldavskoi SSR, Kishinev. Inst. of Geophysics and Geology.
I. V. Zelenin, I. E. Verbitskii, I. K. Morkovkina, and V. V. Romanov.
Water Resources, Vol. 11, No. 1, p 324-334, July-August, 1984. 3 Fig, 4 Tab, 17 Ref. Translated from Vodnye Resursy, No. 4, p 70-81, July-August, 1984.

Descriptors: *Tritium, *Natural waters, *Moldavia, *Dnestr River, *Prut River, *USSR, River water, Precipitation, Groundwater, Water analysis, Groundwater movement, Aquifers.

The main hydrographic elements of Moldavia (USSR) are the Dnestr and Prut rivers. They originate in the Carpathians and have mean annual discharges respectively of 293 and 74 cu m/sec. The main aquifer complex is represented mainly by limestones of Baden-Sarmatina age. Its thickness reaches 100-150 m. The character of groundwater movement is quite complex due to the variability of the conditions of their recharge and discharge, inhomogeneity of the seepage properties of the rocks, intense water withdrawal from wells, and also by the absence in the geological section of thick, persistant impervious horizons which could serve as regional aquicludes. The groundwaters in the cover deposits of divides are partially directed toward the thalwegs of the erosional incisions, where they merge with the waters of the floodplain alluvium, and partially percolate into lower lying aquifers. In 1978-80 the tritium concentrations in river waters varied mainly from 40 to 90 TU. Neither regional nor temporal trends were noted in this case. The observed variations, in particular, are related to the nonuniformity of tritium concentrations in precipitation. Especially noticeable is the relation between tritium concentrations in river water and precipitation for the Dnestr River, where the effect of regulation of surface runoff is apparently not felt so strongly as in small rivers. In the overwhelming majority of cases the tritium concentrations in rivers are less than in precipitation, by about 30% on average in small rivers. This indicates a considerable role of the groundwater component in feeding rivers and agrees well with the hydrological estimate of the portion of groundwaters (23-27%) in the river runoff of the Dnestr-Prut interfluve. (Baker-IVI)
W86-01806

INVESTIGATION OF CO2 GAS EXCHANGE IN A CONVECTIVELY MIXED LAYER,

Moscow State Univ. (USSR).
A. O. Kokorin.
Water Resources, Vol. 11, No. 4, p 343-347, July-August, 1984. 1 Fig, 11 Ref. Translated from Vodnye Resursy, No. 4, p 90-94, July-August, 1984.

Descriptors: *Carbon dioxide, *Convection, *Gas exchange, Temperature effects, Stratification, Model studies, Oxygen transport, Mixing.

The conditions of fall-winter cooling accompanied by convective mixing of the upper layer of the water body and gradual deepening of the boundary of the convectively mixed layer are examined. The experimental profiles obtained made it possible to calculate the flow of carbon dioxide from water into the air and the average gas exchange rate k. The flow and gas exchange rate were calculated for 10 experimental series, each of which consisted of a period of heating of the basin from above (2-4 days) and period of cooling accompanied by convective mixing (6-9 hr). The CO2 distribution with respect to depth is determined by processes of diffusion and gas exchange across the interface and also by the chemical equilibrium between various carbonate forms. The concentration gradients of various carbonate forms are not equal among

themselves and therefore independent diffusion can lead to a redistribution of the total concentration of inorganic carbon between carbonate forms. A model is proposed which proved able to satisfactorily describe the experimental data. The formula used in the model for calculating the exchange coefficient during convective mixing gave values of the coefficient close to those found in natural water bodies, and it is assumed that the given calculation scheme will work satisfactorily also in the case of gas transport during fall-winter cooling of the ocean. In a simplified form the model was tested for calculation of oxygen transport. (Baker-IVI)
W86-01808

PHOSPHORUS FORMS AND CONTENT IN NATURAL WATER AND FACTORS DETERMINING ITS CYCLING,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2K.
W86-01811

HYDROLOGICAL AND HYDROCHEMICAL ASPECTS OF THE TRANSFORMATION OF ORGANIC MATTER IN THE MOZHAISK RESERVOIR,

Moscow State Univ. (USSR).
L. B. Berdavtseva, and G. V. Tsytsarin.
Water Resources, Vol. 11, No. 4, p 370-377, July-August, 1984. 4 Fig, 3 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 121-129, July-August, 1984.

Descriptors: *Organic matter, *Mozhaisk Reservoir, *Hydrology, Chemical analysis, Phosphorus, Dissolved oxygen.

An analysis of the transformation of organic matter in the Mozhaisk reservoir on the basis of the indices of color, permanganate oxidizability (PO), and dichromate oxidizability (DO) in the annual cycle showed the main cause of the most considerable changes in the relationship between the investigated indices is occurrence of labile organic matter (LOM) related to intensification of production-destruction processes. All changes in the relationships between the investigated indices occur synchronously. The character of the relation between color, PO and DO changes practically simultaneously in response to an increase of the amount of LOM in the reservoir, which makes it possible to estimate the direction of processes forming the water quality at each given moment on the basis of one of the relationships or both simultaneously. Two extreme types of dependence, expressed by the equation of linear regression between the investigated indices, which conditionally characterize the maximum degree of transformation and maximum degree of instability of OM were distinguished. (Baker-IVI)
W86-01812

SPACE-TIME INHOMOGENEITY OF DISTRIBUTION OF ORGANIC MATTER IN THE MOZHAISK RESERVOIR,

Moscow State Univ. (USSR).
M. G. Ershova, M. B. Zaslavskaya, and N. M. Zyablova.
Water Resources, Vol. 11, No. 4, p 378-385, July-August, 1984. 4 Fig, 7 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 130-138, July-August, 1984.

Descriptors: *Mozhaisk Reservoir, *USSR, *Organic matter, Reservoirs, Chemical composition, Seasonal variation, Temporal distribution.

Within an accuracy of 25%, the study showed the effect of production-destruction processes on the average organic matter concentrations in individual sufficiently large stretches and in the entire volume of the Mozhaisk reservoir (USSR) is insignificant and it can be neglected in such calculations. It is possible that this conclusion is applicable also to other more eutrophic reservoirs of the forest zone with seasonal streamflow regulation. The characteristic weather changes for this zone during the growing season result in the times of dominance of the production of organic matter are replaced by times of dominance of destruction of autochthonous organic matter and on the whole the average concentration of organic matter is to a considerable extent determined by the amount of allochthonous matter introduced from the drainage basin. (Baker-IVI)
W86-01813

FORMATION OF THE HYDROBIOLOGICAL AND HYDROCHEMICAL REGIME OF THE NORTHERN DONETS-DONBAS CANAL (1958-1981),

Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).
A. I. Kovrizhnykh.
Water Resources, Vol. 11, No. 4, p 391-396, July-August, 1984. 2 Ref. Translated from Vodnye Resurnye, No. 4, p 144-150, July-August, 1984.

Descriptors: *Northern Donets-Donbas Canal, *USSR, *Bottom sediments, Canals, Erosion, Siltation, Phytoplankton, Velocity, Transparency, Bottom sediments.

The Northern Donets-Donbas Canal (USSR) has been operating for more than 20 years. During this period, the main characteristics of the hydrobiological and hydrochemical regimes of the canal at different stages of its operation have been established. Substantial changes were noted in the hydrobiological regime of the canal. Impoverishment of the species composition of phytoplankton occurred due to the elimination of green algae and the abundance of blue-greens decreased. In the phytobenthos the quantity of green filmentous algae decreased considerably and the mass development of Vaucheria and appearance of Thorea occurred. The abundance of submersed higher aquatic plants decreased and a tendency toward an expansion of the areas occupied by amphiphytes was noted. Among the main interdependent factors that caused these changes are an increase of flow velocities, decrease of water transparency, siltation, and erosion and redistribution of bottom sediments in the canal. (Baker-IVI)
W86-01815

CHARACTERISTICS OF FISH HELMINTH FAUNA IN SOME WATER BODIES OF THE NORTH DVINA BASIN UNDER CONDITIONS OF AN ALTERED WATER REGIME,

Gosudarstvennyi Nauchno-Issledovatel'skii Inst. Ozernogo i Rechnogo Rybnogo Khozyaistva, Leningrad (USSR).
E. A. Bogdanova, and L. I. Kotova.
Water Resources, Vol. 11, No. 4, p 396-401, July-August, 1984. 1 Tab, 29 Ref. Translated from Vodnye Resursy, No. 4, July-August, 1984.

Descriptors: *Dvina Basin, *USSR, *Biomass, *Helminths, *Fish parasites, Runoff, Seasonal variations, Shallow water, Lake Kubenskoe, Lake Lacha, Lake Vozhe, Parasites, Hydrological regime.

The region of Lakes Kubenskoe, Lacha, and Vozhe belongs to the excess moisture zone of the European sector of the USSR. Lake Kubenskoe is a large shallow water body with an area of 400 sq km, average depth of 2.5 m, and maximum depth of 4.5 m. The variation of individual elements of the climate is governed by the effect of certain types of atmospheric circulation. The annual distribution of the runoff of the rivers, creeks, and brooks emptying into Lake Kubenskoc mainly determines its level regime. All three lakes are intensely overgrown by macrophytes. In the winter the dissolved oxygen content in the water does not exceed 32% of saturation. During inflow of Sukhona waters into Lake Kubensoe an overall increase of biogenic substances in it is possible. Many fish parasites have favorable ecological conditions in the lake for development. Some reservoirs constructed on rivers possess their own hydrobiocenose, including invertebrates and fishes. Beds of macrophytes with an invertebrate fauna characteristic for them will appear in the littoral, well-heated stretches with a weak current. With time they will become the nesting sites of fish-eating birds, which will lead to increased infestation of fishes by cestodes and trematodes. The presently available ichthyoparasitologic data show that a number of helminths having epizootological and epidemiological significance are found in many fishes of Lake Kubenskoe and the Sukhona River. (Baker-IVI)
W86-01816

INVESTIGATIONS OF THE ECOLOGY OF PLANKTONIC ALGAE OF WATER BODIES IN THE BAIKAL REGION,

Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
O. M. Kozhova, and V. N. Pautova.
Water Resources, Vol. 11, No. 3, p 244-253, May-June, 1984. 2 Fig, 1 Tab, 20 Ref. Translated from Vodnye Resursy, No. 3, p 114-124, May-June, 1984.

Descriptors: *Algal growth, *Seasonal variation, *Phytoplankton, *Lake Baikal, *Angara Reservoir, *USSR, Ice cover, Spatial distribution, Ecology, Reservoirs, Lakes.

The characteristics of the ecology of algae was established during the analysis of their temporal dynamics. Seasonality in the development of phytoplankton of Lake Baikal and the Angara reservoirs is clearly expressed as a replacement of a cryophilic complex of algae developing in the ice-covered period by a more thermophilic summer complex. Such a succession of species is typical for all water bodies of temperate latitudes. The seasonality in the develoment of phytoplankton of Angara reservoirs is expressed differently than in Baikal. In Bratsk reservoir an under ice maximum development of algae is observed every year. In Baikal, productive years for under ice phytoplankton, when the biomass reaches 30 g/cu m and more, recur with a period of 2-4 years. In nonproductive years the under ice biomass of phytoplankton of Baikal does not exceed 0.1 g/cu m. In the Bratsk reservoir in connection with the short time of under ice development of phytoplankton, which is recorded only from the second half of April, before breakup of the reservoir, the bulk of the biomass is created in open water, whereas in Baikal, life in the lake depends on the algal biomass in the ice-covered period in a productive year not only in that year but in subsequent years. In Bratsk reservoir the same species form the under-ice maximum biomass of phytoplankton from year to year. In Baikal there are far more species under the ice. Similar studies were conducted regarding the spatial distribution of the algae as well. (Baker-IVI)
W86-01824

MICROBIOLOGICAL CHARACTERISTICS OF WATER MASSES IN THE MOUTH REGIONS OF LARGE RIVERS FLOWING INTO NORTHERN BAIKAL,

Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
V. N. Maksimov, E. A. Maksimova, and A. R. Rudykh.
Water Resources, Vol. 11, No. 3, p 253-268, May-June, 1984. 3 Fig, 9 Ref. Translated from Vodnye Resursy, No. 3, p 125-130, May-June, 1984.

Descriptors: *Rivers, *Lake Baikal, *USSR, *Microbiology, Vertical distribution, Bacteria, River mouth.

The mouth regions of large rivers of northern Baikal based on microbiological indices, are a complex system of mixing of two water masses, river and lake. Their inhomogeneity is clearly traced on the basis of the vertical dynamics of the production values and abundance of saprophytic bacteria. The water of northern Baikal, and especially the river mouth regions, is distinguished by increased (often by an order of magnitude) indices of microbiological activity compared with waters of central and southern Baikal. The microbiological indices in waters of the Tompa River and its mouth region should be considered natural (background) since, at present, the river is not experiencing direct anthropogenic influences. The lowest bacterial production is found in waters of the Kholodnaya and Rel' rivers (1.33 and 0.79 micro-g C/liter/

day). As a consequence of this their potential capacity for self-purification is quite low. Microorganisms capable of growing on media with hydrocarbons are constant components of microbiocenoses of the water column of northern Baikal. (Baker-IVI)
W86-01825

SHORE ZONE MAPPING AND CLASSIFICATION OF A NORTHERN LAKE,

Ohio State Univ., Columbus. Dept. of Geology and Mineralogy.
G. D. McKenzie, and D. I. McKenzie.
Shore and Beach, Vol. 52, No. 4, p 9-14, October, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Lake shores, *Mapping, *Ontario, *Kesagami Lake, Beaches, Classification, Geology, Peat, Shores.

A descriptive shore zone classification, consisting of ten classes was developed to understand the geology of Kesagami Wilderness Park, a new wilderness park in Ontario, during an earth science assessment of the region. The shore map depicts the types of shores in a descriptive classification and provides useful information for planners, managers, lake users and exploration geologists. The most unusual features of the shores of Kesagami Lake are the peat bluffs up to 4 m in height. They have been recognized for almost a century and remain exceptional for Ontario. They provide an interpretive and scientific resource in that they show the subsurface dimension of a landscape that is common for much of northern Ontario. Probably the most important information shown on the shore zone map of Kesagami lake is the number and location of the sand beaches which historically have been the landing and camping sites. The sand beaches are themselves unusual in that many overlie peat and may be as thin as 10 cm. The shores of another lake (Missinaibi Lake) have been mapped and classified in like fashion for similar purposes. It is believed that these techniques can be applied in a useful manner in lakes throughout the glaciated uplands. (Baker-IVI)
W86-01839

CHEMICAL COMPOSITION OF TRANSKEI RIVER WATER,

Durban-Westville Univ. (South Africa). Dept. of Chemistry.
A. Du Preez.
Water S. A., Vol. 11, No. 1, p 41- 47, January, 1985. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Transkei, *South Africa, *Chemical composition, *Rivers, Water quality, Molybdenum, Arsenic, Mercury, Water pollution sources, Urban areas, Silt.

The water quality of the rivers flowing through Transkei was determined over a period of two years to afford a general picture of the chemical composition of Transkei river water. The period of study coincided with a relatively dry period in Transkei (and Southern Africa) and all results will have to be evaluated within this context. The more important findings resulting from the study are: Transkei River water generally contains very few dissolved constituents; the south-western parts of Transkei exhibit higher concentrations of analytes compared to north-eastern Transkei; pollution within Transkei is limited to Butterworth (urban contamination; macro elements plus molybdenum) and a number of other sites where very high arsenic concentrations are attributed to the leaching of old cattle dip material into rivers; pollution in the Republic of South Africa adjoining Transkei is at Queenstown (urban contamination; macro elements) and in the Elliot-Ugie-Maclear region (mercury); and silt loads in terms of unit areas of catchment are lower than presently accepted norms. (Author's abstract)
W86-01862

MOLYBDENUM AVAILABILITY, NITROGEN LIMITATION, AND PHYTOPLANKTON GROWTH IN NATURAL WATERS,

Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
R. W. Howarth, and J. J. Cole.
Science, Vol. 229, No. 4714, p 653-655, August, 1985. 1 Fig, 1 Tab, 38 Ref. NSF grants BSR-83-06176 and INT-83-04275.

Descriptors: *Limiting nutrients, *Molybdenum, *Phytoplankton, *Nitrogen, Marine environments, Coastal waters, Lakes, Algal growth, Sulfates, Phosphorus, Nitrogen fixation, Nitrates.

In most lakes, the supply of phosphorus controls primary productivity, yet phytoplankton productivity in most estuaries and coastal seas is controlled by nitrogen supply. Rates of nitrogen fixation may be low in coastal waters because molybdenum availability is low. In a series of experiments examining the uptake of radioactive Mo-99 by phytoplankton, environmentally realistic concentrations of sulfate inhibit molybdate assimilation. Sulfate inhibition of molybdate assimilation by phytoplankton makes molybdate less available in seawater than it is in freshwater. As a result, nitrogen fixation and nitrate assimilation, both processes that require molybdenum, may require a greater expenditure of energy in seawater than in freshwater. Experimentally increasing the ratio of sulfate to molybdate inhibits molybdate uptake, slows nitrogen fixation rates, and slows the growth of organisms that use nitrate as their nitrogen source. (Moore-IVI)
W86-01863

STUDY OF THE DISTRIBUTION OF FRESHWATER MUSSELS (MOLLUSCA: PELECYPODA: UNIONOIDA) OF THE LAKE CHAMPLAIN DRAINAGE IN NORTHWESTERN NEW ENGLAND,

Massachusetts Univ., Amherst. Museum of Zoology.
D. G. Smith.
American Midland Naturalist, Vol. 114, No. 1, p 19-29, July, 1985. 3 Fig, 3 Tab, 29 Ref.

Descriptors: *Lake Champlain, *Mussels, *Distribution, Fall line, Migration, Species composition, History.

Lake Champlain occupies a large shallow basin in northeastern North America and drains to the St. Lawrence River. The freshwater mussel fauna of the lake's drainage system includes both Northern Atlantic and Interior Basin species. An analysis of the distribution of the mussel species in the eastern and southern drainage streams of Lake Champlain reveals that fall lines have controlled upstream migration at various stages during the lake's postglacial history. Species composition differs above and below fall lines within drainage streams and varies geographically between drainage streams. Such distribution patterns may be explained by proposed periodic invasions of Lake Champlain by species during specific postglacial lake stages. (Author's abstract)
W86-01877

EFFECTS ON THE FOREST FLOOR OF WHOLE-TREE HARVESTING IN AN APPALACHIAN OAK FOREST,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Forestry.
J. E. Johnson, D. W. Smith, and J. A. Burger.
American Midland Naturalist, Vol. 114, No. 1, p 51-61, July, 1985. 2 Fig, 4 Tab, 40 Ref.

Descriptors: *Whole-tree harvesting, *Logging, *Oak trees, *Nutrients, Forest management, Soil solution, Clear-cutting, Soil temperature, Ammonia, Nitrates, Potassium, Soil water, Cycling nutrients.

The size of the forest floor nutrient pool and degree of mineralization from this pool (as measured by nutrient concentrations in the soil solution) were compared between a clear-cut and an adjacent forested site. Forest floor dry weights and nutrient contents were monitored for 28 months following the whole-tree harvest. Soil solution nutrient concentrations, temperature at a depth of 2.5 cm, and percent moisture in the top 10 cm of mineral soil were also monitored following cutting. Immediately following cutting, the forest floor was significantly heavier in the cut area due to logging residue, but after 28 months the clear-cut area forest floor had a dry weight of 10,500 kg/ha compared to 15,400 kg/ha in the uncut area. Following cutting, concentrations of NH4(+)-N, NO3(-)-N and K were higher in the soil solution of the cut area, whereas concentrations of P, Ca and Mg were similar in both areas. The higher concentrations in the clear-cut were attributed to more rapid decay of logging slash and forest floor material and reduced vegetative uptake. (Author's abstract)
W86-01878

POPULATION AND REPRODUCTIVE DYNAMICS OF NAIS COMMUNIS (OLIGOCHAETA: NAIDIDAE) FROM A WISCONSIN LIMNOCRENE,

Wisconsin Univ.-Milwaukee. Dept. of Zoology.
M. E. Smith.
American Midland Naturalist, Vol. 114, No. 1, p 152-158, July, 1985. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Limnocrenes, *Oligochaetes, *Population dynamics, *Reproduction, Wisconsin, Springs, Paratomy, Water temperature, Alkalinity, Hydrogen ion concentration, Biomass.

Population and reproductive dynamics of the oligochaete Nais communis were studied from August 1982 to November 1983 in a Wisconsin limnocrene (a spring discharging into a small basin which overflows into a stream channel). The study site was located in the township of Saukville, Ozaukee County. Naidids were found only among the large floating mats of Spirogyra which covered most of the limnocrene. Population density was significantly ($P < 0.05$) correlated with water temperature, total alkalinity and pH. Abundance peaks occurred during mid-August 1982 and early October 1983. No sexually mature worms were collected; asexual reproduction by paratomy took place throughout the study. Nais communis exhibited at most three zooids per chain; the majority of worms exhibited two zooids per chain when reproducing. There was no significant ($P > 0.05$) correlation of percentage of worms undergoing paratomy to environmental physico-chemical parameters and worm density. Mean doubling time for the field population of N. communis was 13.57 +/- 13.00 days. Seasonal changes in biomass were similar to those of abundance. (Moore-IVI)
W86-01879

SEASONAL CHANGES IN ABUNDANCE OF BROWN TROUT (SALMO TRUTTA) AND RAINBOW TROUT (S. GAIRDNERII) ASSESSED BY DRIFT DIVING IN THE RANGITIKEI RIVER, NEW ZEALAND,

Ministry of Agriculture and Fisheries, Wellington (New Zealand). Fisheries Research Div.
B. J. Hicks, and N. R. N. Watson.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 1-10, 1985. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Trout, *Seasonal variation, *Rangitikei River, *New Zealand, Drift diving, Fish, Abundance.

Numbers and approximate sizes of brown trout (Salmo trutta L.) and rainbow trout (S. gairdnerii Richardson) were estimated by snorkel divers at 6 sites in the middle reaches of the Rangitikei River, North Island, New Zealand, over 14 months. The results showed that different species and sizes of trout varied in abundance with time. The species of fingerling trout (6-12 cm FL) could not be identified because of their small size and shoaling behavior. Rainbow trout abundance varied seasonally and was greatest in January and April (between 18 and 60 fish per kilometer) when fish between 23 and 38 cm FL were the most abundant size class. Brown trout abundance showed much less variation with time (between 5 and 36 fish per kilometer at most sites). Also in contrast to rainbow trout, the majority of brown trout were > 38 cm FL, and in June, when the greatest density was observed (56 fish per kilometer), 70 redds were

seen at the same site. Two sites were dived within a 48 h period to test the variability of the method. Comparisons between the 3 dives at each site revealed no significant differences between the numbers of fish in different species and size classes. (Author's abstract)
W86-01910

NUTRIENT DEMAND AND AVAILABILITY AMONG PLANKTONIC COMMUNITIES - AN ATTEMPT TO ASSESS NUTRIENT LIMITATION TO PLANT GROWTH IN 12 CENTRAL VOLCANIC PLATEAU LAKES,

Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
E. White, K. Law, G. Payne, and S. Pickmere.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 49-62, 1985. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Limiting nutrients, *Phytoplankton, *Lakes, *New Zealand, Nitrogen, Phosphorus, Algal growth, Bioassays, Nutrient storage.

Water from 12 central volcanic plateau lakes in New Zealand was studied on 4 occasions (one in each season). Four assays of nitrogen demand and 3 for phosphorus were employed in an attempt to identify the nutrients limiting plankton growth. Orthophosphate turnover times chlorophyll, and a range of analyses for nitrogen and phosphorus were made in support of bioassays. Consideration was given to both statistical and biological interpretation of the assays. The study did not produce a clear guide to the assessment of nutrient limitation among natural plankton communities. The phosphorus bioassays assess depletion of storage products rather than the levels of phosphorus in cells at which growth becomes limited. The same is true for most of the nitrogen bioassays, with the added complication that the analytical procedures may be too insensitive to assess depletion of storage products. Some advance can be made in understanding the nutrient status of planktonic communities at least in these 12 lakes, because it is possible to assemble a package of bioassays and measurements with criteria which identify waters in which nutrient limitation by either nitrogen or phosphorus is not operative. The data indicate that the storage capacity for phosphorus is c. x5 the subsistence level, and that for nitrogen may be only c. x0.5. If the storage capacity for phosphorus is indeed an order of magnitude greater than that for nitrogen, then phosphorus storage products must be depleted to 10% of their maximum before phosphorus limitation of plant growth becomes a possibility. (Moore-IVI)
W86-01911

INVESTIGATION OF SAMPLING STRATEGIES FOR LAKE BENTHOS,

Canterbury Univ., Christchurch (New Zealand). Dept. of Zoology.
B. V. Timms.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 71-78, 1985. 1 Fig, 6 Tab, 27 Ref.

Descriptors: *Benthos, *Sampling, *Lakes, Seasonal variation, Lake Pearson, New Zealand, Line transects, Abundance, Population dynamics.

Lake benthos is difficult to sample to obtain accurate estimates of population parameters. Part of the apparent variation in community structure and abundance of macrobenthos between lakes is attributable to the different sampling strategies used. Sampling was carried at Lake Pearson, Canterbury, New Zealand monthly from August 1978 to July 1979 at 12 sampling stations. A comparison of 7 sampling options shows that spot samples and line transects are inadequate but that an augmented line transect is almost as good as stratified random sampling. Winter/early spring and summer samples are needed to account for seasonal variations in species richness and community biomass. Much less effort is required for an augmented line transect, therefore it is recommended for lake survey and management studies. If large species such as mussels occur, it should be realized that this program is inadequate to sample them and either numerous grabs are needed in one period or over a seasonal cycle, or some other sampler should be used. (Moore-IVI)
W86-01913

2I. Water In Plants

EFFECTS OF WATER AND MINERAL NUTRIENT SUPPLY ON A DECIDUOUS AND AN EVERGREEN DWARF SHRUB: VACCINIUM ULIGINOSUM L. AND V. VITIS-IDAEA L.,

Lund Univ. (Sweden). Dept. of Plant Ecology.
P. S. Karlsson.
Holarctic Ecology, Vol. 8, No. 1, p 1-8, March, 1985. 6 Fig, 2 Tab, 51 Ref.

Descriptors: *Nutrients, *Minerals, *Water requirements, Plant growth, Fertilization, Soil properties, Climate, Precipitation, Roots, Evergreen shrubs, Deciduous shrubs.

At time of harvest, in response to fertilization, the deciduous Vaccinium uliginosum had accumulated more nutrients and grown more than the evergreen V. vitis-idaea. This study aimed at testing whether a similar response would be obtained in these species after fertilizing a site that differed from that used in the earlier study both in soil and climate characteristics. The present study was conducted at Abisko, northern Sweden, at a well drained site with a thin layer of organic soil, no permafrost, and relatively low annual precipitation. It is concluded that a sized response pattern cannot be expected for evergreen and deciduous species without considering other plant characteristics such as the amount of roots and (perhaps still more important) the spatial distribution of the roots in the soil. Such differences within a growth form group may be further accentuated by differences in climate, mainly precipitation, and soil quality between sites. The different response patterns recorded for V. vitis-idaea and V. uliginosum in the present study as compared to the earlier study may be result of such site differences. (Baker-IVI)
W86-01360

CANOPY TRANSPIRATION AND WATER FLUXES IN THE XYLEM OF THE TRUNK OF LARIX AND PICEA TREES - A COMPARISON OF XYLEM FLOW, POROMETER AND CUVETTE MEASUREMENTS,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
E. D. Schulze, J. Cermak, R. Matyssek, M. Penka, and R. Zimmermann.
Oecologia, Vol. 66, No. 4, p 475-483, July, 1985. 7 Fig, 1 Tab, 38 Ref.

Descriptors: *Canopy, *Transpiration, *Xylem, *Trees, *Larix, *Picea, *Porometers, Plant tissues, Plant physiology, Leaves.

Leaf gas exchange, transpiration, water potential and xylem water flow measurements were used in order to investigate the daily water balance of intact, naturally growing, adult Larix and Picea trees without major injury. The total daily water use of the tree was very similar when measured as xylem water flow at breast height or at the trunk top below the shade branches, or as canopy transpiration by a porometer or gas exchange chamber at different crown positions. The average canopy transpiration is about 12% lower than the transpiration of a single twig in the sun crown of Larix and Picea. Despite the similarity in daily total water flows there are larger differences in the actual daily course. Transpiration started 2 to 3 h earlier than the xylem water flow and decreased at noon before the maximum xylem water flow was reached, and stopped in the evening 2 to 3 h earlier than the water flow through the stem. The daily course of the xylem water flow was very similar at the trunk base and top below the lowest branches with shade needles. The difference in water efflux from the crown via transpiration and the water influx from the trunk is caused by the use of stored water. The specific capacitance of the crown wood was estimated to be 4.7 x 10 to the minus 8th power and 6.3 x 10 to the minus 8th power kg/kg/Pa and the total amount of available water storage was 17.8 and 8.7 kg, which is 24% and 14% of the total daily transpiration in Larix and Picea respectively. Very little water was used from the main tree trunk. With increasing transpiration and use of stored water from wood in the crown, the water potential in the foliage decreases. Plant water status recovers with the decrease of transpiration and the refilling of the water storage sites. The liquid flow conductance in the trunk was 0.45 x 10 to the minus 9th power and 0.36 x 10 to the minus 9th power mol/sq m/s/Pa in Larix and Picea respectively. The role of stomata and their control by environmental and internal plant factors is discussed. (Author's abstract)
W86-01601

COMPARATIVE WATER RELATIONS OF ADJACENT CALIFORNIA SHRUB AND GRASSLAND COMMUNITIES,

Pepperdine Univ., Malibu, CA. Natural Science Div.
S. D. Davis, and H. A. Mooney.
Oecologia, Vol. 66, No. 4, p 522-529, July, 1985. 10 Fig, 1 Tab, 34 Ref.

Descriptors: *California, *Grasslands, *Shrubs, *Plant physiology, Chaparral, Drought, Water stress, Plant populations, Soil moisture.

Much of the coastal mountains and foothills of central and southern California are covered by a mosaic of grassland, coastal sage scrub, and evergreen sclerophyllous shrubs (chaparral). In many cases, the borders between adjacent plant communities are stable. The cause of this stability is unknown. The water use patterns of representative grasses, herbs, and shrubs across a grassland/chaparrel ecotone were examined and the extent to which patterns of water use contribute to ecotone stability was determined. The effects of seed dispersal and animal herbivory were also examined. During spring months, when water was not limited, grassland species had a much higher leaf conductance to water vapor diffusion than chaparral plants. As the summer drought progressed, grassland species depleted available soil moisture first, bare zone plants second, and chaparral third, with one chaparral species (Quercus durata) showing no evidence of water stress. Soil moisture depletion patterns with depth and time corresponded to plant water status and root depth. Rabbit herbivory was highest in the chaparral and bare zone as indicated by high densities of rabbit pellets. Dispersal of grassland seeds into the chararral and bare zone was low. Results support the hypothesis that grassland species deplete soil moisture in the upper soil horizon early in the drought, preventing the establishment of chaparral seedlings or bare zone herbs. Also, grassland plants are prevented from invading the chaparral because of low seed dispersability and high animal herbivory in these regions. (Author's abstract)
W86-01602

WATER RELATIONS OF PINUS RADIATA IN COMPETITION WITH WEEDS,

Melbourne Univ., Parkville (Australia). Forestry Section.
R. Sands, and E. K. S. Nambiar.
Canadian Journal of Forest Research, Vol. 14, No. 2, p 233-237, 1985. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Pine trees, *Water stress, *Competition, *Weeds, Stomatal resistance, Water potentials, Needles, Roots, Diurnal variation.

Soil water profiles up to 2 m in depth and diurnal patterns of needle water potential and stomatal resistance were measured over a dry summer period in 5-, 16-, and 28-month-old radiata pine (Pinus radiata D. Don) plantations, growing with and without weed competition. Severe water stress with consequent productivity loss occurred in trees with weed competition but the severity of stress decreased progressively with increasing tree age. Transplanted seedlings in their first growing season had shallow root systems which could not efficiently exploit water at depth. By contrast, seedlings in their second and third growing seasons

extracted water from at least a depth of 2 m. Trees without weed competition were not water stressed over this period even when planted at three times their normal stocking rate. Thus there is considerable capacity to increase early growth rates of radiata pine without water being the limit to growth if weeds are adequately controlled. (Author's abstract)
W86-01777

ESTIMATION OF TWIG XYLEM WATER POTENTIAL IN YOUNG DOUGLAS-FIR TREES,

British Columbia Univ., Vancouver. Dept. of Soil Science.
F. M. Kelliher, T. A. Black, and A. G. Barr.
Canadian Journal of Forest Research, Vol. 14, No. 4, p 481-487, August, 1984. 7 Fig, 3 Tab, 49 Ref.

Descriptors: *Water potential, *Fir trees, *Xylem, Soil water potential, Transpiration, Needles, Water stress.

Tree water stress can be an important factor determining productivity of some North American conifer forests. Leaf (needle) water potential is a measure of tree water stress. A method is described which can be used to estimate twig xylem water potential for 10-15 m tall Douglas-fir (Pseudotsuga menziesii) trees. Using pressure chamber measurements, values of needle xylem water pressure potential were found to be similar to twig xylem water pressure potential. Pressure chamber measurements were reproducible and needle deformation was not observed. For root zone soil water potential > -0.4 MPa, measured predawn total twig xylem water potential of these Douglas-fir trees was significantly less than the soil water potential. A transpiration rate dependent single soil to twig liquid resistance accounted for the difference between predawn total twig xylem water potential and soil water potential. For soil water potential > -0.4 MPa, during the daytime when transpiration was high, twig liquid resistance could be described by a logarithmic function of soil water potential. The effect of capacitance on twig xylem water potential was small. A model incorporating the transpiration dependent twig liquid resistance accurately estimated the course of twig xylem water potential on a clear day when soil water potential was -0.04 MPa. (Moore-IVI)
W86-01781

INSTRUMENT FOR MEASURING THE AVERAGE STOMATAL CONDUCTANCE OF CONIFER SEEDLINGS,

British Columbia Univ., Vancouver. Dept. of Soil Science.
N. J. Livingston, T. A. Black, D. Beames, and B. G. Dunsworth.
Canadian Journal of Forest Research, Vol. 14, No. 4, p 512-517, August, 1984. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Stomatal conductance, *Conifers, *Measuring instruments, Porometers, Conductance, Fir trees, Seedlings, Microprocessors.

A ventilated, transient-type porometer was designed to nondestructively measure the average stomatal conductance of conifer seedlings. The porometer consists of a low-power microprocessor unit and a stainless steel chamber which encloses the seedling. Conductance is calculated from the measured rate of increase in chamber relative humidity above the ambient level. Consequently, chamber air does not have to be dried prior to measurement. Direct readout of stomatal conductance is provided by means of liquid crystal display and a serial (RS232) port. Porometer calibration over a range of humidities showed that the effective chamber volume was consistently 25% larger than the actual chamber volume. Stomatal conductance measurements made on Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) seedlings using the porometer agreed well with average values obtained with a ventilated diffusion porometer using four needle samples. The porometer proved to be very convenient to use in a forest clearcut environment, with the measurement procedure taking about 1 min. Measurements can be made on a seedling over the growing season because the use of the instrument causes no injury to stem, branches, and needles. (Author's abstract)
W86-01782

LIGHT REDUCTION AND MOISTURE STRESS: EFFECTS ON GROWTH AND WATER RELATIONS OF WESTERN LARCH SEEDLINGS,

Oregon State Univ., Corvallis. Coll. of Forestry.
N. C. Vance, and S. W. Running.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 72-77, February, 1985. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Larch trees, *Water stress, *Plant growth, Solar radiation, Leaves, Water potential, Seedlings, Humidity, Conductance.

Ten-week-old western larch (Larix occidentalis Nutt.) seedlings were grown in a greenhouse under 70, 37, and 27% full sunlight from late July to early October. In August, seedlings under each light treatment were repetitively water stressed until predawn leaf water potential reached one of three levels: no stress (> -0.4 MPa), moderate stress (-0.7 to -1.0 MPa), and severe stress (-1.5 to -1.8 MPa). Moisture stressing significantly reduced height and diameter of seedlings grown under 70% light. Light reduction reduced shoot and root biomass accumulation. A positive linear relation was found between root dry weight and light intensity. The largest seedlings (on a weight basis) received the highest light, were unstressed, and had the lowest shoot/root ratios. Terminal bud set was not affected by light reduction or moisture stressing but occurred under a 14-h photoperiod and reduced nighttime temperatures. Stressed and shaded seedlings had significantly reduced diurnal leaf conductance (K1), and stress-cycled seedlings showed an adjustment to stressing. The K1 of unstressed seedlings was correlated with humidity deficit (ABHD), and K1 of stressed seedlings, with leaf water potential and ABHD. Maximum K1 declined with decreasing leaf water potential but not to a level indicating complete stomatal closure. (Author's abstract)
W86-01785

NEEDLE WATER POTENTIAL AND SOIL-TO-FOLIAGE FLOW RESISTANCE DURING SOIL DRYING: A COMPARISON OF DOUGLAS-FIR, WESTERN HEMLOCK, AND MOUNTAIN HEMLOCK,

British Columbia Univ., Vancouver. Dept. of Soil Science.
T. M. Ballard, and M. G. Dosskey.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 185-188, February, 1985. 3 Fig, 13 Ref.

Descriptors: *Needles, *Water potential, *Plant water uptake, *Soil water, *Hemlock, *Fir trees, Seedlings, Soil water potential, Water uptake resistance.

Trends of needle water potential and resistance to water uptake by Douglas-fir seedlings are compared to those for western and mountain hemlock. Soil-to-foliage flow resistance for various soil water potentials was calculated as the difference between soil and needle water potentials, divided by the corresponding water uptake rate. Needle water potential in western and mountain hemlock falls as the soil dries, but under the experimental conditions, it remained stable in Douglas-fir. Resistance to water flow from soil to foliage is higher for the hemlocks and increases more steeply as the soil dries. As the soil continues to dry, the effect of larger and more steeply increasing resistance, in hemlocks, is to decrease water uptake to near zero, long before the water potential difference becomes very small. This occurs although root surface area is much greater for the hemlocks than for Douglas-fir, and is especially pronounced for mountain hemlock. (Moore-IVI)
W86-01787

2J. Erosion and Sedimentation

SEDIMENT RESUSPENSION AND CURRENTS IN LAKE MANITOBA,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W86-01341

HYDROLOGY OF MID-ALTITUDE TUSSOCK GRASSLANDS, UPPER WAIPORI CATCHMENT, OTAGO. I. EROSION, SEDIMENT YIELDS AND WATER QUALITY,

New Zealand Forest Service, Rotorua. Forest Research Inst.
C. L. O'Loughlin, L. K. Rowek, and A. J. Pearce.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 45-59, 1984. 6 Fig, 4 Tab, 16 Ref.

Descriptors: *Soil erosion, *Sediment yield, *Water quality, *Grasslands, *Otago, *New Zealand, Temperature effects, Turbidity, Bank stabilization, Catchment area, Hydrology.

A study was designed to determine the erosion status of catchments under lightly modified tussock grassland and to examine the export of sediment from the catchment. The quality of the catchments' streamwater was also considered. Sediment yields from two small tussock catchments underlain by schist bedrock in the East Otago uplands South Island, New Zealand, were 42.8 cubic m and 12.6 cubic m respectively during a 4 year period of study. The area appears to have low erosion rates, as evidenced by the sediment yield rates. Surface erosion and mass wasting were not common occurrences on the catchments' slopes. Most of the sediment delivered to the streams derived from channel scouring and bank collapse during large floods. Suspended sediment concentrations ranged from less than 2 mg/l to 430 mg/l and the streamwaters remained clear at less than 15-20 mg/l sediment concentration for about 97% of the time. Stream pH averaged 6.8, stream conductivity ranged from 12.4 to 54.8 micro-S/cm and stream temperature ranged between maxima of 16 to 19 degrees C in summer and minima of 0-3 degrees C in winter. (Baker-IVI)
W86-01383

SOME THOUGHTS ON FINE-GRAINED SEDIMENT TRANSPORT AND DEPOSITION,

University of Southern California, Los Angeles. Dept. of Geological Sciences.
D. S. Gorsline.
Sedimentary Geology, Vol. 41, No. 2/4, p 113-130, December, 1984. 118 Ref.

Descriptors: *Sediment transport, *Deposition, Sedimentation, Particulate matter, Plankton, Marine environment.

Some aspects of fine-grained sedimentary research are reviewed. Water circulation is instrumental in determining the distribution of these particulates. Planktonic biologic filtering, aggregation, and reworking are of primary importance in deposition. Early diagenesis is controlled by bacterial processes with consequent changes in bulk and chemical properties. Initial deposition of most fine particulates is in the continental margins and then it moves to deep-ocean floors by mass wasting and high concentration flows. The stability of these fine deposits even on slopes of gentle gradient is controlled primarily by water content which, in turn, is a function of sedimentation rate and texture of the supply. Mass transport can occur in a variety of forms from slow creep to catastrophic failures of large scale. The various forms of movement can cause a sequence of morphologies. Most of the fine-grained stratigraphic record urgently needs reevaluation and restudy. Models of paleogeographic reconstructions on a large scale need to include the results of physical and biological oceanographers as the older simpler scenarios of locations of zones of high bioproductivity and of the patterns of major ocean currents have been greatly modified in recent studies. (Baker-IVI)
W86-01397

CHANGES IN SEDIMENT COMPOSITION DURING SEASONAL RESUSPENSION IN SMALL SHALLOW DIMICTIC INLAND LAKES,

Wisconsin Univ.-Platteville. Dept. of Geosciences.

E. B. Nuhfer, and R. Y. Anderson.
Sedimentary Geology, Vol. 41, No. 2/4, p 131-158, December, 1984. 13 Fig, 5 Tab, 36 Ref.

Descriptors: *Resuspension, *Sedimentation, *Lake sediments, Edinboro Lake, Pennsylvania, East Twin Lake, Ohio, Kettle lakes, Chemical analysis, Calcium, Phosphorus, Sulfur, Magnesium, Sodium, Zinc, Nickel, Chromium, Manganese, Iron, Aluminum, Seasonal variation.

Results are presented of resuspension studies at two small shallow kettle lakes, Edinboro Lake, Pennsylvania, and East Twin Lake, Ohio. These lakes have significant amounts of seasonal resuspension and measurable accompanying variations in seston with respect to chemistry, mineralogy, and petrography. The objectives of the work were to study the magnitude and duration of resuspension events; and to acquire sufficient chemical, mineralogical, and petrographic data from an annual record to permit both detection of seasonal variations and statistical analyses of relative importance of detected variations. Resuspension in the lakes occurs from both seasonal holomictic circulation and from continual entrainment of material from the shallow portions of the lake by the circulating epilimnion. Trapping rates were only negligibly affected by rainstorms. These rates varied widely throughout the year with minimum sedimentation rates noted at time of winter ice cover, and maximum rates noted during autumn circulation. Most material collected by the sediment traps was resuspended from the lake bottom. The only inactive time for resuspension was the time period under winter ice cover. Compositional variations included enrichment of Si in winter, Ca, P, S, Mg, Na, Zn, Ni, and Cr in summer, and Mn in late summer and autumn. During times of reduced circulation the sediment is generally enriched in amorphous mineraloids and during spring and autumn, in detrital minerals. Endogenic minerals include calcite, pyrite, and possibly some kaolinite. Most of the mineral fraction is detrital. Trap sample differs in composition from bottom sediment, but samples collected in traps in early winter closely resemble bottom material. Traping rates in early winter appear closest to true rates of fill. (Baker-IVI)
W86-01398

FURTHER EVIDENCE OF FINE-GRAINED SEDIMENT DISPERSAL IN THE SOUTHEASTERN YELLOW SEA,

Seoul National Univ. (Republic of Korea). Dept. of Oceanography.
S. K. Chough.
Sedimentary Geology, Vol. 41, No. 2/4, p 159-172, December, 1984. 8 Fig, 31 Ref.

Descriptors: *Sedimentation, *Dispersion, *Yellow Sea, China, Korea, Yangtze River, Hwangho River, Keum Estuary, Kaolinite, Chlorite, Mineralogy, Sediment transport.

The Yellow Sea is a shallow, post-glacially submerged epicontinental basin, a tectonically stable depocenter of clastics derived from the adjoining land masses of China and Korea. Sediments in the Yellow Sea are fine-grained in the broad western part, where they are derived mainly from the Chinese rivers, the Hwangho and Yangtze, and coarse-grained in the narrow eastern part originating largely from the Korean Peninsula. The coarse grained sediments near the Keum Estuary contain subtantial amounts of fine fractions. Kaolinite and chlorite are abundant in the fine fractions for about 120 km both toward the northwest and the southwest. Trace elements distributed in the bulk sediments follow the same trends. The close correspondence between mineralogical and geochemical evidence and hydrographic data suggests that the bulk of fine-grained sediments in the southeastern Yellow Sea originates from the Keum River and is subsequently transported by prevailing nearshore currents both northwestward during summer and dominantly southwestward in winter. Illite is dominant in the rest of the sea as influenced by discharge of Hwangho River and possibly also the Yangtze. There appears only to be a minimal effect from the Kuroshio discharging into the southeastern Yellow Sea. (Baker-IVI)
W86-01399

SOIL EROSION MEASUREMENT AND SOIL CONSERVATION RESEARCH IN CULTIVATED AREAS OF THE UK,

National Coll. of Agricultural Engineering, Silsoe (England).
R. P. C. Morgan.
Geographical Journal, Vol. 151, No. 1, p 11-20, March, 1985. 7 Tab, 62 Ref.

Descriptors: *Soil erosion, *Soil conservation, *Erosion control, *England, *Cultivated lands, Rill erosion, Wind erosion, Slope, Soil types.

Agricultural soil erosion by both water and wind is a local scale problem in the UK, particularly on the sandy loam soils under continuous cereal production or market gardening in the midland and eastern counties of England. Mean annual rates of soil erosion by water on these soils in fields on hillslopes up to 11 degrees can exceed 2 kg/sq m when rilling occurs, compared with a rate for top soil renewal of only about 0.1 kg/sq m. Rates as high as 1.9 kg/sq m have been recorded in individual storms and storm rates greater than 0.2 kg/sq m can occur as frequently as in four years out of seven. Storm losses by wind erosion are of similar magnitude but those for gully erosion are much higher with rates reaching 15 to 19 kg/sq m in single storms. Research into soil conservation has been carried out on Experimental Husbandry Farms and by farmers and commercial organizations with a direct interest in the problem. It has been largely limited to the use of shelterbelts, guard crops, soil stablizers and land imprinting or pressing to control wind erosion with virtually no work having been undertaken on water erosion control. There is a need for more fundamental research which will allow the mechanics of the control measures to be understood better and to enable their general applicability to be assessed more readily. Research projects with these aims in mind are described involving investigations of the effects of crop cover on splash erosion, tillage effects on soil erodibility and the simple modelling of the erosion system to predict the stability or instability of the soil resource under given systems of agricultural management. (Author's abstract)
W86-01401

SOIL EROSION AND SEDIMENT TRANSPORT RESEARCH IN TROPICAL AFRICA,

International Inst. of Tropical Agriculture, Ibadan (Nigeria).
R. Lal.
Hydrological Sciences Journal, Vol. 30, No. 2, p 239-256, June, 1985. 3 Fig, 3 Tab, 107 Ref.

Descriptors: *Soil erosion, *Erosion, *Sediment transport, *Africa, *Research, Sediment load, Land use, Deforestation, Environmental protection.

The magnitude of soil erosion in tropical Africa is reviewed and related to erodibility, erosivity and landform in different ecological regions. There are few direct measurements of erosivity and erodibility in tropical Africa and the relevance of using the Universal Soil Loss Equation in estimating these parameters is reviewed. Soil erodibility is not a fixed parameter and changes with time. Although localized rates of soil erosion can be high, the erosion rates derived from sediment loads in rivers are often low. Most of the available data on sediment loads of African rivers are 10-20 years old, and little research information is available on the delivery ratios associated with different catchments. Rapidly changing land use is one of the major factors responsible for accelerated soil erosion, and the effects of deforestation, grazing, fire, and of cultural practices are discussed. The economics of soil erosion is reviewed in terms of loss in productivity and siltation of reservoirs. Research and development needs are listed. (Author's abstract)
W86-01447

ESTIMATING UNIVERSAL SOIL LOSS EQUATION FACTOR VALUES WITH AERIAL PHOTOGRAPHY,

Ministry of Works and Development, Palmerston North (New Zealand). Water and Soil Div.
P. R. Stephens, J. K. MacMillan, J. L. Daigle, and J. Cihlar.
Journal of Soil and Water Conservation, Vol. 40, No. 3, p 293-296, May-June, 1985. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Aerial photography, *Infrared imagery, *Soil loss, Soil erosion, Mapping, Crop rotation, Farm management, Slope, Soil type, Remote sensing, Croplands.

Traditionally, inputs for the universal soil loss equation have been based on cropland and soil erosion estimates obtained from field surveys and farmer interviews. But such data can also be obtained by using color-infrared photographs to delineate (a) homogeneous erosion mapping units, crop rotations, and management practices; (b) topographic maps for slope information; and (c) an improved soil map for soil erodibility. This new procedure was tested in a potato growing area near Grand Falls, New Brunswick. With accurate soil erodibility data, soil loss was estimated with an accuracy of 88% +/- 1.2% compared to the traditional method. Such accuracy is sufficient for farm conservation planning. Accuracy dropped to 72% +/- 2.5% when the existing soil map (1:63,360-scale) was used. The new method is two to four times faster and permits year-round mapping, compared to about 120 days for the traditional method in the study area. Aerial photographs also provide a valuable land cover record for future use. (Author's abstract)
W86-01493

NITROGEN MINERALIZATION IN A SEQUENCE OF HYDROMORPHIC SOILS IN A VALLEY IN THE HIGH SEMOIS (BELGIUM) (MINERALISATION DE L'AZOTE DANS UNE SEQUENCE DE SOLS HYDROMORPHES DE LA VALLEE DE LA HAUTE SEMOIS (BELGIQUE)),

Universite Libre de Bruxelles (Belgium). Lab. de Botanique Systematique et d'Ecologie.
For primary bibliographic entry see Field 2G.
W86-01510

GENERALIZED CONTINUUM THEORY FOR MULTIPHASE SUSPENSION FLOWS,

Clarkson Univ., Potsdam, NY. Dept. of Mechanical and Industrial Engineering.
G. Ahmadi.
International Journal of Engineering Science, Vol. 23, No. 1, p 1-25, July, 1985. 118 Ref.

Descriptors: *Continuum theory, *Suspended solids, *Multiphase suspension flow, Particulate matter, Thermodynamics, Mathematical equations, Sedimentation.

A continuum theory for multiphase particulate suspensions in a fluid media is formulated. The generalized fundamental balance laws for the particulate phases as well as for the continuous suspending fluid phase are presented. The thermodynamics of a multiphase system is studied and the method of Lagrangian multipliers is employed to include the constraints of incompressibility of materials of the constituents and the criterion for fully saturated media. Constitutive equations are developed which include microrotational and microdilational effects. The basic equations of motion of different phases are derived and discussed. Special considerations are given to the case of incompressible constituents. Examples of applications of the present theory to dilute suspension flows and multiphase sedimentation are also discussed. (Author's abstract)
W86-01533

FORMATION OF RIPPLES IN ERODIBLE CHANNELS,

Delaware Univ., Newark. Ocean Engineering Program.
N. Kobayashi, and O. S. Madsen.
Journal of Geophysical Research, Vol. 90, No. C4, p 7332-7340, July, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Ripple marks, *Erodible channels, *Hydrodynamic models, *Model studies, Hydraulics, Fluid mechanics, Sediment.

Formation of ripples and dunes in erodible channels was analyzed by using the hydrodynamic model developed by Kobayashi and Madsen. Applying the continuity equation of sediment, the propagation velocity of the wavy bed is expressed in terms of the new fluxes of bed load along the wavy bed and suspended sediment out of the bed load transport layer. The spatial variation of the bed load transport rate is derived by analyzing the balance of forces acting on a representative bed load particle on a sloping bed. The net flux of the suspended sediment out of the bed load transport layer is obtained by solving the diffusion equation for the suspended sediment near the bed. The stability analysis predicts that a perturbation that is either fairly short or long relative to the depth of flow will initially grow, depending on whether the flow is hydraulically smooth or fully rough. The model explains why ripples are not observed in experiments involving fairly coarse sediments, since in these cases the flow is rough turbulent. (Author's abstract)
W86-01538

THEORETICAL MODEL FOR SALTATING GRAINS IN WATER,

Washington Univ., Seattle. Geophysics Program.
P. L. Wiberg, and J. D. Smith.
Journal of Geophysical Research, Vol. 90, No. C4, p 7341-7354, July, 1985. 17 Fig, 2 Tab, 30 Ref.

Descriptors: *Sediment transport, *Geophysics, *Saltation, Streambeds, Particulate matter, Model studies, Fluid mechanics.

The equations of motion for a sediment grain near a noncohesive bed and those for the local fluid flow are combined to produce a set of differential equations that can be solved numerically to describe the trajectory of a saltating grain as a function of time. The lift coefficient is set based on a reanalysis of data produced by Chepil, and the other parameters of the problem are set using standard fluid mechanical relationships; the initial velocity and position are specified with a separate model. The heights of the resulting trajectories are found to be significantly lower than available measurements would indicate; therefore two extensions of the model are examined: the effect that spin lift and form lift have on a series of trajectories, and the effect of partially elastic collisions between a moving grain and the bed over which it is traveling. A model that includes the second process is less complicated than one that includes the first, and it yields trajectories that agree very well with available experimental measurements when a rebound coefficient that varies around 0.5 and depends on the impact momentum is used. The model provides a reasonable representation of saltation in water and both fluid-solid and solid-solid interactions are required to reproduce the parameters of measured trajectories. (Author's abstract)
W86-01539

CHARACTERISTICS OF SUSPENDED SEDIMENT TRANSPORT IN THE LOWER HUDSON RIVER,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
H. Bokuniewicz, and C. L. Arnold.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 184-189. 2 Fig, 1 Tab, 29 Ref.

Descriptors: *Sediment transport, *Hudson River, *New York, *Suspended sediment, Particle size, Path of pollutants, Estuarine environment, Physicochemical characteristics.

Fine-grained suspended particles, and the contaminants associated with them, undergo episodic transport in their downstream migration and do not necessarily follow the water motion. Below the dam at Troy, NY, the suspended sediment transport is substantially modified by tidal resuspension and biological agglomeration. Samples taken seasonally at 16 stations had an average concentration of 30 mg/l ranging from 28 mg/l during low freshwater discharge to 40 mg/l at times of high discharge. The concentrations were increasingly controlled by tidal resuspension towards the month where tidal discharges are typically 20 times the freshwater discharge. The average percentage weight loss on ignition was 22%. Measurements of the particle-size distributions in both undisturbed and disaggregated samples showed that suspended particles were usually mineral-organic aggregates. In contrast to resuspension which increases the time particles spend in the water column, agglomeration tends to decrease that time by increasing the settling velocity. Most of the fine-grained sediment distribution occurs in the geochemical estuary and a substantial amount of this sediment is ultimately dredged and disposed in the ocean. (Author's abstract)
W86-01559

SEDIMENT ACCUMULATION RATES IN IRONDEQUOIT BAY, NEW YORK BASED ON LEAD-210 AND CESIUM-137 GEOCHRONOLOGY,

Geological Survey, San Diego, CA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W86-01566

MINERALIZATION OF ORGANIC CARBON ON AND IN THE SEDIMENT OF LAKE GREVELINGEN,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01579

FORMATION OF PYRITE IN FRESHWATER SEDIMENTS: IMPLICATIONS FOR C/S RATIOS,

Freshwater Biological Association, Ambleside (England).
W. Davison, J. P. Lishman, and J. Hilton.
Geochimica et Cosmochimica Acta, Vol. 49, No.7, p 1615-1620, July, 1985. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Pyrite, *Sediments, *Carbon/sulfur ratio, Lake sediments, Redox status, Volatile compounds, Sulfur.

The vertical distribution of pyrite, acid volatile sulfide (AVS), carbon, and total S (St) were determined directly in the sediments of three lakes of different trophic status. The results showed that freshwater pyrite formation reflects the redox status of the sediment of overlying waters. It appears to form chiefly in reducing sediments which are subject to oxidizing influences, by either a low turnover of organic carbon or periodic incursions of oxygen. Although there are high concentrations of AVS in the near-surface sediments of productive lakes, very little is diagenetically converted to pyrite. The feasibility of using sulfur ratios to diagnose whether rocks were formed in marine or freshwater environments is assessed. New values for FeS2/S of 0.5-5 show that this ratio does not provide a reliable test. Values of C/Sp, where Sp represents pyrite sulfur, lie within the range of 160-700 and are much higher than previously measured ratios of C/St of 1-50. These new determinations show that, if pyrite sulfur is unequivocally measured, C/S ratios may be a more sensitive indicator of salinity than had been previously thought. (Author's abstract)
W86-01615

ENERGY APPROACH TO ESTIMATING SCOUR DOWNSTREAM OF A LARGE DAM,

Vancouver (British Columbia).
For primary bibliographic entry see Field 8B.
W86-01694

USING CREAMS AND ECONOMIC MODELING TO EVALUATE CONSERVATION PRACTICES: AN APPLICATION,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 5B.
W86-01715

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-01731

DETERMINATION OF RIPPLE GEOMETRY,

Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-01732

PREDICTION OF 2-D BED TOPOGRAPHY IN RIVERS,

Waterloopkundig Lab. te Delft (Netherlands).
N. Struiksma.
Journal of Hydraulic Engineering, Vol. 111, No. 8, p 1169-1182, August, 1985. 7 Fig, 2 Tab, 12 Ref, 1 Append.

Descriptors: *River beds, *Topography, *Mathematical models. Bed load, Sediment transport, River mechanics, River morphology.

Mathematical models are being developed at the Delft Hydraulics Laboratory for the computation of time-dependent, two-dimensional bed deformation in alluvial rivers. A most promising verification of the predictive capacity of one such model has been obtained for the Waal River in the Netherlands. This model was developed for rivers with dominant bed load transport without significant grain-sorting effects and with approximately constant width. Also, some results of computations with variable boundary conditions are given which simulate the effect of the river regime and the extraction and return of cooling water on the bed topography. (Author's abstract)
W86-01734

BRAHMAPUTRA RIVER, ASSAM, INDIA: PHYSIOGRAPHY, BASIN DENUDATION, AND CHANNEL AGGRADATION,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
D. C. Goswami.
Water Resources Research, Vol. 21, No. 7, p 959-978, July, 1985. 18 Fig, 6 Tab, 61 Ref.

Descriptors: *Brahmaputra River, *India, *Physiography, *Aggradation, *Erosion, Sediment transport, Suspended sediments, Sediment load, Channels, Himalayas, Geology.

The Brahmaputra River in Assam, India, characterized by high seasonal variability in flow, sediment transport, and channel configuration, experienced a secular period of aggradation from 1971 to 1979. The suspended load budget indicates an overall aggradation of the 607-km Assam reach of the Brahmaputra by about 16 cm during that period, with about 70% of the suspended sediment inflow into the reach being retained in the channel. Expressed as a percentage of the change in storage for the different reaches, computed errors due to sampling variability in sediment discharge generally lie within about 5-15% and do not appear to be large enough to affect the conclusions drawn from the suspended load budget. For a 145-km reach of the Brahmaputra, an alternative method based on measurement of channel cross sections suggests 21 cm of aggradation, somewhat more than estimated by the suspended load budget. Based on the suspended load carried by trans-Himalayan rivers, the present rate of denudation of the eastern Himalayas is estimated to be 73-157 cm/1000 years. The average rate for the last 2-3 million years, estimated from the volume of alluvial fill in the Brahmaputra valley in Assam, the sediment yield of the Himalayan rivers, and assuming a total yield to deposition ratio of 1.4 (present study), is 3 cm/1000 years. The current high rate of denudation of the Himalayas may be attributed mainly to the rapid uplift of the mountain system, recent earthquake activity, and high susceptibility of geologic formations to erosion by running water coupled with the effectiveness of the monsoon rainfall regime. (Author's abstract)

W86-01768

LIMITS ON THE USEFULNESS OF EROSION-HAZARD RATINGS: EXPERIENCES IN NORTHWESTERN CALIFORNIA,

Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
For primary bibliographic entry see Field 4D.
W86-01783

SHORELINE EVOLUTION ALONG THE NORTHERN COAST OF THE GULF OF MEXICO,

Louisiana State Univ., Baton Rouge. Dept. of Geology.
D. Nummedal, R. F. Cuomo, and S. Penland.
Shore and Beach, Vol. 52, No. 1, p 11-17, January, 1984. 12 Fig, 30 Ref.

Descriptors: *Erosion, *Coastal waters, *Shores, *Gulf of Mexico, *Louisiana, Sedimentation, Barrier islands, Sea level, Water level.

The change in position of the sedimentary shoreline along the coastal waters of Louisiana over time is a function of the relative rates of sedimentation and sea level change. The morphology and evolutionary history of barrier islands along the northern coast of the Gulf of Mexico clearly document how differences in the rates of sea level rise and sediment supply controls shoreline evolution. The development on the Missisippi deltaic plain in Louisiana has been one of episodic delta progradation, abandonment, and wave reworking of fluvial distributary sand bodies to generate flanking barrier islands. The central headlands have retreated by surface erosion; on the flanks a set of regressive barriers developed as long as they could be sustained by sediment supply from the eroding updrift headland. Rapid local relative sea level rises ultimately remove the source from the transport system. At that time, the flanking regressive barriers are drowned by the rising sea; the transgressive barriers on the central headland are probably removed by sustained shoreface retreat. Provided there is enough sand on the upper delta plain, a new cycle of barrier island development may be initiated. Rapid sea level rise facilitates the drowning of major coastal barriers and sudden, dramatic landward shifts in the shoreline. Slower rates of sea level rise permit the local development of large regressive sequences as long as sediment supply is present. The ultimate fate of the shoreline under this regime appears to be shoreface erosion of nearly the complete coastal depositional sequence. (Baker-IVI)
W86-01830

COASTAL EROSION IN PUERTO RICO,

Puerto Rico Univ., Mayaguez. Dept. of Marine Sciences.
J. Morelock.
Shore and Beach, Vol. 52, No. 1, p 18-27, January, 1984. 21 Fig, 4 Ref.

Descriptors: *Puerto Rico, *Erosion, *Coasts, Erosion control, Aerial photography, Beach erosion, Accretion, Flood control.

Using a series of aerial photographs from 1936, 1950-51, 1962-63, 1971, and 1977, ten sites of severe coastal erosion in Puerto Rico were studied. El Tuque Park is a public beach west of Ponce. From 1971 to 1977 the straightened shoreline at the most rapidly eroding sites had a rate of erosion of 1.7 m/yr, which compares favorably with the rate of loss of shoreline at this point from 1962 to 1971 which was 7.2 m/yr. At Playa Cortada the present pattern of erosion poses a problem for houses that were built at the waterfront east of the old pier. Aguada has a beach which is a partial foreshore that terminates in an eroding cliff reached by high wave conditions. The period of accretion from 1937 to 1950 may have been caused by an influx of flood sediments. Between 1950 and 1977 there has been a loss of 25 m of shoreline, and the rate of erosion has been increasing. The area has changed from a developed beach profile to the partial foreshore as erosion moved inland and cut into higher ground. At Punta Salinas major modifications have been carried out. The Bayamon River has been closed off from discharge into the bay and flood control channels and jetties have been built to stem the tide of erosion. Isla Cabras, prior to 1971, gave no signs of erosional changes in the shoreline. Between 1971 and 1977, however, there is a drastic change at the southeast corner of the island with erosion occurring at a rate of 3.35 m/yr. Arecibo showed 35 m of shoreline retreat in the southern part of the bay between 1940 and 1959 for an annual rate of 1.7 m. The 1962 to 1971 photographs showed a moderate rate of erosion at the point of Punta Iglesia and a rate of 1.7 m/yr of eroding north of the sand borrow pit. Findings are also presented for Punta Uvero, Boca de Cangrejos, Pozuela, and Law Mareas. A program was recommended in 1978 which called for the classifying of the shoreline in terms of erosion hazard as a corollary to the flood warning classification of coastal areas. (Baker-IVI)
W86-01831

NEWLY DISCOVERED EVIDENCE FROM THE SAN DIEGO COUNTY AREA OF SOME PRINCIPLES OF COASTAL RETREAT,

Scripps Institution of Oceanography, La Jolla, CA.
G. G. Kuhn, and F. P. Shepard.
Shore and Beach, Vol. 51, No. 1, p 3-12, January, 1983. 20 Fig, 25 Ref.

Descriptors: *Erosion, *San Diego County, *Califonia, Erosion control, Flood control, Shores, Coastal waters, Beach erosion, Breakwaters, Groundwater.

The study of coastal changes of San Diego County has thrown some light on coastal erosion along shoreline areas of moderate relief. The development of the breakwater at the entrance of San Diego Bay has demonstrated the importance of beach erosion in the vicinity of the Hotel Del Coronado. Artificial shoreline protection has become necessary in this same vicinity to forestall erosion where huge condominiums have recently been constructed on the sand. The study of Oceanside and areas to the south showed that the general interpretation of the dominance of southflowing sediment-transporting currents is not always applicable. Groundwater must have dissolved the calcareous sandstone cement along remnant shear zones in the Solana Beach area, producing caverns which weaken adjacent cliffs. The high cliffed area from Torrey Pines south to La Jolla show the importance of groundwater, accentuated by man's activities, and huge landslides. The low alluvial cliffs in the vicinity of Scripps Institution show the importance of changing weather cycles and coastal erosion since wide beaches develop during quiet periods with little cliff retreat and give a false sense of security to building sites along the bluff edges. (Baker-IVI)
W86-01832

BASIC PRINCIPLES OF SEDIMENT BUDGET STUDY IN THE COASTAL ZONE,

Odesskii Gosudarstvennyi Univ. (USSR).
For primary bibliographic entry see Field 2L.
W86-01834

COMPREHENSIVE STUDY OF THE COAST OF CALIFORNIA,

Army Engineer District, Los Angeles, CA.
For primary bibliographic entry see Field 2L.
W86-01837

TARAVAL VERTICAL SEA WALL,

San Francisco City, CA.
For primary bibliographic entry see Field 2L.
W86-01841

INLETS AND BARRIER BEACH DYNAMICS: A CASE STUDY OF SHINNECOCK INLET, NEW YORK,

Patchogue, New York.
For primary bibliographic entry see Field 2L.
W86-01843

COMPUTER ASSISTED MAPPING OF SOIL EROSION POTENTIAL,

British Columbia Ministry of Environment, Victoria. Surveys and Resource Mapping Branch.
T. Vold, M. W. Sondheim, and N. K. Nagpal.
Canadian Journal of Soil Science, Vol. 63, No. 3, p 411-418, August, 1985. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Soil erosion, *Erosion potential, *Mapping, *Computers, Algorithms, Soil properties, Soil loss, Slope.

Soil erosion potential maps and summary statistics can be produced from existing information with relative ease with the aid of computers. Soil maps are digitized and survey infomation is stored as attributes for each soil. Algorithms are then prepared which evaluate the appropriate data base attributes (e.g. texture, slope) for each interpretation. Forty surface soil erosion potential maps were produced for the Lower Fraser Valley which identify the most erosion-prone areas and indicate average potential soil losses to be expected under assumed conditions. The algorithm developed follows the universal soil loss equation. Differences across the landscape in the R, K, and S factors are taken into account whereas the L factor is considered as a constant equal to 1.0. Worst conditions of bare soil (no crop cover, i.e. C = 1.0) and no erosion control practices (i.e. P = 1.0) are assumed. The five surface soil erosion potential classes are determined by a weighted average annual soil loss value based both on the upper 20 cm of mineral soil and on the proportion of the various soils in the polygon. A unique polygon number shown on the erosion potential map provides a link to computer tables which give additional information for each individual soil within that polygon. (Author's abstract)
W86-01906

2K. Chemical Processes

PHYSICOCHEMISTRY OF THE UPPER GILA RIVER WATERSHED: II. INFLUENCE OF PRECIPITATION RUNOFF AND FLOOD EVENTS ON THE SAN FRANCISCO RIVER,

Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
J. J. Rampe, R. D. Jackson, and M. R. Sommerfeld.
Journal of the Arizona-Nevada Academy of Science, Vol. 19, No. 2, p 115-120, 1984. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Physicochemical properties, *Rainfall runoff, *Floods, *San Francisco River, Arizona, New Mexico, Runoff, Storm runoff, Chlorides, Sodium, Nitrates, Phosphates, Ammonia.

The chemistry of a permanent desert stream is described during flooding with regard to changes in major anions and cations, nutrients, selected trace metals, and the interactions of the substances with suspended particulates. The San Francisco River is a permanent stream rising in the White Mountains and Mogollon Rim of eastern Arizona and western New Mexico. Flowing south and west it drains the Blue and Mogollon Mountains and receives its major tributary, the Blue River, 20 km northeast of Clifton, Arizona. The river discharges into the Gila River 12 km southwest of Clifton, above the Peconcillo Box Canyon. During two flood events stream turbidity increased 20-250 fold. During increased discharge chloride concentration decreased but the total quantity transported did not change. The ambient concentrations and loads of ammonia, nitrate and phosphate increased during flooding. Dissolved concentrations of major cations decreased by dilution, whereas sediment associated concentrations and total loads increased noticeably. Sodium was an exception since it was transported primarily into the dissolved form. Dissolved concentrations of trace elements either did not change or decreased slightly during flooding, whereas total concentration and transport increased dramatically. (Baker-IVI)
W86-01358

PRELIMINARY INVESTIGATION ON CHEMICAL QUALITY OF INLAND WATERS IN KENYA,

M. Moritsugu.
Berichte des Ohara Institut fur Landwirtschaftliche Biologie Okayama Universitat, Vol. 19, No. 1, p 25-34, March, 1985. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Chemical composition, *Water analysis, *Kenya, Acidity, Calcium, Magnesium, Sodium, Potassium, Carbonate, Conductivity, Salinity.

Electric conductivity, pH, calcium, magnesium, sodium, potassium and carbonate of the water were determined at twenty sites in Kenya in order to evaluate its usefulness for irrigation or tap water. Upstream waters were generally low in salinity as evidenced by Tana, Chania, Ndarugu and Thiririka River results. Waters downstream had a generally high salinity as exemplified by the lower Athi River. The waters of Lakes Naivasha and Baringo were fresh, while those of Lakes Magadi and Nakuru were sodic, even though they are situated in the Rift Valley and have no outflowing river. Except for upstream waters, natural Kenyan waters were alkaline, and carbonate contents in these waters were considerably high. The content of calcium in natural Kenyan waters and of magnesium in river waters was generally lower than in other countries. The sodium content of Kenyan waters in general was not so high as compared with other countries. The potassium content in the naturally available waters in Kenya was much higher than in the waters of other countries, and the average content was more than 8 ppm. (Baker-IVI)
W86-01361

AEROSOL CHEMISTRY IN MINNESOTA AND WISCONSIN AND ITS RELATION TO RAINFALL CHEMISTRY,

Minnesota Univ., St. Paul. Dept. of Plant Pathology.
G. C. Pratt, and S. V. Krupa.
Atmospheric Environment, Vol. 19, No. 6, p 961-971, 1985. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Aerosols, *Minnesota, *Wisconsin, *Chemistry of precipitation, Chemical composition, Sulfates, Nitrates, Metals, Geochemistry.

Chemical characteristics of aerosol and rainfall samples collected at five sites in Minnesota and one site in west-central Wisconsin during the summer of 1982 were generally similar with respect to the relative proportions of major constituents. The most abundant species measured in the aerosol was sulfate, occurring predominantly in the fine fraction (< 2.5 micro-m aerodynamic diameter). The rain chemistry was also dominated by sulfate but not to the same extent as the aerosol. The concentrations of crustal materials in both the aerosol and the rain followed a gradient in which concentrations increased with proximity of the sampling site to the prairie. The concentrations of crustal materials in the aerosol were correlated with their concentrations in subsequent rain, whereas concentrations of other constituents were not significantly correlated between aerosol and rain. Since the aerosol was sampled at the surface this result provided evidence that crustal materials were transported at lower altitudes and were scavenged to a greater degree by below-cloud mechanisms. The measured components in aerosols were divided by factor analysis into: Ammonium sulfates; crustal materials; and a group containing nitrates, metals and other materials. (Author's abstract)
W86-01382

SOLUBILZATION EFFECTS OF SIMULATED ACID RAIN ON THE ORGANIC MATTER OF FOREST SOIL; PRELIMINARY RESULTS,

Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W86-01421

DECIPHERING HYDROLOGICAL SYSTEMS BY MEANS OF GEOCHEMICAL PROCESSES,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W86-01448

ANNUAL LOSSES OF IRON FROM MOORLAND SOILS AND THEIR RELATION TO FREE IRON CONTENTS,

Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W86-01468

CARBONATE CHEMISTRY OF RECENT CHALK GROUNDWATER IN A PART OF EAST ANGLIA, U.K.,

Birmingham Univ. (England). Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W86-01470

ESTIMATES OF AVERAGE MAJOR ION CONCENTRATIONS IN BULK PRECIPITATION AT TWO HIGH-ALTITUDE SITES NEAR THE CONTINENTAL DIVIDE IN SOUTHWESTERN COLORADO,

Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 5B.
W86-01515

DISTRIBUTION AND FLUX OF 226RA AND 228RA IN THE AMAZON RIVER ESTUARY,

Princeton Univ., NJ. Geophysical Fluid Dynamics Program.
For primary bibliographic entry see Field 2L.
W86-01535

IMPACT OF ALKALINE PARTICULATES ON PH OF RAIN WATER IN INDIA,

Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 5B.
W86-01606

SHORT-TERM ENDPRODUCTS OF SULFATE REDUCTION IN A SALT MARSH: FORMATION OF ACID VOLATILE SULFIDES, ELEMENTAL SULFUR, AND PYRITE,

Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
For primary bibliographic entry see Field 2L.
W86-01614

FORMATION OF PYRITE IN FRESHWATER SEDIMENTS: IMPLICATIONS FOR C/S RATIOS,

Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2J.
W86-01615

CHEMICAL COMPOSITION OF FOGWATER COLLECTED ALONG THE CALIFORNIA COAST,

California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W86-01620

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER - III; INORGANIC COMPOUNDS AND RADICALS,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Hoigne, H. Bader, W. R. Haag, and J. Staehelin.
Water Research, Vol. 19, No. 8, p 993-1004, 1985. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Ozone, *Reaction kinetics, *Inorganic compounds, *Free radicals, Sulfur compounds, Chlorine compounds, Nitrogen compounds, Water treatment, Chemical reactions.

The kinetics of reactions of aqueous ozone with inorganic species are of interest for the understanding of a wide variety of systems: ozone interactions in atmospheric cloudwater or urban fog; ozone impinging onto the sea surface; and drinking and cooling water treatment. Second-order rate constants are reported for reactions of ozone with 40 inorganic aqueous solutes. Included are compounds of sulfur (e.g. H2S, H2SO3, HOCH2SO3H), chlorine (e.g. Cl(-), HOCl, NH2Cl, HClO2, ClO2), bromine (e.g. Br(-), HOBr), nitrogen (e.g. NH3, NH2OH, N2O, HNO2) and oxygen (e.g. H2O2), as well as free radicals (e.g. O2(-), OH). Most of these compounds exhibit an increase in rate constant with increasing pH corresponding to their degree of dissociation. Rate constants are based on ozone consumption rates measured by conventional batch-type or continuous-flow methods and determinations of stoichiometric factors. Also listed are data determined by pulse-irradiation techniques using kinetic spectroscopy. Ozone reacts rapidly with many oxidizable inorganic aqueous solutes. Many of them are strongly or fully protected when the site of reaction becomes protonated; most inorganic acids are only reactive in their dissociated form. Ammonia also only reacts when not protonated. Therefore, at pH values below the pKa of the site of the reaction, the rate constants of such solutes generally decrease by a factor of 10 per pH decrement. (Moore-IVI)
W86-01641

222RN CONCENTRATIONS AND VARIATIONS IN UNCONFINED GROUNDWATER,

Kyoto Univ., Osaka (Japan). Research Reactor Inst.
M. Fukui.
Journal of Hydrology, Vol. 79, No. 1/2, p 83-94, July, 1985. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Radon, *Groundwater, *Spatial distribution, Precipitation, Pumping, Geology, Seasonal variation, Sampling, Wells, Japan.

The spatial and vertical distributions of Rn-222 concentration in unconfined groundwater were surveyed, and the change of the concentraiton in groundwater relative to pumping was studied. The daily change of radon concentration in groundwater was observed and the effect of precipitation on the concentration was examined. The surveyed area is located at the Research Reactor Institute of Kyoto University (Japan). Spatial distribution of radon concentrations in groundwater in the limited area of less than 200 sq m showed rather large variation, ranging from about 170 to 300 pCi/l. This may stem from differences in geology, as the boreholes which show the higher concentration of 250-300 pci/l are close to each other. The high values may be due to small differences in the volume of water withdrawn during sampling. Vertical distributions of concentration increase in unconfined groundwater were clearly obtained in summer rather than in winter due to the stability of water density, although the spatial distributions of concentration were observed in a restricted area. The extraction of groundwater leads to about a two-fold increase in the radon concentration compared with the initial value in the borehole. A steady state concentration is reached after the extraction of about 1 cu m of water. Thus it is necessary to pump more than 1 cu m to obtain a representative concentration of the steady state in unconfined shallow groundwater. A decrease in radon concentration caused by dilution by precipitation was observed when the groundwater level rises more than about 50 cm, whereas radon content increased after small rains because the water in the well could exchange with fresh groundwater. The concentration diluted by the precipitation recovers to the former level within a week. (Moore-IVI)
W86-01658

GEOCHEMICAL MASS BALANCE OF A VOLCANIC CRATER LAKE IN AUSTRALIA,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-01663

ALUMINUM MOBILIZATION IN AN ACIDIC HEADWATER STREAM: TEMPORAL VARIATION AND MINERAL DISSOLUTION DISEQUILIBRIA,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5C.
W86-01678

BIOGEOCHEMISTRY OF ALUMINUM IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-01704

MULTIVARIATE ANALYSIS AND INTERPRETATION OF THE HYDROCHEMISTRY OF A DOLOMITIC REEF AQUIFER, NORTHERN ITALY,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2F.
W86-01773

PHOSPHORUS FORMS AND CONTENT IN NATURAL WATER AND FACTORS DETERMINING ITS CYCLING,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
N. G. Dmitrieva, and L. O. Einor.
Water Resources, Vol. 11, No. 4, p 360-370, July-August, 1984. 80 Ref. Translated from Vodnye Resursy, No. 4, p 110-120, July-August, 1984.

Descriptors: *Phosphous, *Natural waters, *Cycling nutrients, Lakes, Rivers, Runoff, Precipitation, Bottom sediments, Water analysis, Organic compounds, Aquatic life.

The formation of the quality of natural water in many respects is determined by the characteristics of hydrochemical and biochemical processes which depend on the effect of a number of factors within and outside of water bodies. The main pools of phosphorus compounds are the water itself, bottom sediments, and biota. The sources of inflow of phosphorus into water objects are the allochthonous runoff, precipitation, groundwater runoff and other factors. The anthropogenic factors of entry of phosphorus into water bodies and streams has become a powerful factor even increasing in significance. Phosphorus is present in surface waters of continental water bodies primarily in an organic form namely, in the composition of living organisms and in particles of dead material suspended in water or settled on the bottom, and in water in the form of soluble organic matter. Balance calculations of the income and outgo of P in various bodies of water is of great value, especially for predicting their state, but is an extremely difficult scientific problem. For its solution it is necessary to have a sufficiently complete and accurate data bank on all components of the phosphorus balance and their changes during a number of years. The calculations can be made as the final step of a quantitative study of sources of the inflow, accumulations, and removal of all P forms. (Baker-IVI)
W86-01811

DETERMINATION OF ZINC, CADMIUM, LEAD AND COPPER IN PRECIPITATION BY COMPUTERIZED DIFFERENTIAL PULSE VOLTAMMETRY,
Netherlands Energy Research Foundation ECN, Petten.
For primary bibliographic entry see Field 5A.
W86-01846

DETERMINATION OF COMMON ANION CONCENTRATIONS IN SURFACE AND GROUNDWATER SAMPLES BY ELUENT-SUPPRESSED ION CHROMATOGRAPHY,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5A.
W86-01847

GROUND-WATER QUALITY IN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. R. Larson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4034, 1984. 71 p, 55 fig, 2 tab, 18 ref.

Descriptors: *Water quality, *Groundwater, *Aquifer, *Dissolved solids, Nitrates, Fluorides, Trace elements, *Wyoming.

This report graphically summarizes ground-water quality from selected chemical-quality data for about 2,300 ground-water sites in Wyoming. Dissolved-solids, nitrate, fluoride, arsenic, barium, cadmium, chromium, lead, mercury, selenium, iron, and manganese concentrations are summarized on a statewide basis. The major chemical-quality problem that limits the use of Wyoming ground-water is excessive dissolved-solids concentrations. The aquifers with the best quality water, based on the lowest median dissolved-solids concentration of water in aquifers with 20 or more sampled sites, are Holocene lacustrine deposits, the upper Testiary Ogallala Formation and Arikaree Formation, and the Mississippian Madison Limestone. The counties with the best quality water, based on the lowest median dissolved-solids concentrations are Teton County and Laramie County. Hot Springs County and Natrona County have the highest median dissolved-solids concentrations. About 3 percent of the nitrate concentrations of ground-water samples exceeded the national primary drinking-water standard of 10 milligrams per liter. Fluoride concentrations exceeded the national primary drinking-water standard in 14 percent of the ground-water samples. Except for selenium, toxic trace elements generally have not been found in concentrations in excess of the drinking-water standards. About 19 percent of the iron and about 30 percent of the manganese concentrations in ground-water samples exceeded the national secondary drinking-water standards. (USGS)
W86-01919

2L. Estuaries

COMPUTER SIMULATIONS OF THE FRASER RIVER PLUME,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
L. Royer, and W. J. Emery.
Journal of Marine Research, Vol. 43, No. 2, p 289-306, May, 1985. 7 Fig, 35 Ref. Canadian Natural Sciences and Engineering Research Council Strategic Grants Program for Oceans grant G0353.

Descriptors: *Computer models, *Plumes, *River mouth, *Fraser River, *Straight of Georgia, *British Columbia, *Salinity, Wind-driven currents, Wind velocity, Tidal effects, Water currents, Stream discharge.

Instruments sampling the engine cooling water on two B.C. ferries were used to monitor the temporal and spatial variations of the Fraser River Plume, in the central Strait of Georgia (British Columbia) for nearly two years. Travelling along two different routes north and south of the river mouth, each ferry provided eight horizontal near-surface salinity transects per day. From each transect, the arithmetic average salinity along the section (denoted southern or northern section average salinity) was extracted, formulated as a time series of hourly or daily values and then compared to equivalent computer simulated series. A numerical model, previously developed to examine the effect of tidal forcing on the plume, was modified to include as inputs the hourly wind and daily discharge data. Average model salinities along the ferry section were computed and compared to the observed ferry data. Good agreement was reached after manipulating the entrainment velocity and the momentum transfer from the wind to the plume. The tides were seen to add a relatively small tidal modulation to the general salinity pattern resulting from the combined effects of wind and discharge. (Author's abstract)
W86-01328

LONG-TERM VARIATION OF MACROBENTHOS IN A MESOHALINE REGION OF CHESAPEAKE BAY,
Martin Marietta Environmental Systems, Columbia, MD.
A. F. Holland.
Estuaries, Vol. 8, No. 2A, p 93-113, June, 1985. 7 Fig, 8 Tab, 50 Ref. Maryland Dept. of Natural Resources, Power Plant Siting Program contract P46-83-02.

Descriptors: *Chesapeake Bay, *Maryland, *Benthos, *Population dynamics, Seasonal variation, Salinity, Estuaries, Marine ecosystems, Water temperature, Dissolved oxygen, Habitats.

The long-term variation of macrobenthos was examined at the Calvert Cliffs (Maryland) region of the Chesapeake Bay. Samples were taken from June 1971 to June 1982. Salinities ranged from 5 to 22 ppt over the 11 year study period. Three distinctive macrobenthic communities, that corresponded to the major sediment types sampled, were found in all years: a nearshore sand community, a transitional muddy-sand community and a deep-water mud community. While the species composition of these communities was similar, relative abundances of component species differed among them. Predictable seasonal cycles accounted for a relatively large (>20%) proportion of the total variation for populations that had one well defined annual recruitment pulse. Predictable seasonal cycles accounted for only a small (<10%) proportion of the variation for species that had recruitment throughout the year or aperiodically. Seasonal cycles did not account for much of the variation for species that had large year to year differences in abundance. Correlations between salinity and year to year abundance patterns were frequently significant but accounted for only small amounts of variation. Correlations between year to year fluctuations in dissolved oxygen concentration and abundances of dominant species were always positive in the deep water mud habitat, where they accounted for relatively large amounts of variation. Correlations between temperature and abundance of a few species were significant, however, these correlations accounted for little of the total abundance variation. Macrobenthic abundances and temperature were more frequently correlated for species living in the deep water mud habitat than in shallow habitats. Differences in summer dissolved oxygen concentration controls year to year variation of macrobenthos in the deep water mud habitat, while salinity controls year to year abundances in shallower habitats. Although significant year to year differences were found in the abundance of dominant species, the rank order of the five most abundant species was not random across years and has remained similar for the study decade. (Baker-IVI)
W86-01330

ABUNDANCE FLUCTUATIONS AMONG BENTHIC INVERTEBRATES IN TWO PACIFIC ESTUARIES,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5C.
W86-01333

LONG-TERM ESTUARINE VARIABILITY AND ASSOCIATION BIOLOGICAL RESPONSE,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint.
Estuaries, Vol. 8, No. 2A, p 158-169, June 1985. 7 Fig, 2 Tab, 35 Ref.

Descriptors: *Corpus Christi Bay, *Texas, *Benthic environment, *Estuaries, Ecosystems, Benthos. Cycling nutrients, Productivity, Rainfall, Salinity.

For the past 11 years, detailed data have been collected on benthic community structure, primary and secondary productivity, and sediment nutrient regeneration which are combined with other information, such as fishery yields, into a reconstructed long term data set for the Corpus Christi Bay area.

In 1979 the lowest salinity recorded was related to a short-term high intensity rainfall. Benthos responded with abundance and biomass levels far greater than any other year. Large increases in shrimp yields were correlated with increased benthic production. Primary, secondary, and tertiary carbon production estimates derived from the reconstructed long-term data base indicated benthos as a major link between primary producers and other consumers. Nutrient recycling was judged to provide more than 90% of the nitrogen needed to support phytoplankton production and was considered a major factor influencing ecosystem function. The matching of biological responses to significant environmental changes in this estuary provided insight into ecosystem function and stressed the importance of short-term variability. While recycling was a major source of nutrients supporting primary production, episodic environmental changes from freshwater input provided a much needed stimulation to productivity. These episodic changes replaced materials lost through recycling and sustained productivity over the long term. (Baker-IVI)
W86-01334

FACTORS INFLUENCING THE SALINITY REGIME OF LAKE PONTCHARTRAIN, LOUSISANA, A SHALLOW COASTAL LAGOON: ANALYSIS OF A LONG-TERM DATA SET,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 6G.
W86-01335

BENTHIC NUTRIENT REMINERALIZATION IN A COASTAL LAGOON ECOSYSTEM,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
B. L. Nowicki, and S. W. Nixon.
Estuaries, Vol. 8, No. 2B, p 182-190, June, 1985. 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Nutrients, *Coastal waters, *Lagoons, *Rhode Island, *Potter Pond, Benthic environment, Mineralization, Ammonia, Nitrates, Phosphates, Sediments, Temperature effects, Light effects.

The results of in situ light and dark chamber measurements of benthic community nutrient flux in Potter Pond, a shallow coastal lagoon on the ocean coast of Rhode Island are presented. The rates of ammonia, nitrate, phosphate and dissolved organic phosphorus exchange between the sediments and the overlying water were measured at different temperatures and light levels, from different sediment types, and were compared to similar measurements reported for the deeper, heterotrophic bottom communities of nearby Narragansett Bay. An attempt was also made to calculate the impact of benthic nutrient remineralization on the water chemistry of the lagoon and the potential contribution of regenerated nutrients to both benthic and pelagic primary production. The release of ammonia from muddy sediments in dark chambers ranged from 20-440 micromol per sq m per hr and increased sharply with increase in temperature. On the sandy tidal flat ammonia release rates were significantly lower and showed no response to increasing temperature from 4 to 23 degrees C. Ammonia release rates in corresponding light chambers were somewhat lower than those in dark chambers, though not statistically different. Nitrate fluxes in both light and dark chambers were an order of magnitude lower than ammonia release rates and were also erratic, showing both net uptake and release, with no apparent correlation with either temperature or light. Fluxes of dissolved inorganic phosphate ranged from a net uptake of -10 to a net release of 50 micromol per sq m per hr in dark chambers and from -7 to 29 micromol per sq m per h in light chambers. Phosphate fluxes over mud-sediment areas rose sharply with temperature, while fluxes from the sandy tidal flat tended to fall below those for mud sediments and showed no consistent response to temperature. The lack of mineralized phosphate in the lagoon is reflected in water column phosphate concentration and water column N/P ratios and suggests that the lagoon may show phosphate limitation rather than the nitrogen limitation commonly associated with marine systems. (Baker-IVI)
W86-01336

EUTROPHICATION AND MANAGEMENT INITIATIVES FOR THE CONTROL OF NUTRIENT INPUTS TO RHODE ISLAND COASTAL LAGOONS,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
For primary bibliographic entry see Field 5C.
W86-01337

TIDAL EXCHANGE BETWEEN A COASTAL LAGOON AND OFFSHORE WATERS,

Applied Science Associates, Inc., Wakefield, RI.
T. Isaji, and M. L. Spaulding.
Estuaries, Vol. 8, No. 2B, p 203-216, June, 1985. 11 Fig, 2 Tab, 23 Ref.

Descriptors: *Coastal waters, *Lagoons, *Tidal waters, Rhode Island, Charlestown Lagoon, Block Island Sound, Model studies, Finite element method, Hydrodynamics, Model studies.

The integration of a field observation program and hydrodynamic modeling studies are described. A better understanding of the pond circulation dynamics and exchanges of water with the ocean is derived through this integration. The Charlestown lagoon system, located on the southern coast of Rhode Island, consisting of two major basins, Ninigret Pond and Green Hill Pond, served as the study area. The pond system studied responds to first order in a simple pumping mode with the pond water levels rising and falling uniformly throughout in response to offshore forcing. At the semidiurnal tidal frequencies, where most of the energy is located, the sea level response factor is 0.18 with a high water phase shift of 2.5 hr. As the frequency of the forcing function decreases the response factor increases and the phase shift decreases until at periods greater than 4-5 days the water level variations in side and outside the pond are identical in phase and amplitude. The hydrodynamic model predictions for M2 tidal forcing, using the simple inlet hydraulics method of representing the system, are in good agreement with data and also compare well to measurements derived from lab experiments on a simple ocean-inlet bay system. While the geomagnetic electrokineograph (GEK) data provided reasonable estimates of the tidal currents in the breachway its low frequency response was particularly poor. The primary source of long term signal drift in GEK systems is that caused by variation of electrode temperature. A second significant drift source is the random variations which occur in the basic electrochemical potentials of the electrodes themselves. A third source is the telluric potentials which occur at both low and high frequencies. In extreme situations, continuous conductivity monitoring may be required. (Baker-IVI)
W86-01338

VARIABILITY OF DISSOLVED REACTIVE PHOSPHATE FLUX RATES IN NEARSHORE ESTUARINE SEDIMENTS: EFFECTS OF GROUNDWATER FLOW,

Harbor Branch Foundation, Inc., Fort Pierce, FL.
C. F. Zimmermann, J. R. Montgomery, and P. R. Carlson.
Estuaries, Vol. 8, No. 2B, 228-236, June, 1985. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Estuarine environment, *Sediments, *Groundwater movement, *Phosphates, Seagrass, Seepage, Interstitial water, Tidal effects, Indian River, Florida.

Factors influencing the spatial and short term temporal variability inherent in seepage meter measurements and how these measurements relate to variations of selected pore water nutrient concentrations were investigated using the Indian River, a narrow estuarine lagoonal system extending approximately 182 km along the east coast of Florida as the study site. How much of the total flux for dissolved reactive phosphate can be attributed to seepage in nearshore estuarine sediments was determined. The extent of short term dilution effects on sediment pore water was measured. In situ samplers and seepage meters located in the grass beds yielded results very different from the control sampler and meter in the nongrass area of the study site. The variation in seepage velocities and DRP flux rates within a small area of nearshore sediment was closely linked with the heterogeneity of the system. Sediment size analysis of cores collected adjacent to the in situ samplers in the seagrass bed indicated the highest percentage of particles to be in the 130 micro-m range. A higher percentage of these particles was present in the area with no seagrass. The study indicates that the continual movement of groundwater from the sediments of nearshore estuarine areas and the inherent variability of the system is an extremely important factor when considering the total flux of nutrients in a specific area. The effect of the tide, in this case, was to alter the hydraulic gradient. The relationship between groundwater seepage velocity and dissolved reactive phosphate flux in nearshore sediments and its dependence on hydrogeological variables is important in determining nutrient flux budgets. The apparent relationship between tidal height and seepage velocities needs more careful examination and may be even more dramatic in areas with greater tidal ranges. (Baker-IVI)
W86-01339

IMPACT OF DISCHARGES FROM SEAFOOD PROCESSING ON SOUTHEASTERN ESTUARIES,

Georgia Univ., Brunswick. Marine Extension Service.
For primary bibliographic entry see Field 5C.
W86-01340

NUTRIENT ENRICHMENT OF ESTUARINE SUBMERSED VASCULAR PLANT COMMUNITIES. 1. ALGAL GROWTH AND EFFECTS ON PRODUCTION OF PLANTS AND ASSOCIATED COMMUNITIES,

Maryland Univ., Cambridge. Horn Point Environmental Labs.
R. R. Twilley, W. M. Kemp, K. W. Staver, J. C. Stevenson, and W. R. Boynton.
Marine Ecology - Progress Series, Vol. 23, p 179-191, 1985. 8 Fig, 3 Tab, 62 Ref. EPA grants R805932020 and X003248010.

Descriptors: *Nutrients, *Estuarine environment, *Ponds, *Algal growth, Fertilization, Water pollution effects, Aquatic plants, Macrophytes, Solar radiation, Phytoplankton, Epiphytes.

Large experimental estuarine ponds were used to investigate the effects of nutrients on submersed vascular plant communities. The possibility that the decline in these plant communities as a result of fertilization can be explained in terms of increases in epiphytic algal and planktonic biomass which decrease the available light to leaves for macrophyte productivity was investigated. Seston and phytoplankton chlorophyll a increased with fertilization, and pronounced algal blooms were evident under high dosage. Of the total seston, phytoplankton exerted the greatest influence on attenuation of photosynthetically active radiation, such that there was insufficient light for submersed vascular plant growth at the sediment surface during blooms. An extensive epiphytic community developed on plants in all nutrient treated ponds at densities similar to those observed in nature on senescent plants. At high nutrient treatments the accumulation of epiphytic material resulted in over 80% attenuation of the incident radiation at the leaf surface. Biomass of submersed macrophytes decreased significantly under high and medium nutrient treatments compared to control and low treatments within 60 days following initial fertilization. Apparent production of vascular plants was reduced at the higher nutrient treatments. Most of this reduction was explained by attenuation of PAR associated with epiphytic material. Without PAR attenuance in the overlying water, observed levels of epiphytic growth would be insufficient to reduce light below compensation levels needed to

sustain vascular plant growth. At the high fertilization rates, integrated primary production of pond communities was significantly reduced with the loss of the vascular plants, even though phytoplankton and epiphytic growth were enhanced. (Baker-IVI)
W86-01351

PARTITIONING AND TRANSPORT OF METALS ACROSS THE O2/H2S INTERFACE IN A PERMANENTLY ANOXIC BASIN: FRAMVAREN FJORD, NORWAY,

Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W86-01396

EFFECTS OF PH AND PLANT SOURCE ON LIGNOCELLULOSE BIODEGRADATION RATES IN TWO WETLAND ECOSYSTEMS, THE OKEFENOKEE SWAMP AND A GEORGIA SALT MARSH,

Georgia Univ., Athens. Dept. of Microbiology.
R. Benner, M. A. Moran, and R. E. Hodson.
Limnology and Oceanography, Vol. 30, No. 3, p 489-499, May, 1985. 4 Fig, 33 Ref. NSF grants OCE81-17834, BSR 81-14823, BSR 82-15587 and NOAA, Office of Sea Grant grant NA 80AA-D00091.

Descriptors: *Georgia, *Okefenokee Swamp, *Sapelo Island, *Salt marshes, *Wetlands, *Hydrogen ion concentration, *Lignocellulose, *Biodegradation, Lignin, Isotope studies, Sediments, Microorganisms.

The microbial mineralization of synthetic C-14 labeled lignin, specifically radiolabeled (C-14 lignin)-lignocellulose and (C-14 polysaccharide)-lignocellulose from a variety of aquatic herbaceous and woody plants was investigated in water and sediment from a salt marsh on Sapelo Island, Georgia, and from the Okefenokee Swamp, an acidic peat-forming freshwater swamp in southern Georgia. Rates of microbial degradation of lignocellulose were depressed in the Okefenokee relative to those in the salt marsh. About 50% of the difference in mineralization rates was attributable to the low ambient pH (3.9) of Okefenokee water relative to the pH of salt marsh water (pH 7.1). Rates of mineralization of the lignin component of lignocellulose were only minimally affected within the range of pH 4-8, whereas mineralization of the polysaccharide component increased severalfold with increasing pH. Differences in the biodegradability of the various lignoceluloses were also observed; lignocelluloses from herbaceous plants were mineralized several times faster than lignocellulose from wood. (Author's abstract)
W86-01413

NITROGENOUS NUTRIENT UPTAKE, PRIMARY PRODUCTION, AND SPECIES COMPOSITION OF PHYTOPLANKTON IN THE CARMANS RIVER ESTUARY, LONG ISLAND, NEW YORK,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
E. J. Carpenter, and S. Dunham.
Limnology and Oceanography, Vol. 30, No. 3, p 513-526, May, 1985. 16 Fig, 3 Tab, 26 Ref. NOAA Office of Marine Pollution Assessment grant NA 80-RAD0062, and NSF grant OCE 82-14764.

Descriptors: *Nitrogen, *Nutrients, *Primary production, *Species composition, *Phytoplankton, *Carmans River Estuary, *Long Island, *New York, *Estuarine environment, Ammonium, Nitrates, Urea, Cycling nutrients, Seasonal variation.

Uptake of NH4(+), NO3(-), and urea was measured at four stations in a small temperate-zone estuary over a 10-month period. Considering all four stations, NO3(-) accounted for 45% of all N taken up, followed by NH4(+) (43%) and urea (12%). Nitrogen uptake was highly temperature-dependent (r = 0.82), and an exponential relationship was apparent. Recycling was very important as a source of nitrogen, and mean NH4(+) pool turnover times were rapid, ranging from 4.3 to 6.8 h in the lower estuary in summer. PN turnover times in the lower estuary were also rapid, averaging 28.8 h in summer and being as short as 3.1 h in July and August. An analysis of N uptake using the relative preference index (RPI) indicated that NH4(+) was the preferred nutrient. However, high NO3(-) concentrations appeared to override the repressive effect of NH4(+) concentrations on nitrate reductase, and NO3(-)uptake was significant even at relatively high NH4(+) concentrations. Urea uptake did not appear to be affected by NH4(+) concentration. (Author's abstract)
W86-01415

DISTRIBUTION AND CHARACTERISTICS OF CARBOXYPEPTIDASE ACTIVITY IN POND, RIVER, AND SEAWATERS, IN THE VICINITY OF TOKYO,

Tokyo Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-01418

DEGRADATION AND MINERALIZATION OF THE POLYCYCLIC AROMATIC HYDROCARBONS ANTHRACENE AND NAPHTHALENE IN INTERTIDAL MARINE SEDIMENTS,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5B.
W86-01481

DISTRIBUTION, ABUNDANCE, AND GROWTH OF JUVENILE DUNGENESS CRABS, CANCER MAGISTER, IN GRAYS HARBOR ESTUARY, WASHINGTON,

Washington Univ., Seattle. School of Fisheries.
B. G. Stevens, and D. A. Armstrong.
Fishery Bulletin, Vol. 82, No. 3, p 469-483, July, 1984. 9 Fig, 6 Tab, 23 Ref. Army Corps of Engineers contracts DACW-67-80-C-0086 and DACW-67-81-M-1096.

Descriptors: *Crabs, *Distribution, *Grays Harbor Estuary, *Washington, Immature growth stages, Migration, Habitats, Estuaries, Growth, Seasonal variation.

Dungeness crabs, Cancer magister, were collected biweekly or monthly from May 1980 to July 1981 in Grays Harbor, Washington. Age of each crab was estimated from width-frequency analyses, and the population density and growth rate were monitored for each age class over the 14-month period. In April 1980 and 1981, crabs entered the estuary either as megalops larvae that metamorphosed to first instar postlarvae or directly as first instars. Intertidal mudflats with beds of eelgrass (Zostera spp.) were important habitats for the first few postlarval stages. Some crabs may have emigrated from the estuary during their second year of life, whereas others dispersed throughout the estuary and appeared to emigrate at sexual maturity (about 2 years). No gravid females were ever found in the bay. Population size was estimated to range from 3.3 million crabs (winter) to 39.0 million crabs (summer); 74% of the summer population were early instars. Growth of early instars was rapid and resulted in a 282-fold increase in dry weight from May to September, but little growth occurred during the remainder of the year. Based on summer population abundance, it is estimated that this estuary could account for a substantial portion of recruitment to the offshore commercial fisheries. (Author's abstract)
W86-01496

MICROBIAL DEGRADATION OF THE LEACHABLE AND LIGNOCELLULOSIC COMPONENTS OF LEAVES AND WOOD FROM RHIZOPHORA MANGLE IN A TROPICAL MANGROVE SWAMP,

Georgia Univ., Athens. Dept. of Microbiology.
R. Benner, and R. E. Hodson.
Marine Ecology - Progress Series, Vol 23, p 221-230, 1985. 6 Fig, 2 Tab, 28 Ref. NSF grant OCE-81117834 and Department of Commerce grant NA 80AA-D-00091.

Descriptors: *Mangroves, *Leaves, *Wood, *Microbial degradation, *Lignocellulose, Swamps, Tropical areas, Carbon radioisotopes, Mineralization, Leachability, Polysaccharides, Detritus, Sediments, Biodegradation.

Preparations of uniformly C-14 labeled mangrove leaves and specifically radiolabeled (C-14 lignin) lignocelluloses and (C-14 polysaccharide) lignocelluloses from mangrove leaves and wood were used in experiments to determine the microbial rates of mineralization of the leachable and lignocellulosic components of mangrove detritus in aerobic and anaerobic sediments of a tropical mangrove swamp. The bulk of the leachable fraction from mangrove leaves was mineralized relatively rapidly and was assimilated into microbial biomass with high efficiency (30%). In contrasts, rates of mineralization of the lignocellulosic component of mangrove leaves and wood were 10-fold lower than mineralization rates or the leachable fraction. The polysaccharide component of the lignocelluloses was mineralized at rates 2 times higher than rates of mineralization of the lignin component, indicating that mangrove detritus becomes relatively enriched in lignin-derived carbon with time. Anaerobic rates of mineralization of the leachable and lignocellulosic components of mangrove leaves and wood were 10 to 30 times lower than respective aerobic mineralization rates, suggesting a very long residence time for mangrove detritus in anaerobic sediments. Comparison of the rates of degradation of mangrove detritus in sediments from a mangrove swamp and a salt marsh demonstrated that the lignocellulolytic potential in sediments of the two marine ecosystems are similar, but that lignocellulose from mangroves is less biodegradable than lignocellulose from the salt-marsh plants, Spartina alterniflora and Juncus roemerianus. (Author's abstract)
W86-01503

SETTING OF THE AMERICAN OYSTER CRASSOSTREA VIRGINICA IN THE JAMES RIVER, VIRGINIA, USA: TEMPORAL AND SPATIAL DISTRIBUTION,

Virginia Inst. of Marine Science, Gloucester Point.
D. S. Haven, and L. W. Fritz.
Marine Biology, Vol. 86, p 271-282, 1985. 7 Fig, 5 Tab, 33 Ref.

Descriptors: *Oysters, *Spatfall, *Temporal distribution, *Spatial distribution, *James River, *Virginia, Larvae, Estuarine environment, Water circulation, Salinity, Stratification, Population dynamics.

Setting of larvae of the oyster Crassostrea virginica was monitored in the James River, Virginia from 1963 to 1980. Setting patterns were similar in two ways to those described prior to 1960 (before the onset of the oyster pathogen Haplosporidium nelsoni (MSX) in Chesapeake Bay): (1) setting intensity (average number of spat per shell) was greater at stations in the lower than upper estuary, and (2) on the average, 60 to 80% of the total annual set at each station occurred during a 6-week period from mid-August through September. However, annual setting intensity from 1963-1980 was lower than previously recorded, and annual sets occurred as a series of discrete pulses rather than continuously throughout the season. Pulses were each approximately 1 to 2 weeks in duration and separated by a period of diminished or no setting. Cross-correlation analysis of annual setting patterns among stations revealed three zones in the James River: the upper estuary and entire southwest side, the lower estuary, and a mid-estuary transition zone. Setting pulses tended to be synchronous at stations within each zone, but occurred 1 to 2 weeks later at stations in downriver than in upriver zones. The location of zones is related to known aspects of water circulation in the James River estuary. Moreover, pulse setting itself may be related to the absence of strong vertical salinity gradients accompanying the fortnightly stratification-destratification process. (Author's abstract)
W86-01504

WATER QUALITY IN AN ESTUARINE ENVIRONMENT: ANNUAL CYCLE OF THE PHYSI-

CAL AND CHEMICAL PARAMETERS OF THE WATER OF THE LOIRE ESTUARY (QUALITE DES EAUX EN MILIEU ESTUARIEN: SUIVI ANNUEL DE CRITERES PHYSIQUES ET CHIMIQUES DANS LES EAUX DE L'ESTUAIRE DE LA LOIRE),

Nantes Univ. (France). Lab. de Biologie Marine.
Y. Rince, J.-F. Guillaud, and B. Gallenne.
Hydrobiologia, Vol. 124, No. 3, p 199-210, May, 1985. 11 Fig, 2 Tab, 30 Ref.

Descriptors: *Estuarine environment, *Water quality, *Loire estuary, *France, River flow, Chemical composition, Nutrients, Dissolved oxygen, Suspended solids, Turbidity, Nitrogen, Phosphorus, Silica.

Chemical composition and physical parameters of waters from the Loire estuary were examined in 1981-1982 in order to assess water quality. It appears that riverflow is of first importance on suspended matter load, dissolved nutrient concentrations and oxygenation. The annual hydrological cycle is made of two periods. During the first one low riverflow, low nutrient concentrations, high suspended matter load and oxygen depletion are noticed. During the second one higher riverflows occur accompanied with increasing nutrient concentrations, decreasing turbidity and restoration of dissolved oxygen. Results indicate that annual inputs of dissolved nutrients attain 60 000 t/a for nitrogen, 2 400 t/a for for phosphorus and 100 000 t/a for silica. It is suggested that the high suspended matter loading (1 million t/a) is a significant factor disturbing oxygenation and by the way limiting water quality within the estuary. (Author's abstract)
W86-01505

ZOOPLANKTON ABUNDANCE DISTRIBUTION, OF A MEDITERRANEAN LAGOON ECOSYSTEM: THE SARRAZINE LAGOON (DISTRIBUTIONS D'ABONDANCES DU ZOOPLANCTON D'UN ECOSYSTEME LAGUNAIRE MEDITERRANEEN: LA LAGUNE DE LA SARRAZINE),

Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
T. L. Hoai, M. Amanieu, and G. Lasserre.
Acta Ecologica, Vol. 5, No. 3, p 301-315, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Lagoons, *Zooplankton, *Abundance distribution, Mediterranean, Ecosystems, Model studies, Coastal lagoons, Distribution.

A survey of zooplankton abundance distributions has been carried out from October 1980 to October 1981 in a lagoon artificially managed for aquaculture on the north-western Mediterranean coast. The water body, supplied with sea-water by pump, is considered as an open ecosystem. This is particularly shown by population profiles close to the ones proposed by the Preston and Mandelbrot models of abundance distribution. The Motomura model prevails whenever the lagoon environment is being subject to more severe conditions or the confinement from the near-by sea is intensifying. The parameters of the models of abundance distribution quoted above have been studied as synthetic descriptors of the organization of existing communities. (Author's abstract)
W86-01511

NOTE ON THE DETERMINATION OF VERTICAL TURBULENT TRANSPORT COEFFICIENTS IN A PARTIALLY MIXED ESTUARY,

Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, D. W. Knight, and K. Shiono.
Proceedings of the Institution of Civil Engineers, Vol. 79, p 235-246, June, 1985. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Turbulence, *Estuaries, Velocity, Salinity, Mixing, Mathematical equations, Vertical transport, Great Ouse estuary, England.

Turbulence measurements of two components of velocity and of salinity have been made in the Great Ouse estuary (England) for partially mixed conditions. The data have been used to investigate the dependence on Richardson number of several coefficients associated with the turbulence closure problem. Empirical equations are presented for the variation of the mixing lengths for momentum and solute with Richardson number for the observed conditions. A limited number of evaluations of the turbulence coefficients associated with the flux terms uw (mean) and sw (mean) gave values which were of the same order as those assumed by other workers for neutrally stable conditions. The field measurement techniques have been shown to be feasible and to yield useful results. More measurements are required over a wider range of conditions in order to substantiate these preliminary findings. (Author's abstract)
W86-01517

DISTRIBUTION AND FLUX OF 226RA AND 228RA IN THE AMAZON RIVER ESTUARY,

Princeton Univ., NJ. Geophysical Fluid Dynamics Program.
R. M. Key, R. F. Stallard, W. S. Moore, and J. L. Sarmiento.
Journal of Geophysical Research, Vol. 90, No. C4, p 6995-7004, July, 1985. 6 Fig, 5 Tab, 32 Ref.

Descriptors: *Radium radioisotopes, *Isotope studies, *Amazon River estuary, *Estuarine environment, Suspended particulates, Mixing, Sediments, Geochemistry, Water chemistry.

Measurements of Ra-226 and Ra-228 in the Amazon River estuary show that desorption from river-borne suspended particulate matter in the estuary increases the riverine flux of both isotopes to the ocean by a factor of approximately 5 over the flux attributable to radium dissolved in the river water alone. The total Amazon flux supplies approximately 0.20% of the Ra-226 and approximately 2.6% of the Ra-228 standing crops in the near-surface Atlantic (0-200 m). Diffusive flux from estuarine and shelf sediments and desorption from resuspended sediments in the region of the estuary approximately double the estuarine Ra-226 concentration and quadruple the estuarine Ra-228 concentration above that caused by the dissolved and desorbed river components alone. (Author's abstract)
W86-01535

EXCHANGE OF WATER IN FJORDS: THE EFFLUX/REFLUX THEORY OF ADVECTIVE REACHES SEPARATED BY MIXING ZONES,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. D. Cokelet, and R. J. Stewart.
Journal of Geophysical Research, Vol. 90, No. C4, p 7287-7306, July, 1985. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Fjords, *Mixing, *Advection, Stratification, Salinity, Saline-freshwater interface, Coastal waters, Path of pollutants.

Many fjords consist of deep, stratified reaches separated by shallower sills above which most of the mixing between water masses occurs. On a long time scale, each reach can be modeled as a steady, two-layer advective flow. These flows intermingle in turbulent mixing zones, where the flow from any incoming layer can be split into two parts: an efflux fraction, which continues on into the next reach, and a reflux fraction, which mixes vertically and recirculates into its original reach. These fractions were defined using conservation of mass, and expressed in terms of the salinities observed in the reaches. The processes of the complex mixing zones need not be considered in detail. These ideas are applicable to complicated branched fjords and linked sequences of reaches. Where more than two reaches meet at a multiple junction the conservation of two tracers (usually fresh water and salt) is insufficient to determine completely the efflux/reflux fractions. We propose an entropy maximization technique to resolve the uncertainty. Long-term pollutant concentrations relate directly to the circulation via the new efflux/reflux formulation. The method demonstrates that refluxing leads to conservative pollutants being broadcast throughout the fjord system with magnified concentrations. A new quantity, the mean tracer age, provides a relevant time scale that includes the effects of recirculation and to which the rates of nonconservative processes should be compared. Conservative pollutants may be retained for a surprisingly long time in a refluxing system. (Author's abstract)
W86-01536

SEDIMENT ACCUMULATION RATES IN IRONDEQUOIT BAY, NEW YORK BASED ON LEAD-210 AND CESIUM-137 GEOCHRONOLOGY,

Geological Survey, San Diego, CA. Water Resources Div.
R. A. Schroeder.
Northeastern Environmental Science, Vol. 4, No. 1, p 23-29, 1985. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Sedimentation, *Irondequoit Bay, *New York, *Lead radioisotopes, *Cesium radioisotopes, Stratigraphy, Particle size, Erosion, Copper, Zinc, Metals, Estuarine environment.

Recent sediment accumulation rates in Irondequoit Bay, determined by the lead-210 and cesium-137 techniques, range from 0.10 to 0.36 grams per square centimeter per year. The lowest rate is in Ides Cove, a small inlet on the west side of the bay. On the basis of these rates, it is presumed that sediment below a depth of about 1 meter was deposited before European colonization of the basin in the early 1800's. Average flux of lead-210 in the core from Ides Cove, calculated from lead-210 inventories in the core, equals the published atmospheric deposition rate (from measurements in New Haven, Connecticut); but, the average flux of lead-210 is two to three times higher in the cores from the central parts of Irondequoit Bay. The higher flux is most likely caused by preferential scavenging (sediment focusing) on fine-grained sediments. However, direct input of lead-210 attached to eroding material in the watershed is possible. Concentrations of lead, copper and zinc in the sediments show a marked increase beginning about 50 years ago. As in many other areas, this increase is most likely caused by human activities. The increment over natural background levels is a factor of about 14 for lead, 5 for copper, and 4 for zinc. These ratios are much larger than in many water bodies because urbanization covers a comparatively large proportion of this watershed. (Author's abstract)
W86-01566

METHOD FOR MEASURING HORIZONTAL TRANSPORT OF ORGANIC CARBON OVER SEDIMENTS,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2H.
W86-01590

SHORT-TERM ENDPRODUCTS OF SULFATE REDUCTION IN A SALT MARSH: FORMATION OF ACID VOLATILE SULFIDES, ELEMENTAL SULFUR, AND PYRITE,

Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
G. M. King, B. L. Howes, and J. W. H. Dacey.
Geochimica et Cosmochimica Acta, Vol. 49, No. 7, p 1561-1566, July, 1985. 4 Fig, 1 Tab, 39 Ref.

Descriptors: *Sulfate reduction, *Salt marshes, Sulfides, Sulfur, Pyrite, Oxygen, Carbon dioxide, Metabolism, Marshes, Dissolved solids, Volatile compounds, Wetlands.

Rates of sulfate reduction, oxygen uptake and carbon dioxide production in sediments from a short Spartina alterniflora zone of Great Sippewissett Marsh were measured simultaneously during late summer. Surface sediments (0-2 cm) were dominated by aerobic metabolism which accounted for about 45% of the total carbon dioxide production over 0-15 cm. Rates of sulfate reduction agreed well with rates of total carbon dioxide production below 2 cm depth indicating that sulfate reduction was the primary pathway for subsurface carbon metabolism. Sulfate reduction rates

were determined using a radiotracer technique coupled with a chromous chloride digestion and carbon disulfide extraction of the sediment to determine the extent of formation of radiolabelled elemental sulfur and pyrite during short-term (48 hr) incubations. In the surface 10 cm of the marsh sediments investigated, about 50% of the reduced radiosulfur was recovered as dissolved or acid volatile sulfides, 37% as carbon disulfide extractable sulfur, and only about 13% was recovered in a fraction operationally defined as pyrite. Correlations between the extent of sulfate depletion in the marsh sediments and the concentrations of dissolved and acid volatile sulfides supported the results of the radiotracer work. The data suggest that sulfides and elemental sulfur may be major short-term end-products of sulfate reduction in salt marshes. (Author's abstract)
W86-01614

DEVELOPMENT OF A TREED BOG ISLAND IN A MINEROTROPHIC FEN,

Northern Forest Research Centre, Edmonton (Alberta).
S. C. Zoltai, and J. D. Johnson.
Canadian Journal of Botany, Vol. 63, No. 6, p 1076-1085, June, 1985. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Bogs, *Fens, *Alberta, Vegetation, Nutrients, Calcium, Magnesium, Sulfur, Peat, Trophic level, Trees, Wetlands, Ecology.

Bogs are acid and extremely low in mineral nutrients, while fens are less acidic and more nutrient rich. The development of a heavily treed bog island situated in a wooded fen was studied. The study site itself is a treed bog island, about 0.5 ha in size, situated some 150 m from the edge of a large, 1.2 km wide fen complex in Alberta. An oligotrophic peat layer exists over a mineral-enriched base on the treed island, which supports a predominantly bog vegetation. Macrofossils indicate that the central part of the island has supported oligotrophic treed bog vegetation almost since the beginning of its formation. Three volcanic ash layers allow the reconstruction of the position of the wetland surface at different times. The treed island was initiated on a slight rise and it was always slightly higher than the surrounding fen, maintaining oligotrophic conditions above the fen level. On the treed island, the peat above the fen level is low in such nutrients as calcium, magnesium, and sulfur, but below the fen level the chemical characteristics of the peat are similar to those of the fen peat. Plant remains indicate that conditions have been relatively stable both on the treed island and in the fen; the only major change has been caused by the lateral expansion of the treed island. (Moore-IVI)
W86-01630

DISPERSAL PATHWAYS FOR PARTICLE-ASSOCIATED POLLUTANTS,

Exxon Production Research Co., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-01677

INVESTIGATION OF A EUTROPHIC TIDAL BASIN: PART 2 - NUTRIENTS AND ENVIRONMENTAL ASPECTS,

Southern Water Authority, Otterbourne (England). Resources Planning Lab.
For primary bibliographic entry see Field 5C.
W86-01789

SULFIDE CONTROL OF CADMIUM AND COPPER CONCENTRATIONS IN ANAEROBIC ESTUARINE SEDIMENTS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-01800

EFFECT OF SEAWATER MAGNESIUM ON NATURAL FLUORESCENCE DURING ESTUARINE MIXING, AND IMPLICATIONS FOR TRACER APPLICATIONS,

North Carolina Univ. at Wilmington. Div. of Chemistry.
J. D. Willey.
Marine Chemistry, Vol. 15, No. 1, p 19-45, 1984. 10 Fig, 7 Tab, 43 Ref.

Descriptors: *Seawater, *Magnesium, *Fluorescence, *Estuarine environment, *Mixing, *Tracers, Environmental tracers, Humic compounds, Fulvic compounds, Metals, Copper, Iron, Calcium, Salinity.

Natural fluorescence, which is thought to result from low molecular weight humic and fulvic compounds, can be used as a tracer to distinguish between individual river waters. Natural fluorescence exhibits conservative mixing with seawater, except for a slight fluorescence increase which is sometimes observed in the low salinity range (0-5%). This increase is not due to the inner filter effect (internal quenching). Laboratory experiments can reproduce this low-salinity natural fluorescence increase. Of the major seawater ions, only magnesium can cause a similar natural fluorescence increase. Variation in sample pH, ionic strength, or particle content cannot explain the natural fluorescence increase, nor does it appear to be related to the estuarine flocculation of humic material. Addition of seawater magnesium to the fluorescent material with subsequent loss of hydrogen ions could enhance fluorescence by adding crosslinking to the structure. Replacement of a fluorescence-depressing metal like copper or iron by magnesium could also enhance fluorescence, essentially by removing the quenching effect of the metal. Experimental data in this study are consistent with both of these possible mechanisms. Calcium also enhances fluorescence, however the effect of seawater calcium during estuarine mixing is not as apparent as the magnesium effect. The implications of this low-salinity natural fluorescence increase with respect to estuarine and coastal tracer applications depend on whether individual rivers mix in the high or low salinity region of an estuary or coastal area. (Author's abstract)
W86-01801

ORGANIC MATTER IN THE VOLGA DELTA AND DELTA FRONT,

All-Union Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
M. P. Maksimova, and M. P. Metreveli.
Water Resources, Vol. 11, No. 4, p 352-360, July-August, 1984. 1 Fig, 2 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 100-109, July-August, 1984.

Descriptors: *Volga Delta, *USSR, *Organic matter, Estuarine environment, Rivers, Chemical compounds, River flow, Seasonal variation, Deltas, Runoff, Caspian Sea.

The concentration and biochemical composition of organic matter in river waters entering the Volga upper delta, delta front, and North Caspian are not identical. The zonal differences are due to the intensity and direction of a number of in situ processes specific for various delta zones. The degree and character of zonal differences of organic matter vary seasonally and also depend on the hydrologic characteristics of the year. Physical processes of erosion of organic matter from soils are most characteristic for the upper zones of the western and eastern parts of the delta, especially in the flood period. Decompositional processes are most pronounced in the lower reach of the delta as a result of a decrease of current speeds. The maximum concentrations of organic matter in delta waters are characteristics for the summer low-flow period; slightly lower concentrations are observed in the fall and the minimum in the winter. In an annual aspect processes leading to enrichment of waters in organic matter dominate in the aggregate of differently directed physical, chemical, and biological processes occurring in the Volga delta and delta front. However, enrichment of river waters of continental runoff inorganic matter in the delta does not lead to an increase of organic runoff to the North Caspian, since a considerable part of the organic matter is deposited in the lower reach. As a result of transformation in the delta, the organic continental runoff undergoes qualitative changes: the organic matter entering the North Caspian is somewhat richer in the nitrogen component compared with the organic matter of waters entering the upper delta. (Baker-IVI)
W86-01810

LAW OF THE COAST IN A CLAMSHELL; PART X: THE NORTH CAROLINA APPROACH,

California Dept. of Justice, San Francisco. Office of the Attorney General.
P. H. F. Graber.
Shore and Beach, Vol. 51, No. 1, p 18-23, January, 1983. 2 Fig, 76 Ref.

Descriptors: *Coastal waters, *Erosion, *North Carolina, *Legal aspects, Public rights, Water rights, Erosion control, Coastal zone management.

In 1978 the North Carolina Coastal Management Program became the South's first federally approved coastal plan, and in 1981 an extensive Beach Access Program was initiated. The coastal lands of the state may be divided into three categories, uplands, tidelands, and submerged lands. In common with most coastal states, North Carolina has adopted a high water legal boundary between uplands and tidelands. In general the state follows the usual rule that both accretion and erosion cause changes in the upand/tideland boundary. Noth Carolina's Supreme Court was one of the earliest tribunals to articulate what is now termed the public trust doctrine. In 1981 North Carolina's legislators created the Coastal Beach Access Program to acquire, improve and maintain property along the Atlantic Ocean for a system of public access to ocean beaches. In addition to the right to natural accretion private littoral owners in North Carolina enjoy a qualified right of access to the adjoining navigable waters. Leasing and regulation of coastal zone lands and waters are briefly discussed. (Baker-IVI)
W86-01833

BASIC PRINCIPLES OF SEDIMENT BUDGET STUDY IN THE COASTAL ZONE,

Odesskii Gosudarstvennyi Univ. (USSR).
Y. D. Shuisky, and M. L. Schwartz.
Shore and Beach, Vol. 51, No. 1, p 34-40, January, 1983. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Coastal waters, *Sedimentation, Erosion, Beaches, Sediment budget, Mathematical equations, Geomorphology.

Methods are presented which make it possible to calculate a sediment budget for the coastal zone of any body of water. For that purpose the coastal zone should be broken down into elementary subsystems (longshore cells). Then one must calculate the numerical values of those budget elements which are identified when compiling the preliminary list of elements. Following this, corresponding elements from each of the subsystems are summed up: erosional with erosional, biogenous with biogenous, fluvial with fluvial, etc. As a result, numerical values of the budget elements for the coast as a whole can be obtained. At the present day stage of coastal geomorphology, numerical data are not available to construct a budget equation for the entire coast of the world. However, it is now possible to develop such a sediment budget for large regions of the better-studied coastal zones. (Baker-IVI)
W86-01834

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,

Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
For primary bibliographic entry see Field 6G.
W86-01835

LAW OF THE COAST IN A CLAMSHELL; PART XV: THE SOUTH CAROLINA APPROACH,

P. H. F. Graber.
Shore and Beach, Vol. 52, No. 2, p 18-25, April, 1984. 1 Fig, 98 Ref.

Descriptors: *Coastal waters, *Legal aspects, *South Carolina, Public access, Public rights, Environmental protection, Public trust doctrine, Coastal zone management.

The South Carolina Coastal Management Program, based on the state's 1977 Coastal Zone Management Act articulates ambitious goals and objectives for this valuable zone which includes a 1,241 mile shoreline. Traditionally South Carolina law has recognized that the legal boundary between private uplands and adjoining sovereign tidal-flowed lands is subject to fluctuation as a result of accretion and erosion, which is consistent with the usual common-law rule. A provision in the state's coastal management law purports to alter that rule with respect to owernship of accreted land. The public trust doctrine has not been clearly and expensively applied by South Carolina courts, but in many cases the courts have indicated that tidal flowed lands are held in trust for the public. South Carolina has historically not encouraged public access to the seashore, nor have the state's courts bolstered coastal access by invoking such legal doctrines as implied dedication and custom, which have been used by other jurisdictions. Private landowners along South Carolina's coast still enjoy many traditional littoral rights, but some constraints recently have been imposed under the state's coastal management law and program. The coastal management program discourages private upland owners from developing and keeping certain types of impoundments, such as wetland areas diked off from adjacent tidal rivers and estuaries. South Carolina's coastal zone leasing activities are relatively limited when compared with those of other states, although there are a number of oyster cultivation and phosphate mining leases. (Baker-IVI)
W86-01836

COMPREHENSIVE STUDY OF THE COAST OF CALIFORNIA,

Army Engineer District, Los Angeles, CA.
D. Muslin.
Shore and Beach, Vol. 52, No.2, p 31-35, April, 1984. 2 Fig.

Descriptors: *Coastal waters, *California, *Environmental protection, Water management, Planning, Sedimentation, Sediment transport, Wind, River flow, Aerial photography, Precipitation, Waves.

Prediction of future changes, whether natural or human-induced, is the ultimate goal of scientific studies. This prediction capability allows planners and engineers to allocate valuable natural resources, such as scenic coastal bluffs and sandy beaches, to uses and functions which will maximize their benefits to society, and minimize the harmful social and environmental effects of such allocations. Due to the concern in recent years of the sometimes slow, but always consistent erosion of the California coastline, research by public agencies, private industry, research corporations, and educational institutions has intensified. Although these efforts contribute greatly to the planning and engineering efforts of local areas or circumscribed regions, comprehensive planning for coastal reaches has seldom taken place. The effect of a coastal development on the upcoast or downcoast shoreline is seldom realized until that effect becomes a problem. Coastal development pressures will continue into the next century and beyond. The inadequacy of our knowledge of why shorelines shift, why harbors shoal, and when lagoons will breach their barriers to the sea must be acknowledged and the need for a comprehensive, all encompassing coastal processes study must be addressed. The Section 208 authority addresses the need to study floods aggravated by or due to wind or tidal effects. The Plan of Study outlines the tasks to be undertaken so the effects of wind and tidal waves can be understood and thus the potential for economic growth and the preservation of scenic and wildlife resources will not be diminished or lost in the future. (Baker-IVI)
W86-01837

LAW OF THE COAST IN A CLAMSHELL; PART XVI: THE MAINE APPROACH,

P. H. F. Graber.
Shore and Beach, Vol. 52, No. 3, p 17-20, July, 1984. 59 Ref.

Descriptors: *Maine, *Coastal waters, *Legal aspects, Environmental protection, Tidal lands, Public access, Public rights, Public trust doctrine.

As a result of Maine's adherence to the colonial ordinance of 1647, the property boundary between public and private lands within the state's coastal zone is generally the low-water line. The littoral owner of the upland parcel prima facie owns the adjoining tidelands. Maine, like Massachusetts, is among the minority of coastal states in which the low water line generally demarcates public and private ownership in tideflowed lands. Presumably, Maine accepts the traditional common law concepts that property boundaries along the coast change when there is accretion or erosion. Compared with many other coastal states, public access to the shoreline is somewhat restricted in Maine because the vast majority of the tidelands are privately held. Private upland owners in Maine are legally presumed to have the right of access to the ocean along their entire frontage. The director of the state Bureau of Public Lands may lease state-owned tide and submerged lands for statutorily designated purposes, including dredging, filling, or other needs. Submerged lands may be leased for aquaculture or scientific research. A number of statutes regulate activities in the coastal zone. (Baker-IVI)
W86-01838

LAW OF THE COAST IN A CLAMSHELL; PART XVII: THE CONNECTICUT APPROACH,

P. H. F. Graber.
Shore and Beach, Vol. 51, No. 4, p 15-18, October, 1984. 56 Ref.

Descriptors: *Connecticut, *Coastal waters, *Legal aspects, Water management, Environmental protection, Water rights, Public access, Public rights, Public trust doctrine, Planning, Beaches.

Under the Connecticut Coastal Management Program, the state's coastal area stretches seaward to the limit of state jurisdiction in Long Island Sound. The program utilizes a two-tier approach. The first extends only a short distance landward from the shoreline, while the second tier is bounded by the inland limits of 36 coastal municipalities. The high water mark divides the private uplands from the public tidelands. The upland owner is in general entitled to the benefit of gradual accretion to his property. The public trust doctrine has been judicially recognized but apparently not widely applied in Connecticut. Instead, the state has relied on its regulatory authority under the police power to protect public rights. Beaches are a limited resource in Connecticut. Most of the uplands adjoining these beaches are owned by private parties or by beach associations that usually restrict access to the water across their uplands to residents or association members. The right of access to adjoining navigable waters is the fundamental littoral right of upland owners in Connecticut. The state commissioner of agriculture may lease certain areas for the purpose of planting and cultivating shellfish. Although some restrictions on the use of tidal lands and waters had been imposed earlier, Connecticut's most sweeping legislation in this field has occurred during the past quarter century. These regulatory programs reach beyond the control of navigation and encompass environmental and other concerns. (Baker-IVI)
W86-01840

TARAVAL VERTICAL SEA WALL,

San Francisco City, CA.
P. D. Berrigan.
Shore and Beach, Vol. 53, No. 1, p 3-7, January, 1985. 9 Fig, 5 Ref.

Descriptors: *Beaches, *Erosion control, *Seawalls, *California, *San Francisco, Ocean Beach, Erosion, Sediment transport.

There is a serious beach erosion problem at Ocean Beach, San Francisco in the reach between Noriega and Santiago Streets. The problem will not be solved by beach nourishment alone, but can be solved by extending the Taraval Sea Wall to Noriega Street. The Taraval Sea Wall was originally built in 1941 to protect the Great Highway along Ocean Beach. The area is now part of the Golden Gate National Recreation Area, and is also the site of the construction of the Westside Transport, a large sewer for wet weather flow. If the National Park Service will not alter its policy of No Structures on Beaches, it should return to the city the needed strip of duneland which the city donated to the Park Service, in order that the City can have and maintain, at reasonable cost, a proper beach and highway and have control of the area where planting and fences for abatement of blowing sand can be constructed and maintained. (Baker-IVI)
W86-01841

LAW OF THE COAST IN A CLAMSHELL; PART XVIII: THE VIRGINIA APPROACH,

P. H. F. Graber.
Shore and Beach, Vol. 53, No.1, p 8-14, January, 1985. 97 Ref.

Descriptors: *Legal aspects, *Virginia, *Coastal waters, Public access, Public rights, Public trust doctrine, Water mangement, Water resources development.

Along Virginia's Atlantic coast, many stretches of the uplands immediately adjoining the shoreline are publicly owned. Under a Virginia statute enacted in 1819, the titles of private landowners of uplands adjoining tidewater were generally extended down to the low water mark. The low water mark as the principal property boundary separating private and public lands, shifts with gradual, imperceptible accretion and erosion. In Virginia, an argument might be made that a provision of the conservation of natural resources, added to the state Constitution in 1971, would support a broader application of this doctrine by the commonwealth's courts. In the 1982 decision involving Hog Island's beaches and marshes the commons concept was favored as a means of protecting public rights. In addition to enjoying the benefit of accretion to their property, private owners of land adjoining tidal waters in Virginia have a number of other rights. The commonwealth's Marine Resources Commission, subject to statutory limitation, is empowered to lease the beds of certain state-owned waters for the prospecting for and removal of oil, gas and other minerals. Coastal zone lands and waters are regulated under three principal statutory schemes: the subaqueous lands management program, the Wetlands Act and the Coastal Primary Sand Dune Protection Act. (Baker-IVI)
W86-01842

INLETS AND BARRIER BEACH DYNAMICS: A CASE STUDY OF SHINNECOCK INLET, NEW YORK,

Patchogue, New York.
J. Kassner, and J. A. Black.
Shore and Beach, Vol. 51, No. 2, p 22-26, April, 1983. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *New York, *Shinnecock Inlet, *Beach stabilization, Inlets, Stabilization, Erosion control, Beach erosion, Groins, Sediment transport.

The history of Shinnecock Inlet, its role in coastal processes and the consequences of efforts to stabilize it are reviewed. The dredging and stabilization of the inlet at Shinnecock appear to be the major factors involved in the accelerated erosion of the barrier beach to the west of the inlet. This erosion was exacerbated by the construction of the mid-beach groin field and the failure to backfill the groins to maintain the longshore transport of sediment. This flaw in implementation then led to the construction of additional groins to the west which merely displaced the problem further west. Ironically it appears that the entire beach stabilization project, begun in 1965, may have been unnecessary. By that time, Shinnecock Inlet had entered Period IV and sediment was being naturally by-

passed to the west. The accelerated erosion of the 1950s was therefore significantly reduced. The construction of the groins to address the initial erosion problem caused by the stabilization of the inlet created several others. The history of Shinnecock Inlet illustrates the need for comprehensive barrier beach planning and management. Finally, it must be realized that there are no shortcuts in beach stabilization. (Baker-IVI)
W86-01843

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

VISCOELASTIC MODEL FOR INITIAL FLUX DECLINE THROUGH REVERSE OSMOSIS MEMBRANE,

Tohoku Univ., Sendai (Japan). Faculty of Engineering.
Y. Kurokawa, M. Kurashige, and N. Yui.
Desalination, Vol. 52, No. 1, p 9-14, December, 1984. 3 Fig, 10 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Model studies, Flow, Membrane processes, Fluctrations.

Asymmetric cellulose acetate reverse osmosis (RO) membranes exhibit a decline in water flux when operated under RO performance. Especially under the high pressure necessary to desalinate seawater, the membrane creeps and compacts. A homogeneous membrane was prepared from a cellulose acetate butylate (CAB) acetone cast solution. Compression test of the membrane was carried out in such a way that the membrane could be inserted and pressurized mechanically between two cylindrical rods by an electric servohydraulic universal testing machine. RO experiment was performed by using a continuous flow type apparatus. The flux decline through a reverse osmosis membrane is described by assuming that the membrane behaves as a viscoelastic body composed of three elements. This model can be used to predict the flux decline with time for the RO membrane. (Baker-IVI)
W86-01367

EFFECTS OF ACCELERATION ON SPIRAL-WOUND MEMBRANE PERFORMANCE IN REVERSE OSMOSIS,

SRI International, Menlo Park, CA. Engineering Sciences Lab.
J. C. Eid, and G. B. Andeen.
Desalination, Vol. 52, No. 1, p 15-24, December, 1984. 6 Fig, 9 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Buoyance, *Acceleration, Membrane processes, Centrifugation.

Buoyance in reverse osmosis has been considered by several investigators as a means of increasing the flow of contaminants from the membrane surface to reduce fouling and concentration polarization. Buoyance effects arise from the presence of enriched, and thus higher density brine near the membrane, and an acceleration field. An acceleration field placed over a density gradient results in a pressure gradient, which - given proper orientation - leads to a flow. By placing the increasing density gradient in a membrane system in the same direction as the vector of positive acceleration, the flow of contaminants from the membrane surface can be increased. Experimental data show that acceleration, applied to spiral-wound reverse osmosis membranes by centrifugation, increases membrane performance. The effects of acceleration on concentration polarization were determined by testing spiral-wound membranes under accelerations up to 500 x g with 0.5% sodium chloride. The data indicate a reduction in salt concentration at the membrane surface from 2.2 to 1.0% from a nonaccelerated state when 500 x g acceleration is applied to a properly oriented membrane. This reduces the osmotic pressures at the membrane and increases permeate recovery by 21%. (Baker-IVI)
W86-01368

INHIBITION OF CALCIUM SULFATE DEPOSITIONS BY A FLUIDIZED BED,

Akzo Chemie Nederland B.V., Deventer.
J. A. M. Meijer.
Desalination, Vol. 52, No. 1, p 25-42, December, 1984. 15 Fig, 15 Ref.

Descriptors: *Scale, *Fluidized beds, *Desalination, *Calcium sulfate, Seawater, Salts, Temperature effects, Evaporators.

To investigate the influence of the fluidized bed on the deposition of calcium sulfate and to determine the top operational temperature, a test unit with four full-size heat exchanger tubes was built. In these tubes the same mean porosities, the same particles, the same liquid velocities and a comparable heat flux were applied as in an actual multistage flash/fluidized bed evaporator design. Since the attention was mainly focused on the formation of calcium sulfate scale in seawater solutions, the experiments were performed with a brine consisting of calcium, sulfate, magnesium, sodium and chloride ions in water in the same ratio as in standard seawater. In these experiments the top temperature was determined as a function of the following parameters: concentration factor of the brine, exclusion or recirculation of seed crystals, degassing or aeration of the brine, and tube diameter and diameter of the fluidized bed glass particles. In addition, the modification of the deposited calcium sulfate crystals forming the scale layer was examined, as well as the habit of the crystals situated either close to the heat transfer surface or at a certain distance from this surface. In all experiments deposition on the tube walls was prevented as long as the hemihydrate solubility line was not exceeded, yielding a practical procedure to assure scale-free operation of a multi-stage flash/fluidized bed evaporator. The scale layers deposited at temperatures above the hemihydrate line consisted initially of stellated conglomerates of hemihydrate crystals, which frequently seemed to be mixed with substantial amounts of gypsum. This initially formed layer was replaced by an anhydrite layer at a rate enhanced by increasing temperatures and decreasing pH values. (Baker-IVI)
W86-01369

FLOCCULATION, PRECIPITATION, SEDIMENTATION AND FLOTATION FOR USE AS PRETREATMENT STAGES FOR BRACKISH WATER AND SEAWATER IN DESALINATION PLANTS,

Hager und Elsaesser G.m.b.H., Stuttgart (Germany, F.R.).
K. Marquardt.
Desalination, Vol. 52, No. 1, p 43-55, December, 1984. 11 Fig, 3 Ref.

Descriptors: *Pretreatment of water, *Desalination, *Flocculation, *Precipitation, *Sedimentation, *Flotation, Water treatment, Water supply development, Brackish water, Seawater.

Groundwater, bank-filtered river water, brackish water and seawater are increasingly being contaminated by high salt contents and organic, colloidal matter. These different types of water can therefore not be fed to a desalination plant without prior pretreatment. Conventional pretreatment methods are characterized by extensive space requirement, excessive building costs and considerable amount of waste water and sludge which is produced. The objectives of this study were to use precipitation and flocculation reactions for removing inorganic and organic matter; to bring about separation of the suspension by using flotation and sedimentation; to apply these processes in compact units to minimize investment costs; and to include sludge treatment in water processing using mechanical techniques of dehydration. (Baker-IVI)
W86-01370

OPTIMIZING DESIGN AND COST OF SEAWATER REVERSE OSMOSIS SYSTEMS,

DHV Consulting Engineers, Amersfoort (Netherlands).
J. C. Van Dijk, P. J. De Moel, and H. A. Van den Berkmortel.
Desalination, Vol. 52, No. 1, p 57-73, December, 1984. 5 Fig, 7 Tab, 3 Ref.

Descriptors: *Desalination, *Resources development, *Saudi Arabia, *Reverse osmosis, *Seawater, Total dissolved solids, Dissolved solids, Costs, Design criteria.

The influence of design parameters, such as raw water temperature and total dissolved solids content (TDS), design pressure, and recovery, on total unit cost for the production of desalinated water from the Arabian Gulf in Saudi Arabia by means of reverse osmosis is presented for plant capacities ranging from 75,000 cu m/d to 700,000 cu m/d. Total unit water cost is significantly influenced by raw water TDS, design pressure and design recovery. Investigation of the feasibility of operation at increased pressure is recommended. Total costs for reverse osmosis desalination are presented also as a function of salinity, with TDS levels ranging from 3000 mg/l to 55,000 mg/l. (Author's abstract)
W86-01371

REHABILITATION OF AN UNECONOMIC MSF PLANT IN THE CANARY ISLAND, SPAIN,

PRODESA, Las Palmas de Gran Canaria (Spain).
J. Guzman.
Desalination, Vol. 52, No. 1, p 75-85, December, 1984. 5 Fig, 3 Tab.

Descriptors: *Desalination, Fuel, Economic aspects, Evaporators, Spain, Fuerteventura I, Heat recovery.

When the Fuerteventura I plant was installed in 1970 in Spain, the price of fuel was about 15 times lower than it is at present. It is currently prohibitive to run the plant under the same conditions. Rehabilitation of the MSF desalination plant producing 2000 cu m/day is described. Waste heat from diesel engine units in operation nearby has been channeled at a reasonable, economically feasible cost, to the local water authority. These waste gases have an average temperature of 400 degrees C. From the total heat energy of the fuel-oil supplied to a diesel engine only about 40% is converted into mechanical energy; the remaining 60% is wasted mainly in the form of heat as escape gases through the chimneys as well as the water cooling cylinders The energy loss of the escape gases could even reach 40% of the fuel-oil total heat energy. Three possible means of using these waste gases were explored: conducting the escape gases of the engines to a common collector and installing a single recovery boiler; removing the partial waste heat recovery boiler and providing each diesel engine chimney with a new total waste heat recovery boiler for the full utilization of exhaust gas energy; and eliminating only some of the existing partial waste heat recovery boilers and substituting new ones capable of total utilization of exhaust gas energy. The adopted solution consisted in replacing partial recovery boilers from Diesel chimney Nos. 1, 3 and 5 by total recovery boilers interconnecting chimneys of diesel 1-2 and 4-5 in order to take advantage of the residual energy when twin engines are working at the same time. Thus it makes no difference which engine is working at any one time, since the escape gases could be conveyed indiscriminately to the new total recovery boiler of either group. (Baker-IVI)
W86-01372

DESALINATION PLANTS WITH A CAPACITY OF MORE THAN 95 CU M/D INSTALLED BY JAPANESE MANUFACTURERS (AS OF JANUARY 1, 1984),

Water Re-Use Promotion Center, Tokyo (Japan).
J. Hori.
Desalination, Vol. 52, No. 1, p 87-93, December, 1984. 4 Tab.

Descriptors: *Desalination, Evaporators, Membrane processes, Water management, Japan.

A summary is given of desalination plants installed by Japanese manufacturers in Japan and overseas. The summary is presented in tabular form. Data is divided into the following categories: desalination plants with a capacity of more than 95 cu m/d installed by Japanese manufacturers as of January 1, 1984; desalination plants with a capacity of more than 95 cu m/day installed in overseas countries; process/feed/use breakdown of desalination plants installed in Japan and overseas by Japanese manufacturers in cu m/day. (Baker-IVI)
W86-01373

ECONOMICS OF MSF PLANTS: INFLUENCE OF VARIATIONS IN THE DESIGN PARAMETERS AND USE OF DIFFERENT CONSTRUCTION MATERIALS,

Italimpianti S.p.A., Genoa.
S. Arazzini, R. Borsani, G. Migliorini, and U. Zuboli.
Desalination, Vol. 52, No. 2, p 97-103, May, 1985.
4 Tab, 3 Ref.

Descriptors: *Desalination, *Economic aspects, *Design criteria, *Multistage flash distillation, Drinking water, Capital costs, Construction costs, Evaporators, Water resources development.

Ways in which MSF (multistage flash distillation) can be modified to meet the market demands of reliability and economics are considered. Three aspects are particularly taken into account: comparison between technological features of the long flow against cross flow MSF type, low cost material adoption possibilities, and comparison of process design parameters of the long flow compared with the cross flow MSF type. A substantial reduction of costs (up to 5%) can be obtained adopting a philosophy on material choice and process design criteria which is fully reliable. This aim can be reached through two different steps. First, choice of process parameters to reduce the dimensions of the MSF evaporator. Second, choice of low cost materials to reduce the unit cost of the MSF evaporator. The annual capital cost is thus reduced lowering the initial capital cost and containing the life of the plant within usual terms. The cost of MSF product water is substantially reduced and can be comparable with the cost of water for other desalting processes. (Baker-IVI)
W86-01668

GAS TURBINE WASTE HEAT UTILIZATION FOR DISTILLATION,

Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
R. Rautenbach, and B. Arzt.
Desalination, Vol. 52, No. 2, p 105-122, May, 1985.
14 Fig, 5 Tab, 5 Ref.

Descriptors: *Desalination apparatus, *Waste heat, *Gas turbines, Distillation, Multiple effect stack process, Multi-stage flash process, Cost analysis, Seawater, Water resources development.

There are many gas turbines in operation in the Near East and along the North African coast which are suitable for use as a heat source for a desalination unit. The turbines operate in places where fresh water is needed and they are located near the sea. The MES (multiple effect stack) process is found to be superior for this use compared to the standard MSF (multi-stage flash) process. The cost of heating steam from a waste heat boiler is compared with the cost of steam from other sources such as solar energy and fuel-fired boilers. A MES unit will produce much more distillate for comparable investment costs or, the investment costs will be considerably lower in the case of equal distillate production. MES is especially suited for low top-brine temperatures. (Moore-IVI)
W86-01669

MECHANICAL VAPOUR COMPRESSION PROCESS APPLIED TO SEAWATER DESALINATION: A 1,500 TON/DAY UNIT INSTALLED IN THE NUCLEAR POWER PLANT OF FLAMANVILLE, FRANCE,

Societe Internationale de Dessalement, Paris (France).
M. Lucas, and B. Tabourier.
Desalination, Vol. 52, No. 2, p 123-133, May, 1985.
3 Fig, 3 Tab.

Descriptors: *Mechanical vapor compression process, *Desalination, *Seawater, Evaporation, Water quality, Costs, Drinking water, Industrial water, Water resources development.

The largest mechanical vapor compression process unit for seawater desalination in the world is a 1,500 cu m/d unit installed in the Nuclear Power Plant of Flammanville in France which supplies a high quality water to that plant. The process used in this skid-mounted package unit is distillation: spray-film evaporation working at low temperature (60 C) by mechanical vapor compression (13 C) and multistage process (4 effects). Advantages include: high energy savings; reliability; low temperature; compactness of package units which reduces the transportation and erection costs; simple seawater intake without particular pretreatment; seawater flow 2 times the production flow; high purity of distillate from any kind of seawater; easy operation and maintenance. Such units may be used to produce drinkable water or high purity process water for industrial needs. (Moore-IVI)
W86-01670

DEVELOPMENTS IN VERTICAL TUBE EVAPOPATION,

Snamprogetti S.p.A., Milan (Italy). Desalination Dept.
M. Bertuzzi, M. Polla, and P. Tiraboschi.
Desalination, Vol. 52, No. 2, p 135-143, May, 1985.
4 Fig, 3 Tab, 3 Ref.

Descriptors: *Desalination, *Water treatment, *Vertical tube evaporation, Thermodynamics, Multistage flash plants, Snamprogetti process, Evaporation, Salinity, Water resources development.

Multiple effect desalination plants using falling film evaporation and vertical arrangement of the effects have proved significantly advantageous thermodynamically because of reduced energy consumption and advantageous due to high operational flexibility and due to ease of erection in restricted areas. The combination of a vertical tube evaporation (VTE) plant with an existing multi-stage flash plant is presented with a view to improving its efficiency and production. The VTE plant based on Snamprogetti technology has proved highly reliable as demonstrated by the data relevant to the desalination plant at a refinery; the first unit has been running since March 1978 with a capacity of 1440 cu m/day with an 86% stream factor chiefly caused by shutdowns that occurred due to refinery requirements. The second unit, with a capacity of 2400 cu m/day has been running since October 1982 with a 99% stream factor. Additional utilization of VTE could make the multiple effect technology even more competitive. Desalination plants could be run at a high concentration factor (C.F. > 2) and VTE could be combined with existing multi-stage flash (MSF) units. Operation at higher concentration factors is becoming important as the salinity of seawater has steadily increased along the Arabian Gulf due to the presence of numerous desalination plants. A case study demonstrated the advantages offered by a combined plant; in the case of separate plants the output is equal to that of a combined plant, but the performance ratio is far lower and corresponds to the mean of the MSF performance ratio (8.0 lb/kBtu) and the VTE performance ratio (5.1 lb/lBtu), that is 6.5 lb/kBtu, as compared to 12.3 lb/kBtu of the combined plant. The problem of revamping an existing MSF plant according to the flow diagram presented, can be easily solved from a practical viewpoint, because the installation of a VTE column requires a restricted area. (Collier-IVI)
W86-01671

SELECTION OF SMALL DESALINATION PLANTS FOR SPECIFIC LOCATIONS - REVERSE OSMOSIS, FLASH DISTILLATION, VAPOUR COMPRESSION,

Wangnick Consulting Engineers, Gnarrenburg (Germany, F.R.).
K. Wangnick.
Desalination, Vol. 52, No. 2, p 145-165, May, 1985.
29 Fig, 2 Tab.

Descriptors: *Desalination, *Reverse osmosis, *Flash distillation, *Vapor compression, Water treatment, Costs, Economic aspects, Thermodynamics, Decision making, Water resources development.

Selection criteria are given for small desalination plants (2000-3000 cu m/d) for specific locations using reverse osmosis (RO), multistage flash distillation (MSF) or mechanical vapor compression (VC) processes. Of prime economic importance to customers, consultants and manufacturers are peripheral location conditions and operating suitability. Choice by the manufacturers is especially complicated due to the fact that the decision for small plants is left to the bidder. However, based on knowledge of local conditions, manufacturers can anticipate costs. Examples given show that under the assumed conditions the MSF process cannot possibly be the most cost-effective. This applies also to RO when the required product is high-purity process water instead of drinking water. For drinking water any choice between MVC and RO is dependent on energy costs and the capitalization factor. (Author's abstract)
W86-01672

ECONOMICS OF SOLAR STILLS,

3 Plastira Street, Pefki 151-21, Athens (Greece)
Tel. 01-8020236.
E. E. Delyannis, and A. Delyannis.
Desalination, Vol. 52, No. 2, p 167-176, May, 1985.
9 Fig, 2 Tab, 13 Ref.

Descriptors: *Desalination, *Economic aspects, *Solar stills, Solar radiation, Energy, Costs, Distillation, Solar distillation, Water treatment, Water resources development.

Since the intensity of solar radiation per unit of evaporating area is determined by nature, the output of a solar distillation unit in a given location can only be increased by increasing the evaporating surface. The productivity of a conventional solar still cannot be more than four to five l/sq m/d for high values of solar radiation. Solar distillation is a free energy operation, however low its efficiency because of low incident radiation. It requires a larger installation area for water production than other conventional desalination processes. Nevertheless it remains the best solution for remote areas and small communities where other water supply systems are not available. Eight solar still designs are illustrated and their physical limitations are discussed. Efficiency of the still plants may be increased by combination with solar collectors, use of available preheated water and by integration with rainwater catchment systems. Solar energy can be converted to thermal, mechanical or electrical energy and then utilized in the solar still process. Solar still efficiency may also be increased by preheating the feed water using condensers inside the solar stills; this method involves additional cost for installation and maintenance and thus may not be justified by the increase in efficiency obtained. It is more economic to install more still units than to attempt to increase the output of a single still by unconventional methods. Distillation with solar energy remains the most favorable process for small capacity water desalting for remote locations where there is considerable solar radiation, but where there are no erection and maintenance facilities or skilled personnel available. In contrast with other desalination processes, in which the cost of energy is very important, if not the major element, solar distillation involves virtually no energy cost. (Collier-IVI)
W86-01673

SEAWATER REVERSE OSMOSIS - AN ECONOMIC ALTERNATIVE TO DISTILLATION,

Du Pont de Nemours International S.A., Geneva (Switzerland).
D. C. Brandt.
Desalination, Vol. 52, No. 2, p 177-186, May, 1985.

5 Fig, 4 Tab, 3 Ref.

Descriptors: *Reverse osmosis, *Desalination, *Distillation, *Multistage flash distillation, Water treatment, Costs, Energy, Environmental effects, Water resources development.

During the last 10 years reversed osmosis (RO) has achieved growing acceptance as an economical and viable alternative to multi-stage flash distillation (MSF) for seawater desalting. The acceptance of this technology is further increasing as a result of plant performance histories and membrane improvements. The abundance of electricity in the Middle East combined with increasing demands for water and restraints on capital spending point to seawater RO as the technology whose time has come. Either alone or in combination with MSF, seawater RO can claim several benefits over MSF: Lower operating costs primarily as the result of energy cost savings. These savings are greater as energy cost increases. Flexibility of operation by the ability to use grid electricity, diversification of plant location and greater load following capability. Replacement of aging MSF plants at minimum capital cost. The ability for power plants to be efficiently designed and operated for power production rather than being controlled by water demands. Combined RO/MSF plants have synergistic benefits through efficiency of plant operation, load following capability, use of excess electricity, product water blending, and lower operating costs than MSF alone. Environmental effects are reduced for a specified quantity of power and water produced due to less fuel burned and warm water discharged to the sea. (Author's abstract)
W86-01674

SEAWATER DESALINATION BY REVERSE OSMOSIS PLANT DESIGN, PERFORMANCE DATA, OPERATION AND MAINTENANCE (TANAJIB, ARABIAN GULF COAST),
Preussag A.G. Bauwesen, Hemmingen (Germany, F.R.). Water Treatment Dept.
W. Heyden.
Desalination, Vol. 52, No. 2, p 187-199, May, 1985. 5 Fig, 5 Tab.

Descriptors: *Desalination, *Reverse osmosis, *Design criteria, *Tanajib, *Saudia Arabia, Water treatment, Seawater, Membrane processes, Water resources development.

A systematic interpretation of critical combinations of feed water, pretreatment and membranes can avoid setbacks in reverse osmosis (RO) processes. RO systems manufacturers will find the right approach if their responsibilities are expanded - beyond just design, construction, installation and commissioning - to an overall responsibility including operation and maintenance. In 1982/83 an oil company ordered a temporary RO seawater desalination plant for Tanajib, on the Arabian Gulf Coast of Saudi Arabia, with a total net capacity of 600,000 gpd. The orders were placed on a turnkey basis including operation and maintenance. The highlights of the RO seawater desalination plant are: shallow beach wells, ultrafiltration, vacuum deaeration, high-pressure multi-stage centrifugal pumps with an energy recovery turbine, single stage reverse osmosis and free programmable logic and process controller. During more than one and a half years of operation, product quantity and quality has always met the design specification. The excellent experience so far with the first temporary Tanajib reverse osmosis seawater desalination plant permit the conclusion that RO technology can avoid setbacks and may face distillation processes competition with confidence. (Author's abstract)
W86-01675

LOW-TEMPERATURE VAPOUR COMPRESSION AND MULTI-EFFECT DISTILLATION OF SEAWATER. EFFECTS OF DESIGN ON OPERATION AND ECONOMICS,
Israel Desalination Engineering Ltd., Tel-Aviv.
R. Matz, and Z. Zimerman.
Desalination, Vol. 52, No. 2, p 201-216, May, 1985. 11 Fig, 3 Tab.

Descriptors: *Distillation, *Vapor compression, *Seawater, *Design criteria, *Economic aspects, Water treatment, Water temperature, Low temperatures, Water resources development.

The design and operating factors are analyzed which lead to the great stability of operation and reliability of low-temperature horizontal tube vapor compression and multi-effect plants. These factors are stated, discussed, and an attempt is made to assess their relative contribution to process economics. Recent reports on the state of the art of desalination technology have indicated the leading position of both low-temperature vapor compression and horizontal tube multi-effect distillation, on technical and economic grounds, for both single- and dual-purpose plants. The practical experience of on-site performance of such has demonstrated the remarkable stability, flexibility and reliability of these processes in comparison with others. The basic concept of low-temperature operation (50-70 C) leads to a chain of interrelated consequences which have a profound effect on the design, economics, operation and maintenance of such plants, some of which can be evaluated in terms of plant and process economics. (Author's abstract)
W86-01676

3B. Water Yield Improvement

AGRICULTURAL BENEFITS FOR SENEGAL RIVER BASIN,
Army Engineer Battalion (79th), APO New York 09360. Company B.
G. L. Hargreaves, G. H. Hargreaves, and J. P. Riley.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 113-124, June, 1985. 4 Tab, 6 Ref, 1 Append.

Descriptors: *Senegal River Basin, *Mauritania, *Mali, *Water resources development, *Agriculture, Economic aspects, Costs, Crops, Computer programs, Irrigation, Water requirements.

A multipurpose water resource development project is proposed for construction and development in the Senegal River Basin. The plans include the irrigation of an area of 274,805 ha by the year 2030 in three countries: Senegal, Mauritania, and Mali. Agricultural benefits were estimated and analyzed by means of a computer program. The factors influencing crop yields were analyzed and summarized including crop selection, water, fertility, and management. Some of the considerations that will produce higher crop yields in future years are presented. It is proposed that the irrigation project management should be responsible for calculating crop water requirements and insuring acceptable irrigation efficiencies. A method is presented for estimating crop water requirements from maximum and minimum air temperatures. The desirability of using irrigation supplemental to rainfall for maximizing benefits from limited water is presented. The maximum contribution of a unit of irrigation water to yield is possible during the rainy season. Projected revenues and costs and years required for each crop to become economically profitable are presented in tables. (Author's abstract)
W86-01432

ECONOMICS OF MSF PLANTS: INFLUENCE OF VARIATIONS IN THE DESIGN PARAMETERS AND USE OF DIFFERENT CONSTRUCTION MATERIALS,
Italimpianti S.p.A., Genoa.
For primary bibliographic entry see Field 3A.
W86-01668

GAS TURBINE WASTE HEAT UTILIZATION FOR DISTILLATION,
Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik.
For primary bibliographic entry see Field 3A.
W86-01669

MECHANICAL VAPOUR COMPRESSION PROCESS APPLIED TO SEAWATER DESALINATION: A 1,500 TON/DAY UNIT INSTALLED IN THE NUCLEAR POWER PLANT OF FLAMANVILLE, FRANCE,
Societe Internationale de Dessalement, Paris (France).
For primary bibliographic entry see Field 3A.
W86-01670

DEVELOPMENTS IN VERTICAL TUBE EVAPORATION,
Snamprogetti S.p.A., Milan (Italy). Desalination Dept.
For primary bibliographic entry see Field 3A.
W86-01671

SELECTION OF SMALL DESALINATION PLANTS FOR SPECIFIC LOCATIONS - REVERSE OSMOSIS, FLASH DISTILLATION, VAPOUR COMPRESSION,
Wangnick Consulting Engineers, Gnarrenburg (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W86-01672

ECONOMICS OF SOLAR STILLS,
3 Plastira Street, Pefki 151-21, Athens (Greece) Tel. 01-8020236.
For primary bibliographic entry see Field 3A.
W86-01673

SEAWATER REVERSE OSMOSIS - AN ECONOMIC ALTERNATIVE TO DISTILLATION,
Du Pont de Nemours International S.A., Geneva (Switzerland).
For primary bibliographic entry see Field 3A.
W86-01674

SEAWATER DESALINATION BY REVERSE OSMOSIS PLANT DESIGN, PERFORMANCE DATA, OPERATION AND MAINTENANCE (TANAJIB, ARABIAN GULF COAST),
Preussag A.G. Bauwesen, Hemmingen (Germany, F.R.). Water Treatment Dept.
For primary bibliographic entry see Field 3A.
W86-01675

LOW-TEMPERATURE VAPOUR COMPRESSION AND MULTI-EFFECT DISTILLATION OF SEAWATER. EFFECTS OF DESIGN ON OPERATION AND ECONOMICS,
Israel Desalination Engineering Ltd., Tel-Aviv.
For primary bibliographic entry see Field 3A.
W86-01676

CURRENT STATUS OF DENVER'S POTABLE WATER REUSE PROJECT,
Denver Water Dept., CO.
W. C. Lauer, S. E. Rogers, and J. M. Ray.
Journal of American Water Works Association, Vol. 77, No. 7, p 52-59, July, 1985. 6 Fig, 7 Tab, 5 Ref. U.S. EPA contract CS-806821.

Descriptors: *Denver, *Colorado, *Water reuse, Water supply development, Water treatment, Municipal water, Potable water, Drinking water.

The feasibility of directly treating processed wastewater plant effluent to potable quality is being tested in Denver, Colo., with a full-scale, 1-mgd (3.8-ML/d) demonstration plant. The complexity of putting the system into operation and the results to date are described, along with an outline of the plans for health effects research, economic studies, and programs to gain public acceptance of direct reuse. This project is expected to provide the information necessary to evaluate the feasibility of direct reuse, especially for cities located in water-scarce areas where development of more conventional water resources is becoming increasingly costly, both in terms of the environment and in capital investments. (Author's abstract)
W86-01742

WATER REUSE IN CALIFORNIA,
California Dept. of Health Services, Berkeley.
J. Crook.
Journal of American Water Works Association, Vol. 77, No. 7, p 60-71, July, 1985. 4 Tab, 43 Ref.

Descriptors: *Water reuse, *California, *Water treatment, *Irrigation practices, Groundwater recharge, Water quality, Public health, Water resources development.

Advances in wastewater treatment technology and reliability allow the safe reuse of effluent for several purposes when reasonable precautions are taken. A 1984 survey in California indicates that approximately 220,000 acre-ft (272 million cu m) of wastewater is reclaimed in the state by 240 wastewater plants that supply reclaimed water to more than 380 use areas. Irrigation accounts for approximately 80% of the total quantity of wastewater reclaimed in the state. Well over half of the reused wastewater in the state is for the irrigation of fodder, fiber, and seed crops and for the surface irrigation of orchards and vineyards - uses that do not require a high degree of wastewater treatment. The Department of Health Services has established statewide wastewater reclamation criteria for various uses, based on the degree of human exposure to pathogens and other contaminants that could be present in treated wastewater. For most uses of reclaimed water, biological agents pose a greater health risk than chemical contaminants and quality standards are properly directed at these agents. The chemical constituents are a major concern when reclaimed water is used for indirect potable reuse via groundwater recharge and could also be a concern when reclaimed water is used for crop irrigation. The degree of contact between irrigation water and the edible tissues of a crop - as influenced by the irrigation method practiced - will modify the type of treatment required for reclaimed water before its agricultural use does not pose a health threat. California regulations specify wastewater reuse standards for irrigation, impoundments and groundwater recharge and include water quality standards, treatment process requirements, sampling and analysis requirements, operational requirements, and treatment reliability requirements. (Collier-IVI)
W86-01743

OBTAINING PUBLIC SUPPORT FOR REUSE WATER,
California Univ., Berkeley. Dept. of Social Administrative Health Services.
W. H. Bruvold.
Journal of American Water Works Association, p 72-77, July, 1985. 4 Tab, 10 Ref.

Descriptors: *Water reuse, *Public opinion, *Surveys, Attitudes, Public relations, Water resource development, Potable water, Irrigation water, Drinking water.

Nine public opinion surveys taken during the past 13 years have shown remarkably similar attitudes towards the use of reclamined wastewater for drinking and nonpotable purposes. The number of respondents who were negative, opposed, or unfavorably disposed toward the concept ranged from 45 to 60% for most studies; six of nine studies showed a majority were opposed to the use of reclaimed wastewater for drinking. Thirty to 50% of the respondents were positive or not opposed, with more favorable results associated with a positive bias in question phrasing. Although people are generally opposed to the use of reclaimed wastewater for drinking, there is a sizable minority who are not opposed, and thus there may be uses of reclaimed wastewater for purposes other than drinking that are much more acceptable to the general public. People having the most favorable attitude toward using reclaimed wastewater for drinking would believe that their water supply was already polluted, that there was a water shortage in their area, that technology for effectively treating wastewater exists, that health risks involved in high-contact uses of reclaimed water are not substantial, that economic benefits would accrue to the community that uses reclaimed water, and that public opinion favors the use of reclaimed water. Older, less well-educated people would have more negative attitudes, not because they are older and less well educated, but because they do not believe in water purification technology and because they do not believe a water supply shortage exists in their community; the opposite would be true of younger, better educated people. The survey research provides a basis for recommending the content of persuasive communications constituting an educational campaign. (Collier-IVI)
W86-01744

3D. Conservation In Domestic and Municipal Use

RECLAIMING DESERT LANDS THROUGH WATER REUSE,
Goff Consulting and Engineering Corp., Chandler, AZ.
For primary bibliographic entry see Field 5D.
W86-01746

CONSERVATION USING A RATE OF RETURN DECISION RULE: SOME EXAMPLES FROM CALIFORNIA MUNICIPAL WATER DEPARTMENTS,
California Univ., Santa Barbara. Dept. of Economics.
L. J. Mercer, and W. D. Morgan.
Water Resources Research, Vol. 21, No. 7, p 927-933, July, 1985. 5 Tab, 9 Ref. Bureau of Reclamation grant 14-34-0001-0477.

Descriptors: *Water conservation, *Rate of return, *Pricing, *California, Municipal water, Utilities, Simulation, Economic aspects.

A significant alternative to physical rationing of water to achieve conservation is provided by the price system. To act like profit maximizing firms, municipal water utilities (MWD's) should price their water so as to earn the opportunity cost of capital (the market rate of return) on the assets. The actual internal rate of return is calculated for a sample of 30 California MWD's for a 12-year period. For the 26 MWD's with a rate of return less than 10%, iterative simulations are run with increases in the MWD's average price to achieve the target rate of return. The magnitude of water conservation using the rate of return rule is reported for three alternative price elasticities of demand. The new implicit prices necessary to achieve the target rate of return are shown to be less than the cost of the cheapest new surface supply. (Author's abstract)
W86-01763

3F. Conservation In Agriculture

SALINE GROUNDWATER MANAGEMENT AND OPTIMAL CROPPING PATTERN,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 4B.
W86-01380

IRRIGATION SCHEDULING USING CROP INDICATORS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 7B.
W86-01433

FURROW IRRIGATION SIMULATION TIME REDUCTION,
California Univ., Davis. Dept. of Agricultural Engineering.
M. Rayej, and W. W. Wallender.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 134-146, June, 1985. 6 Fig, 15 Ref.

Descriptors: *Furrow irrigation, *Irrigation practices, *Computer models, Model studies, Moving boundary method, Infiltration.

Temporal and spatial changes in the flow profile decrease with time under furrow irrigation, and these slow changes suggest modifications in the simulation methods. Geometrically increasing time steps and node deletion at the upstream boundary are introduced and evaluated for accuracy and CPU time reduction. Increasing the time steps reduced CPU time without sacrificing accuracy significantly in predicting advance. The geometric progression factor is estimated automatically from the first two advance increments, thus incorporating site-specific flow and infiltration characteristics. The moving left boundary method is slightly more accurate, but is less cost-efficient than the varying time-step modification for the example conditions. However, special infiltration conditions may favor the latter method. (Author's abstract)
W86-01434

EFFICIENT WATER USE IN RUN-OF-THE-RIVER IRRIGATION,
Central Luzon State Univ., Munoz (Philippines). Dept. of Agricultural Engineering.
H. L. Angeles, and R. W. Hill.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 147-159, June, 1985. 3 Fig, 5 Tab, 10 Ref, 1 Append.

Descriptors: *Irrigation practices, *Water use efficiency, *Philippines, Hydrographs, Model studies, Soybeans, Rice, Drainage, Costs, Seasonal variation.

Irrigation water demand, crop yield and water allocation models were developed and applied to a Philippine run-of-the-river irrigation project. Dry season water supply hydrographs were classified into four levels of availability from high (I) to low (IV). These levels were correlated with the October stream flow volume to provide a prediction of dry season supply. Project net annual benefits could be increased for all four season water supply hydrograph levels by growing an upland crop (soybean) and rice, instead of only rice, providing that costs were less than $90/ha for additional drainage facilities. Net benefits for all rice were greater for reduced area planted, but fully irrigated when the available dry season water supply was lower than average as compared to planting the total area with inadequate irrigation. The irrigation system water demand model was calibrated to match actual diversions for the 1977-78 dry season. The project irrigation efficiency, combined effects of conveyance and application, was determined to be 41%. Thus, a savings in available water supply could be realized by increased system efficiency both from physical modifications as well as from improved management. (Author's abstract)
W86-01435

REUSE SYSTEM DESIGN FOR BORDER IRRIGATION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
M. Yitayew, and D. D. Fangmeier.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 160-174, June, 1985. 4 Fig, 5 Tab, 17 Ref, 1 Append.

Descriptors: *Water reuse, *Border irrigation, *Irrigation practices, Design criteria, Model studies, Runoff.

Significant and rapid improvement in surface irrigation systems is needed to minimize critical water shortages. There is a great potential for improving surface irrigation systems without affecting the farmer's application method; this can be done with reuse systems. The primary purpose of a reuse system is to collect irrigation runoff water and control it for furthur use. The system requires a sump or reservoir to collect and store the water, pump facilities for pumping it back, and a pipeline or canal for conveying water back to the irrigation system. A procedure is presented for designing a system to reuse runoff from free outflow irrigation borders. Runoff volumes are obtained using four dimensionless variables and runoff curves developed with a zero-inertia mathematical model. The equations make use of runoff curves previously developed to give the components of the reuse system, mainly the sump and pump sizes. Use of

the ultimate post irrigation subsurface water profile was made to get the time of runoff without the need for different design curves. An example of the design procedure includes different modes of reuse system operation. (Collier-IVI)
W86-01436

VOLUMETRIC PRICING OF AGRICULTURAL WATER SUPPLIES: A CASE STUDY,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6C.
W86-01766

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SOUTHLAND FLOOD OF JANUARY 1984,
Southland Catchment Board, Invercargill (New Zealand).
For primary bibliographic entry see Field 2E.
W86-01388

IMPACT OF RIVER CHANNELIZATION; II. CHANNELIZATION: SOME ENGINEERING ASPECTS,
North West Water Authority, Warrington (England). Rivers Div.
D. L. Hockin.
Geographical Journal, Vol. 151, No. 1, p 54-57, March, 1985.

Descriptors: *Channeling, *Land development, *Flood control, Environmental effects, Design criteria, Drainage, Hydraulic design.

One reason for channelization is to control urban flooding. Land developers have noticed that the floodplain area along a river frequently offers flat land for easy industrial, residential and recreational development, ignoring the fact that this same land is subject to floods during major storms. Other problems which require attention to proper channelization arise from the need to provide improved drainage of agricultural land, and taking care that mining subsidence does not adversely affect natural drainage. Factors which influence channel design and are considered here include hydraulic parameters, the standard of protection that is adopted, adjoining land use, ground conditions, maintenance requirements for channel works, and environmental and amenity aspects. Two of the most frequent criticisms of the engineer's channelization work are indiscriminate removal of trees and vegetative cover from the banks of watercourses and excessive straightening. (Baker-IVI)
W86-01402

IMPACT OF RIVER CHANNELIZATION; III. DOWNSTREAM MORPHOLOGICAL CONSEQUENCES OF RIVER CHANNELIZATION IN ENGLAND AND WALES,
Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
A. Brookes.
Geographical Journal, Vol. 151, No. 1, p 57-62, March, 1985. 3 Fig, 11 Ref.

Descriptors: *Channeling, *England, *Wales, *Environmental effects, *Channelization, Water resources development, Land use, Erosion control, Rivers, Construction, Stream morphology.

Recent field investigations of the downstream morphological consequences of river channelization at a total of 57 water authority sites were reviewed. This research indicates that the downstream consequences can be divided into those effects associated with construction, and characterized by the release of excess amounts of sediment, and those which occur during the years following completion of a scheme in response to changes in the frequency and magnitude of discharges. The majority of sites studied in high energy environments in England and Wales underwent some form of erosive adjustment in the downstream reach in the long term and it is proposed that the increased flows generated by each scheme were sufficient to exceed a threshold required for erosion. Channel enlargement varied spatially, declining with distance away from each channelization scheme. A further type of channel change observed was the accentuated erosion of the outside of bends, but without the associated point bar deposition characteristic of natural landform changes. The majority of sites studied in low energy environments in lowland Britain had not undergone downstream channel change. Analyses of the amount of change produces relationships which can be useful in indicating the amount of adjustment likely in specific situations. (Baker-IVI)
W86-01403

IMPACT OF RIVER CHANNELIZATION; IV. THE ECOLOGICAL EFFECTS OF CHANNELIZATION,
Welsh Water Authority, Nelson. South East District.
For primary bibliographic entry see Field 6G.
W86-01404

RIVER RECESSION ANALYSIS IN THE OPERATIONAL MANAGEMENT OF LAKE ABSTRACTION,
For primary bibliographic entry see Field 2E.
W86-01522

4B. Groundwater Management

GROUNDWATER IN WATER RESOURCES PLANNING: CONJUNCTIVE USE,
Universidad Politecnica de Valencia (Spain).
A. Sahuquillo.
Water International, Vol. 10, No. 2, p 57-63, June, 1985. 25 Ref.

Descriptors: *Groundwater, *Water supply development, *Conjunctive use, Planning, Water management, Water storage, Drought, Water supply.

Growing water needs, the constraints caused by water pollution and the cost of water development projects, including the cost of responding to social and environmental concerns, are increasing dramatically. It has become imperative to take into consideration all water sources and facilities in order to satisfy present and future water demands. Although groundwater has very often been overlooked by planning specialists, it can offer technical and economic advantages worthy of consideration. Groundwater can provide additional resources as well as the means for water storage, distribution and treatment, which can be combined advantageously with surface water resources. Likewise, groundwater can provide other advantages such as its adaptability to a progressive increase in the demand for water, the possibility of temporary overexploitation as a means to defer costly construction projects, mitigate the effects of droughts and alleviate drainage problems. (Baker-IVI)
W86-01375

SALINE GROUNDWATER MANAGEMENT AND OPTIMAL CROPPING PATTERN,
Punjab Agricultural Univ., Ludhiana (India).
M. P. Kaushal, S. D. Khepar, and S. N. Panda.
Water International, Vol. 10, No. 2, p 86-91, June, 1985. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Irrigation water, *Groundwater management, *Saline waters, *Cropping patterns, Conjunctive use, Water resources, Water quality, Water supply development, Model studies.

A decision model has been developed for optimal cropping pattern based on both leaching requirements and salinity response functions. This model, a deterministic linear programming model, represents the real world situation prevailing in different regions of the world. The model has been applied to the command area of a minor canal to solve a real world problem. The design discharge of the minor canal is 59 liters/s. The culturable command area is 28 ha. The full supply days in winter season and monsoon season are 131 and 146, respectively. The command area is irrigated by canal and groundwater. In order to find the optimal cropping pattern and optimal canal and saline groundwater mix, the possibility of increasing available water by mixing canal and saline groundwater in suitable proportion was examined. The model effectively adjusted the cropping pattern according to the availability of irrigation water as one would expect in the real world situation. Top priority should be accorded to irrigation extension activities to encourage conjunctive surface water-groundwater use. The optimal mixing of surface water and poor quality groundwater is essential for maximizing the returns and to ensure optimum soil conditions for plant growth. (Baker-IVI)
W86-01380

DIFFERENCES IN ANNUAL EVAPORATION BETWEEN GRAZED PASTURE AND EUCALYPTUS SPECIES IN PLANTATIONS ON A SALINE FARM CATCHMENT,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2D.
W86-01473

GROUNDWATER AT HOME AND ABROAD,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-01524

EFFECT OF INCOMPLETE RECOVERY PRIOR TO A PUMP TEST IN A LARGE-DIAMETER WELL,
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 2F.
W86-01664

CAN WE SAVE THE OGALLALA,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
R. M. Sweazy.
Civil Engineering, Vol. 55, No. 8, p 36-39, August, 1985. 3 Fig.

Descriptors: *Ogallala Aquifer, *High Plains, *Texas, *Groundwater management, Artificial recharge, Water conservation, Water reuse, Desalination, Weather modification, Aquifers.

Management of the Ogallala aquifer has been widely criticized, but half truths and misinterpretations abound. Water conservation on the High Plains takes many forms. Crops have been genetically manipulated to increase their tolerance to drought. Irrigation practices have been modified on farms, city parks and lawns, moisture detecting devices determine when to irrigate and how much water to apply. Reclaimed municipal waste water has been used for almost 50 years for irrigation and industrial cooling. Surface drainage on the High Plains of Texas tends to be to playa lakes, shallow basins several hundred feet across that occur naturally about one per square mile. A combination of current and future conservation practices, reuse of water, recharge and secondary recovery could well render the Ogallala a quasi-stable aquifer in the next century. All this depends on more research. Areas to be investigated are the cost of desalination, which could provide a valuable source of water supply, and weather modification. (Baker-IVI)
W86-01737

COMPONENTS OF FLOW RESULTING FROM ABSTRACTION IN A TWO-LAYERED CONFINED AQUIFER WITH NO CROSS FLOW,
Institute of Hydrology, Wallingford (England).

For primary bibliographic entry see Field 2F.
W86-01770

4C. Effects On Water Of Man's Non-Water Activities

LONG-TERM STREAMFLOW OBSERVATIONS IN RELATION TO BASIN DEVELOPMENT,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
M. Owe.
Journal of Hydrology, Vol. 78, No. 3/4, p 243-260, June, 1985. 11 Fig, 1 Tab, 29 Ref.

Descriptors: *Streamflow, *Land use, *Watersheds, Forests, Urban areas, Cultivated lands, Grasslands, Suburban areas, Overland flow, Evapotranspiration, Chester Creek basin, Pennsylvania.

Watersheds located in rapidly developing areas undergo complex land-use transitions in relation to the more unidirectional trends generally displayed in more rural areas. The Chester Creek basin, located in southeastern Pennsylvania is representative of developing areas in the Northeast. Streamflow estimated by the Thornthwaite Water Balance Method was used as an unbiased control to demonstrate an increase in actual runoff during the 51-yr. period of record. Relationships between streamflow and the historical trends of five land cover classes, forest, urban, residential, cultivated crop land and open grass were investigated. While urban and residential areas experienced an increase, crop lands steadily decreased. Forested areas initially decreased, then increased, while open areas first increased then decreased rapidly. The net effect on the basin has been an increase in overland flow and a decrease in evapotranspiration. Annual, growing and dormant season streamflow were found to have increased 51, 57 and 46% respectively. Evidence suggests that these increases are the direct result of changes in the surface character of the basin. (Author's abstract)
W86-01472

WATER QUALITY EFFECTS OF PINE FLATWOODS SILVICULTURE,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
H. Riekerk.
Journal of Soil and Water Conservation, Vol. 40, No. 3, p 306-309, May-June, 1985. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Water quality, *Pine trees, *Forest management, Florida, Cutting management, Forest watersheds, Hydrogen ion concentration, Suspended sediments, Calcium, Potassium, Nonpoint pollution sources.

Three watersheds in the poorly drained pine flatwoods region of north central Florida were monitored for 6 years. Three silvicultural treatments were imposed during the second year; harvest with minimum disturbance and site preparation, harvest with maximum disturbance and site preparation, and an undisturbed control. The minimum treatment included manual shortwood harvesting, slash chopping, soil bedding, and machined planting. The maximum treatment included machine tree-length harvesting, slash burning, windrowing, soil bedding, and machine planting. There were small but significant increases in pH, suspended sediment, Ca, and K, proportional to the degree of disturbance during the treatment year. Only K and Ca levels remained significant during the first post-treatment year. Minimum-disturbance practices with protective stream management zones will minimize nonpoint-source pollution. (Author's abstract)
W86-01494

WATERSHED PROTECTION STRATEGIES FOR THE SCITUATE RESERVOIR,
Rhode Island Dept. of Environmental Management, Providence. Office of Environmental Coordination.
L. B. Joubert.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 136-156, June, 1985. 8 Ref.

Descriptors: *Scituate Reservoir, *Rhode Island, *Watershed protection, *Water quality control, Water quality, Drinking water, Water resources development, Non-point pollution sources, Land use, Hazarous materials spills.

The Scituate Reservoir is the sole source of water for the City of Providence and the surrounding metropolitan area. The watershed is predominantly rural in character but it is certainly not isolated. The current study confirmed the excellence of the water quality in the Reservoir. Watershed management and emergency spill response has been effective in maintaining water quality. Contaminants that do find their way into the reservoir from nonpoint sources and spills have been assimilated and diluted within the system with little effect. Future water quality is subject to increasing traffic volumes and growth pressures - factors over which there is presently little control. Objectives of proposed actions are to improve highway safety and drainge, reduce the amount of hazardous materials transported across the watershed, promote more efficient spill response, and control non-point source discharges through land use management. (Baker-IVI)
W86-01752

GLOBAL STATUS AND TREND OF DESERTIFICATION,
United Nations Environment Programme, Nairobi (Kenya). Desertification Branch.
For primary bibliographic entry see Field 2B.
W86-01855

WATER QUALITY OF A SMALL URBAN CATCHMENT NEAR DURBAN, SOUTH AFRICA,
Durban-Westville Univ. (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W86-01861

4D. Watershed Protection

LIMITS ON THE USEFULNESS OF EROSION-HAZARD RATINGS: EXPERIENCES IN NORTHWESTERN CALIFORNIA,
Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. M. Rice, and P. D. Gradek.
Canadian Journal of Forest Research, Vol. 14, No. 4, p 559-564, August, 1984. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Erosion-hazard ratings, *Logging, *California, Forest management, Soil erosion, Erosion control, Yarding, Prediction.

Although erosion-hazard ratings are often used to guide forest practices, those used in California from 1974-1982 have been inadequate for estimating erosion potential. To improve the erosion-hazard rating procedure, separate estimating equations were used for different situations. The ratings were partitioned according to yarding method, erosional process, and both yarding method and erosional process. Partitioning by yarding method resulted in a slight improvement in the precision of erosion estimates. The other two methods resulted in fourfold increases in prediction errors. Results indicate that a single unified erosion-hazard rating procedure is the most practical way of predicting logging-related erosion in northwestern California. (Author's abstract)
W86-01783

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

SPECIES DIVERSITY OF ALGAL FLORA IN VISHWAMITRI RIVER, BARODA (INDIA),
S.S.V.P. Santha's Science Coll., Dhule (India). P.G. Dept. of Botany.
S. N. Nandan, and R. J. Patel.
Polskie Archiwum Hydrobiologii, Vol. 32, No. 1, p 1-6, 1985. 4 Tab, 12 Ref.

Descriptors: *Species diversity, *Algae, *Vishwamitri River, *Baroda, *India, Physico-chemical characteristics, Water pollution, Bioindicators, Indicators, Chemical oxygen demand, Carbonates, Alkalinity, Nitrates, Phosphates, Calcium, Total solids, Water pollution effects.

Shannon's diversity index was studied to analyze the structure of the algal community in the Vishwamitri river flowing through Borada city during December, 1980 to December, 1982. The diversity index was calculated according to Shannon's function. All the three stations selected did not show any difference in the mean values of DI, but the values of each month showed slight variation. The diversity index was correlated with 17 physico-chemical parameters. It showed direct relationships with carbonate, total alkalinity, nitrate, phosphate, calcium and total solids whereas it showed inverse relationships with COD at all 3 stations. DI holds promise as an index for determining the degree of pollution. (Author's abstract)
W86-01325

INDICATORY ROLE OF SOME INVERTEBRATES FOR QUALITY OF WATER IN THE VISTULA RIVER AND IN SUBSEQUENT STAGES OF ITS TREATMENT,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
H. Sztrantowicz, and M. Kaniewska-Prus.
Polskie Archiwum Hydrobiologii, Vol. 32, No. 1, p 71-95, 1985. 13 Fig, 34 Ref.

Descriptors: *Vistula River, *Warsaw, *Poland, *Invertebrates, *Bioindicators, Paramecium, Daphnia, Crustaceans, Water pollution, Indicators, Water quality, Water treatment.

Based on previously published data on physical and chemical properties of Vistula River water treated for municipal use in the city of Warsaw the processes of mortality, adaptation and reproduction were traced in Paramecium aurelia, P. caudatum and Daphnia magna. In the case of Protozoa, growth parameters of the population were examined (growth rate, generation time) under effect of changes in water chemical properties. It was shown that there is a dependence between water quality as calculated by the method of averaged discriminants, and mortality of test animals. Seasonal and annual changes in mortality of Daphnia magna in the water examined were also ascertained. The organisms used for studies are good bioindicators for the aquatic environment with a high degree of chemical pollution. (Author's abstract)
W86-01327

ESTIMATING THE EXTENT OF REDUCTION NEEDED TO STATISTICALLY DEMONSTRATE REDUCED NON-POINT PHOSPHORUS LOADING TO LAKE ERIE,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 5G.
W86-01343

METAL CONCENTRATIONS IN THE GROUND WATER OF THE OUCHITA MOUNTAINS, ARKANSAS, U.S.A.,
Arkansas Univ., Fayetteville. Dept. of Geology.
G. H. Wagner, and K. F. Steele.

Water, Air, and Soil Pollution, Vol. 25, No. 3, p 339-347, July, 1985. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Groundwater, *Metals, *Ouachita Mountains, *Arkansas, Manganese, Drinking water, Water quality, Lead, Iron, Zinc, Cadmium, Copper, Cobalt, Nickel, Mercury, Antimony, Strontium, Barium.

Groundwater in the Ouachita Mountains near deposits of Mn-oxide mineral deposits have anomalously high Mn and Fe concentrations in a significant percentage of cases (Mn-50%, Fe-44%) and background concentrations of Mn and Fe for these groundwaters tend to be greater than for lesser mineralized areas. There is some evidence that the trace metals in these Mn mineral deposits also are reflected in greater groundwater concentrations. Barite and cinnabar mineral deposits are similarly reflected in higher concentrations of Ba and Hg, respectively, not only in the groundwater near these deposits, but also generally in the mineralized districts. The concentrations of Mn and Fe in about 30% of the springs exceeded the EPA drinking water criteria of 50 micro-g/L Mn and 300 micro-g/L Fe. Three springs exceeded the EPA criterion for Pb of 50 micro-g/L, one spring exceeded the 2 micro-g/L Hg criterion and no Ba concentrations exceeded the Ba criterion of 1000 micro-g/L. (Baker-IVI)
W86-01357

DETERMINATION OF ALKYLPHENOLS AND ALKYLPHENOL MONO- AND DIETHOXYLATES IN ENVIRONMENTAL SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. Ahel, and W. Giger.
Analytical Chemistry, Vol. 57, No. 8, p 1577-1583, July, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Alkylphenols, Chromatography, Organic compounds, Wastewater analysis, Water analysis, High-performance liquid chromatography, Mass spectrometry, Gas chromatography.

Rapid, reliable and sensitive methods for the quantitative determination of alkylphenols (AP), 4-alkylphenol mono- (AP1EO) and diethoxylates (AP2EO) in wastewaters, natural waters, and sludges were sought. The necessary prerequisites for successful quantitative determinations of chemicals in environmental research are efficient and preferably selective enrichment, effective separation, and specific and sensitive detection. For routine determinations of large numbers of samples, simplicity and ease of operation as well as short analysis times are desirable. The normal-phase high-performance liquid chromatography (HPLC) method for the quantitative determination of 4-nonylphenol, 4-nonylphenol mono- and diethoxylate described largely fulfills these requirements. High-resolution gas chromatography/mass spectrometry and reversed-phase HPLC may serve as confirmatory techniques to ensure correct identifications. A broad range of aqueous and solid samples from different processes of wastewater and sludge treatment and from various compartments of the environment can be analyzed. The method is particularly suitable for investigations of the occurrence and fate of AP, AP1EO and AP1EO in sewage sludges, treated wastewaters and in the aquatic environment. (Baker-IVI)
W86-01389

MICROBIAL ASSAY FOR DETERMINING THE INFLUENCE OF PHYSICOCHEMICAL ENVIRONMENTAL FACTORS ON THE TOXICITY OF ORGANICS: PHENOL,

New York Univ., NY. Lab. of Microbial Ecology.
For primary bibliographic entry see Field 5C.
W86-01407

IMPACT OF LAND-APPLIED INCINERATOR ASH RESIDUE ON A FRESHWATER WETLAND PLANT COMMUNITY,

Massachusetts Univ., Waltham. Suburban Experiment Station.
For primary bibliographic entry see Field 5C.
W86-01466

GRADIENTS OF PIGMENT CONCENTRATION IN MARINE CONTAMINATED SYSTEMS (GRADIENTES PIGMENTARIOS EN SISTEMAS MARINOS SOMETIDOS A EFLUENTES CONTAMINANTES),

Malaga Univ. (Spain). Dept. de Ecologia.
P. Algarra, and F. X. Niell.
Investigacion Pesquera, Vol. 49, No. 1, p 107-119, 1985. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Chlorophyll a, *Marine environment, Water pollution effects, Probability, Pigments.

The Whitney and Darley's method to estimate chlorophyll a free of degradation products, has been compared with the classical method of Talling and Driver which does not discriminate these interferences. Both methods have been used to estimate gradiental changes in three sytems stressed by a single or a double focus. The amount of impact, as a percent, has been estimated by means of a probabilistic method based on Montecarlo methodology using as variable the values of active chlorophyll a. The general discussion of the data suggest problems of theoretical interest. (Author's abstract)
W86-01495

SIMPLE, COMMUNITY LEVEL, ECOTOXICOLOGICAL TEST SYSTEM USING SAMPLES OF PERIPHYTON,

Goeteborg Univ. (Sweden). Dept. of Botany.
H. Blanck.
Hydrobiologia, Vol. 124, No. 3, p 251-261, May, 1985. 8 Fig, 4 Tab, 59 Ref.

Descriptors: *Periphyton, *Photosynthesis, *Phytotoxicity, Water pollution effects, Algae, Ecotoxicity, Aliphatic amines, Industrial wastewater, Textile industry.

The design and performance of a simple, community level ecotoxicological test system is reported. Samples of periphyton communities, established on artificial substratum in natural streams were used to study effects on photosynthetic activity in short-term experiments. Photosynthesis was measured as light-dependent oxygen evolution or as C-14 labeled CO2-incorporation. The variability in photosynthetic activity between samples collected at the same time, expressed as coefficient of variation, was ca. 20%. The variation in sensitivity of periphyton photosynthesis as dependent on sampling season was less than threefold for the two long-chained aliphatic amines and the textile industry effluent studied. Effects of the amines on periphyton from five different streams were also investigated. The ratio between maximum and minimum values of sensitivity was 5.6. It is concluded that the variation in sensitivity between different periphyton communities is similar to or less than that observed for fresh-water algal species. Some advantages with regard to ecological realism of using periphyton communities as test systems are discussed. (Author's abstract)
W86-01507

QUANTITATIVE CHEMOBEHAVIOR OF FISH: AN IMPROVED METHODOLOGY,

Texas A and M Univ., College Station. Dept. of Veterinary Anatomy.
A. D. Scarfe, C. W. Steel, and G. K. Rieke.
Environmental Biology of Fishes, Vol. 13, No. 3, p 183-194, July, 1985. 7 Fig, 27 Ref.

Descriptors: *Fish behavior, *Monitoring, *Octagonal fluvarium, Behavior, Water pollution, Odor, Chemobehavior, Food habits.

A new behavioral monitoring system, an 'octagonal fluviarium', and associated time-series analytical techniques were developed to quantitatively examine and assess the chemobehavior of fish to waterborne chemicals. Together they aid in the solution of many of the quantitative behavioral and physical problems inherent in earlier experimental approaches. The fluviarium utilizes a quasi-circular channel in which fish are able to move freely through any of eight areas, any of which can receive a predetermined concentration of a chemical stimulus. Movements and preferential stays of animals monitored with a video system are analyzed to determine spatial and temporal preference in their distributions within the system in response to introduced chemicals. The advantages of these designs include precise control of the water flow dynamics affecting the odor plume, virtual elimination of the 'wall-hugging' tendency of animals due to the quasi-circular construction of the octagonal trough, and the assessment of temporal changes in the behavioral responses of the animals which can be correlated with the presence of odoriferous cues. The efficacy of the fluviarium and statistical analysis is illustrated with data on the chemoresponse of zebrafish, Brachydanio rerio, to 0.001 M L-alanine. This system should have extensive application in investing the chemoresponses of aquatic organisms to waterborne chemicals (presented singularly and in combinations) such as food substances, pheromones or pollutants. (Author's abstract)
W86-01509

MONITORING AND EVALUATION OF WATER POLLUTION IN TUMEN RIVER BY MEANS OF ALGAE (IN CHINESE),

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W86-01512

ORGANOCHLORINES AND TRACE METALS IN GREEN-LIPPED MUSSELS PERNA VIRIDIS FROM HONG KONG WATERS: A TEST OF INDICATOR ABILITY,

Environmental Protection Agency, Kowloon (Hong Kong).
D. J. H. Phillips.
Marine Ecology - Progress Series, Vol. 21, No. 3, p 251-258, February, 1985. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Bioindicators, *Chlorinated hydrocarbons, *Trace metals, *Mussels, *Hong Kong, Copper, Lead, Cadmium, Mercury, Zinc, DDT, Polychlorinated biphenyls, Pesticides, Coastal waters.

While the use of biological indicators to quantify aquatic pollution by trace elements and organochlorines is well-established in temperate waters, this technique has been relatively little used in tropical areas. This is partly because a suitable species has yet to be identified. In South-East Asia, the green-lipped mussel Perna viridis (Linnaeus) has been proposed as a candidate for regional bioindicator studies. The capacity of P. viridis to act as an efficient and accurate bio-indicator for trace metals and organochlorines has been tested in Hong Kong coastal water, using samples from 15 locations. It is concluded that P. viridis is an excellent bio-indicator species for studies of copper and lead. Its use to monitor cadmium, mercury and zinc requires further study, however; in particular, the mussel may partially metabolically regulate zinc concentrations in its tissues. P. viridis appears to be a capable indicator species for organochlorines; the data reported here reveal a generalized contamination of Victoria Harbor by DDT and its metabolites, and localized pollution by PCBs. (Author's abstract)
W86-01514

POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER: THE VALUE OF INDIVIDUAL PACKED-COLUMN PEAK ANALYSIS,

Lamont-Doherty Geological Observatory, Palisades, NY.
H. J. Simpson, R. F. Bopp, B. L. Deck, S. Warren, and N. Kostyk.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 159-165. 10 Fig, 6 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Packed-column peak analysis, *Chemical analysis, *Fate of pollutants, Chlorinated hydrocarbons, Sediments, Chemical composition.

As the result of discharges of approximately 500 tons of PCBs since the 1940's, the sediments, water and biota of the Hudson River (New York) over a 300 km reach are contaminated to a level up to several orders of magnitude greater than other large urban river-estuaries in North America. Although the original contamination probably consisted predominantly of unmodified commercial PCB mixtures, especially Aroclor 1242 which was released about 80 km upstream of tidal waters, the cumulative effect of physical and biological processes, including sorption and desorption to and from suspended particles and sediments plus gas exchange between the water and atmosphere, has been to accomplish major changes in PCB component composition in sediments along the axis of the tidal Hudson. Much of the scientific value of environmental PCB measurements in the Hudson is lost by reporting of data as total PCB concentrations, rather than in terms of a number of distinct components. Ideally, each of the more than 100 individual PCB congeners that can be analyzed in environmental samples by capillary column chromatography should be separately reported, but in practice a significant advance would be accomplished by expressing data in terms of mass of PCB represented by individual peaks resolved by packed-column chromatography (each peak includes several distinct compounds with very similar physiochemical properties). Less informative, but never the less of considerable value, is the practice of reporting data in terms of one or more commercial Aroclor mixtures, especially if the method of standardization is carefully documented (i.e. which chromatogram peaks are actually used for both the standard and sample). Comparison of PCB compositions based on individual packed-column peak analysis in depth segments of a sediment core from near the upstream end of the tidal Hudson demonstrates that even relatively subtle changes in PCB source composition (conversion from Aroclor 1242 to Aroclor 1016), such as occurred at the upstream G. E. facilities in 1971-1972, can be clearly observed in the sediments many 10's of km downstream of the release points, providing a useful stratigraphic marker. In contrast to such subtle changes in PCB source composition to the tidal fresh-water Hudson, major differences are observed in sediment PCB composition near New York City. In an area such as Jamaica Bay, which is largely isolated from the influence of downstream transport of PCBs from the capacitor plant releases, sediment PCBs contain much greater proportions of higher chlorinated biphenyls (penta-octachlorobiphenyls) than the main stem of the Hudson, probably due to the impact of domestic sewage discharges. Such large difference in composition provide the single most useful set of information for characterizing sources and transport properties of this family of toxic contaminants in the Hudson. (Author's abstract)
W86-01556

IDENTIFYING POLLUTION RELATED CHANGES IN CHIRONOMID COMMUNITIES AS A FUNCTION OF TAXONOMIC RANK,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-01583

DISCRIMINATION OF THE STOCK OF FISH (EELS, ANGUILLA ROSTRATA) BASED ON THE PRESENCE OF THE SYNTHETIC CHEMICAL MIREX (DISCRIMINATION D'UN STOCK DE POISSON, L'ANGUILLE (ANGUILLA ROSTRATA), BASEE SUR LA PRESENCE D'UN PRODUIT CHIMIQUE DE SYNTHESE, LE MIREX),

Department of Fisheries and Oceans, Quebec. Fisheries Research Branch.
For primary bibliographic entry see Field 5C.
W86-01584

BENTHIC ORGANISMS AS INDICATORS OF WATER QUALITY IN LAKE PATZCUARO, MEXICO,

Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
I. Rosas, M. Mazari, J. Saavedra, and A. P. Baez.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 401-414, August, 1985. 8 Fig, 3 Tab, 34 Ref.

Descriptors: *Lake Patzcuaro, *Mexico, *Benthos, *Water quality, *Bioindicators, Water pollution effects, Bacterial analysis, Animal wastes, Invertebrates, Aquatic plants, Wastewater pollution.

The water quality was evaluated in Lake Patzcuaro by biological methods using bacteria and macroinvertebrates as indicators, as well as physicochemical parameters. The bacteriological determinations showed critical areas near the two main villages, Patzcuaro and Janitzio. The bacterial ratio FC/FS indicated significant amounts of animal excreta throughout the lake. In areas with less urban influence where there was an abundance of immersed vegetation, the benthic macroinvertebrate community presented high Bioic, Diversity, and Equitability Indices, which were > 2, > 2, and > 0.6, respectively. At the most polluted station (station 8), oligochaetes, which are tolerant to organic matter, comprised 94% of the organisms. Physicochemical characteristics are similar in the lake, except at station 8 where the lowest dissolved oxygen levels, highest ammonia and phosphorus concentrations were registered. This area, adjacent to a fish processing plant, is affected by domestic and industrial wastewater discharges. The results show that up to the present the lake has been moderately polluted, but critical zones exist that restrict the use of the lake for water supply and recreational purposes. (Author's abstract)
W86-01608

STRIPPING ANALYSIS AND CHROMATOGRAPHIC SNIFFING FOR THE SOURCE IDENTIFICATION OF ODOROUS COMPOUNDS IN DRINKING WATER,

Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
For primary bibliographic entry see Field 7B.
W86-01696

ANALYSIS OF VARIANCES AS DETERMINED FROM REPLICATES VS. SUCCESSIVE SAMPLING,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-01698

USE OF IONIC MIXING CURVES IN DIFFERENTIATING OIL FIELD BRINE FROM NATURAL BRINE IN A FRESH WATER AQUIFER,

Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
V. A. Mast.
Ground Water Monitoring Review, Vol. 5, No. 3, p 65-69, Summer, 1985. 5 Fig, 2 Tab, 4 Ref.

Descriptors: *Pollutant identification, *Brines, *Saline water intrusion, Dissolved solids, Chlorides, Statistical studies, Model studies, Water pollution sources.

The study and analytical technique used to determine the relative contribution of various pollution sources to the increased salinity of the fresh water aquifer in the south Wichita, Kansas area were investigated. A statistical model is presented which has proven to be a valuable tool in determining the percentage contribution of pollution from the various sources of contaminants. For the most reliable factors, chloride and total dissolved solids, the volumetric percentage contribution of oil field brine and Wellington Formation natural brine at the bottom of the aquifer ranged from 6.5% to 8.5% and 6.8% to 7.1%, respectively. For the analytical model itself, two drawbacks are pointed out. First, the water system in the model is highly simplified. For a system with more than two potential pollutant sources, this analysis will not serve a proper function. Second, the choice of factor pairs is site dependent. With different geological environments, as well as different pollutant types, the factor pairs used must be chosen accordingly. Three suggestions are made for future analysis in multisource pollution systems: for the unstready-state system, a time factor should be included in the analysis; for a system of N number of pollutant sources, factor group of N items should be used for analysis; and every item in the factor group selected should represent the characteristics of the respective pollutant sources. (Baker-IVI)
W86-01699

GROUND WATER QUALITY ANOMALIES ENCOUNTERED DURING WELL CONSTRUCTION, SAMPLING AND ANALYSIS IN THE ENVIRONS OF A HAZARDOUS WASTE MANAGEMENT FACILITY,

Woodward-Clyde Consultants, Walnut Creek, CA. Environmental and Engineering Services.
D. Dunbar, H. Tuchfeld, R. Siegel, and R. Sterbentz.
Ground Water Monitoring Review, Vol. 5, No. 3, p 70-74, Summer, 1985. 1 Fig, 3 Tab, 1 Ref.

Descriptors: *Water quality, *Monitoring, *Well construction, Construction, Wells, Hazardous waste, Hydrogeology, Waste disposal, Aquifer characteristics, Potentiometry, Tetrahydrofuran, Trihalomethanes, Organic compounds, Water pollution sources.

The occurrence of a number of ground water quality anomalies during field investigations demonstrates the need for careful attention to specialized well construction, sampling and analytical procedures. The specific anomalies and their corresponding causes include elevated pH values due to poor well construction procedures; the presence of tetrahydrofuran, caused by the use of glue at casing joints; the temporary occurrence of trihalomethanes produced during the breakdown of synthetic drilling fluid; and cross contamination of groundwater samples due to incomplete equipment decontamination procedures. (Baker-IVI)
W86-01700

REDUCTION OF HEXAVALENT CHROMIUM IN WATER SAMPLES ACIDIFIED FOR PRESERVATION,

Geological Survey, Denver, CO.
K. G. Stollenwerk, and D. B. Grove.
Journal of Environmental Quality, Vol. 14, No. 3, p 396-399, 1985. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Chromium, *Sample preservation, *Hexavalent chromium, Water chemistry, Preservation, Chemical reactions, Hydrogen ion concentration, Nitrates, Organic carbon, Water temperature.

Reduction of hexavalent chromium, Cr(VI), in water samples, preserved by standard techniques, was investigated. The standard preservation technique for water samples that are to be analyzed for Cr(VI) consists of filtration through a 0.45-micro-m membrane, acidification to a pH < 2, and storage in plastic bottles. Batch experiments were conducted to evaluate the effect of H(+) concentration, NO2, temperature, and dissolved organic carbon (DOC) on the reduction of Cr(VI) to CR(III). The rate of reduction of Cr(VI) to Cr(III) increased with increasing NO2, DOC, H(+), and temperature. Reduction of Cr(VI) by organic matter occurred in some samples even though the samples were unacidified. Reduction of Cr(VI) is inhibited to an extent by storing the sample at 4 C. Stability of Cr(VI) in water is variable and depends on the other constituents present in the sample. Water samples collected for the determination of Cr(VI) should be filtered (0.45-micro-m membrane), refrigerated, and analyzed as quickly as possible. Water samples should not be acidified. Measurement of total Cr in addition to Cr(VI) can serve as a check for Cr(VI) reduction. If total Cr is greater than Cr(VI), the possibility that Cr(VI) reduction has occurred needs to be considered. (Author's abstract)
W86-01713

ESTIMATING ALGAL AVAILABLE PHOSPHORUS IN SUSPENDED SEDIMENTS BY CHEMICAL EXTRACTION,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. A. Dorich, D. W. Nelson, and L. E. Sommers.
Journal of Environmental Quality, Vol. 14, No. 3, p 400-405, 1985. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Phosphorus, *Algae, *Suspended sediments, *Chemical analysis, *Extraction, Sediments, Bioavailability, Nutrients, Cycling nutrients.

The availability of sediment inorganic phosphorus (P sub i) to algae was determined in 28 suspended stream sediments collected from an agricultural watershed in northeastern Indiana by short (2-d) and longer-term (14-d) incubations. Unincubated sediment was also analyzed for dissolved molybdate reactive P sub i (DMRP) and P sub i extracted by: (i) sequential NaOH and HCl, (ii) sequential NH4F, NaOH, and HCl, (iii) nitrilotriacetic acid (NTA), (iv) hydroxy-Al resin, and (v) total P. Available P (P sub aa) measured in sediments by 2-d and 14-d incubations with algae averaged 21 and 25% of total sediment P, respectively. Extraction of sediments with 0.1 M NaOH, 0.5 M NH4F, sequential 0.5 M NH4F + 0.1 M NaOH, NTA, and hydroxy-Al resin removed an average of 36, 22, 31, 45, and 17% of the total P, respectively. Of the extractants tested, NaHO-extractable P sub i was significantly correlated with 2-d and 14-d P sub aa (r = 0.89*** and 0.95***, respectively) but NaOH extraction removed amounts of P sub i that exceeded sediment P sub aa by a relatively constant amount. The results suggest that a single extraction with 0.1 M NaOH can be used to estimate both short- and longer-term P sub aa in suspended stream sediments derived from noncalcareous soils in the Northcentral USA. (Author's abstract)
W86-01714

DETERMINATION OF POTASSIUM, SODIUM, CALCIUM, AND MAGNESIUM IN NATURAL WATERS BY ION CHROMATOGRAPHY,

Iowa State Univ., Ames. Dept. of Agronomy.
N. T. Basta, and M. A. Tabatabai.
Journal of Environmental Quality, Vol. 14, No. 3, p 450-455, 1985. 4 Fig, 5 Tab, 20 Ref.

Descriptors: *Potassium, *Sodium, *Calcium, *Magnesium, *Chemical analysis, *Ion chromatography, Chromatography, Conductimetric detection, Metals, Iron.

Simultaneous determination of alkali and alkaline earth metals in water samples is needed. Studies to evaluate the Dionex Model 10 Ion Chromatograph (IC) for simultaneous determination of K and Na or Ca and Mg in diverse types of natural waters, including soil extracts, showed that the results by the IC method closely agreed with those obtained by flame photometry for K and Na and by atomic absorption spectrophotometry of K, Na, Ca, and Mg. The IC method is based on separation of the monovalent and divalent cations by a separator column containing a low-capacity sulfonated divinylbenzene polystyrene copolymer, cation-exchange resin in the H(+) form and on converting the various metal ions to their corresponding hydroxides by a suppressor column containing a high-capacity, anion-exchanged resin in the OH(-) form. The eluent used for determination of alkali metals was 5 mM HCl, and a solution containing 2.5 mM HCl + 2.5 mM m-phenylenediamine dihydrochloride was used for determination of alkaline earth metals. Electrical conductivity is used as the mode of detection. The method is precise, accurate, and can detect as little as 0.1 mg/L of K, Na, Ca, or Mg in water samples. The coefficient of variation values ranged from 1.3 to 5.0% for K, from 0.63 to 9.1% for Na, from 1.9 to 3.5% for Ca, and from 0 to 24% for Mg. With the IC method, K and Na or Ca and Mg can be determined simultaneously in 2 mL of water in approximately 7 min. A single operator can perform about 40 analyses of alkali or alkaline earth metals in a normal working day. Successive analyses of waters containing high concentrations of metals (e.g., Fe) may lead to loss of resolution of alkali metals, but this can be restored by washing the separator column with 3 M HCl saturated with EDTA. (Author's abstract)
W86-01717

PRECONCENTRATION AND X-RAY SPECTROMETRIC DETERMINATION OF ARSENIC(III/V) AND CHROMIUM(III/VI) IN WATER,

Link Systems Ltd., High Wycombe (England).
D. E. Leyden, K. Goldbach, and A. T. Ellis.
Analytica Chimica Acta, Vol. 171, p 369-374, 1985. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Spectrometry, *Arsenic, *Chromium, Water analysis, Chemical analysis, Speciation.

Two precipitation methods have been used successfully to determine chromium and arsenic in their respective oxidation states in water samples. The DBDTC (dibenzyldithiocarbamate) precipitation method recovers Cr(VI) and As(III) selectively over Cr(III) and As(V) as a first precipitation step. The remaining Cr(III) and As(V) are quantified in a second step by coprecipitation with hydrated iron(III) oxide. Sensitivity is higher for chromium and arsenic by the DBDTC method because of increased matrix absorption for iron(III) in the coprecipitated samples. The method will likely not supplant atomic absorption or inductively coupled plasma emission spectrometry for accuracy and precision, but it does provide speciation information and a fast economical method. Standards can be stored indefinitely. (Baker-IV)
W86-01719

ZIRCONIUM COPRECIPITATION FOR SIMULTANEOUS MULTIELEMENT DETERMINATION OF TRACE METALS IN SEAWATER BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY,

Tokyo Univ. (Japan). Dept. of Chemistry.
T. Akagi, Y. Nojiri, M. Matsui, and H. Haraguchi.
Applied Spectroscopy, Vol. 39, No. 4, p 662-667, 1985. 3 Fig, 5 Tab, 38 Ref.

Descriptors: *Zirconium, *Coprecipitation, *Precipitation, *Chemical analysis, *Seawater, *Inductively Coupled Plasma Atomic Emission Spectrometry, *Trace metals, Metals, Preconcentration, Spectroscopy, Atomic emission spectrometry, Inductively coupled plasma.

Zirconium coprecipitation for simultaneous multielement determination of trace metals in seawater has been examined by inductively coupled plasma atomic emission spectrometry. Optimum pH conditions and other experimental procedures for coprecipitation were investigated in order that the method for multielement preconcentration could be evaluated. The concentration factor of 20 times the original concentration was obtained, although it was limited by spectral interference with zirconium. The present coprecipitation method improved the detection limits and other analytical figures of merit for 17 trace metals (Al, As, Cd, Co, Cr, Cu, Fe, La, Mn, Mo, Ni, Pb, Sb, Ti, V, Y, and Zn), which were estimated by the use of artificial seawater samples, and it was applied to natural seawater analysis. (Author's abstract)
W86-01720

ATTENUATION VERSUS TRANSPARENCY,

Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler.
Journal of Environmental Engineering, Vol. 111, No. 4, p 448-459, August, 1985. 5 Fig, 1 Tab, 33 Ref.

Descriptors: *Light attenuation, *Transparency, *Secchi disks, Downwelling irradiance, Absorption, Scattering, Solar radiation, Physical properties, Physicochemical characteristics.

The differential response of the two commonly used measures of light penetration in water, Secchi disc transparency (SD, m) and the attenuation coefficient for downwelling irradiance (Kd, per m), to the light attenuating processes of absorption and scattering is described. The commonly invoked constancy in the product Kd x SD should only be expected when the relative contributions of scattering and absorption of Kd remains uniform. A number of scenarios and documented phenomena are presented for which preferential effects on scattering or absorption, and therefore variable values of Kd x SD, are expected. Measurement errors also contribute to variability in Kd x SD, particularly at low (< 1.5 m) SD values. Paired observations of Kd and SD presented from four different systems, representing a wide range of Kd and SD values, demonstrate the variability of the magnitude of Kd x SD within individual systems. Secchi disc transparency is probably not a reliable indicator of Kd in many systems. The uncertainty associated with invoking the constancy of Kd x SD in various ecological modeling efforts, in which Kd measurements are missing or are temporally limited, should be accommodated. (Author's abstract)
W86-01725

DETERMINATION OF METHYLMERCURY BY PHASE-SENSITIVE A.C. POLAROGRAPHY,

Institutul Politehnic din Bucuresti (Romania). Dept. of Analytical Chemistry.
I. Ioneci, I. Tanase, and C. Luca.
Analytical Letters, Vol. 18(A8), p 929-945, May, 1985. 6 Fig, 64 Ref.

Descriptors: *Methylmercury, *Polarography, Pollutant identification, Mercury compounds, Organic compounds, Water analysis.

Direct determination of organically-bound mercury in water is very difficult because of the high volatility of the organomercury compounds. A method is described for the determination of methylmercury in water using polarography. The polarographic reduction of methylmercury in aqueous medium takes place in two steps, each of which involves the transfer of a single electron. The first reduction step proceeds reversibly both in direct current and in sinusoidal alternating current (a.c.). Since the polarograms corresponding to this step are well defined, they can be successfully used to determine methylmercuric compounds by phase-sensitive sinusoidal a.c. polarography, in the concentration range 1 x 10 to the minus 7th power to 1 x 10 to the minus 4th power mole/cu dm. Phase-sensitive sinusoidal a.c. polarography offers an advantageous way of determining methylmercury in the presence of inorganic mercury and also in the presence of other forms of organically-bonded mercury, especially of phenylmercury, an advantage not offered by any other known analytical technique. (Moore-IVI)
W86-01755

COPPER AND SILVER ACCUMULATION IN TRANSPLANTED AND RESIDENT CLAMS (MACOMA BALTHICA) IN SOUTH SAN FRANCISCO BAY,

Geological Survey, Menlo Park, CA.
D. J. Cain, and S. N. Luoma.
Marine Environmental Research, Vol. 15, p 115-135, 1985. 7 Fig, 1 Tab, 45 Ref.

Descriptors: *Copper, *Silver, *Clams, *Bioaccumulation, Bioindicators, Heavy metals, Water pollution effects, San Francisco Bay, California.

Accumulation of Cu and Ag by soft tissues of the deposit-feeding clam Macoma balthica was less than half in clams transplanted to a contaminated area than in clams native to that area. During a period of tissue growth, the transplants retained 50% and 90%, respectively, of the net Cu and Ag accumulated, but loss of metals from soft tissue by the resident population equalled net accumulation. Copper accumulation in the transplants did not occur during some periods when increases in the metal body burden of the resident population indicated that environmental exposures were high. The difference in metal accumulation of the two groups of clams may be the result of past environmental exposures. The results illustrate some limitations of using transplant as indicators of pollution events or

of pollutant impact upon resident populations. (Author's abstract)
W86-01793

EFFECT OF SEAWATER MAGNESIUM ON NATURAL FLUORESCENCE DURING ESTUARINE MIXING, AND IMPLICATIONS FOR TRACER APPLICATIONS,

North Carolina Univ. at Wilmington. Div. of Chemistry.
For primary bibliographic entry see Field 2L.
W86-01801

DETERMINATION OF ZINC, CADMIUM, LEAD AND COPPER IN PRECIPITATION BY COMPUTERIZED DIFFERENTIAL PULSE VOLTAMMETRY,

Netherlands Energy Research Foundation ECN, Petten.
W. A. Lingerak, A. M. v. Wensveen-Louter, and J. Slanina.
International Journal of Environmental Analytical Chemistry, Vol. 19, p 85-98, 1985. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Chemistry of precipitation, *Zinc, *Cadmium, *Lead, *Copper, *Differential pulse voltammetry, Voltammetry, Heavy metals, Chemical composition, Computers.

A method is described for the determination of metals in rainwater by means of differential pulse anodic stripping voltammetry. Organic interferants are removed by passing the sample over active carbon at pH $<$ or $=$ 1. A symmetrical, mercury-drop electrode flow through cell is mounted on a PAR 303 electrode stand. The polarography and the flow injection sample handling system are computer controlled. Results are obtained by means of a calibration graph, standard additions are not necessary. Results for Zn, Cd, Pb and Cu in rainwater are in agreement with results obtained by AAS. (Author's abstract)
W86-01846

DETERMINATION OF COMMON ANION CONCENTRATIONS IN SURFACE AND GROUNDWATER SAMPLES BY ELUENT-SUPPRESSED ION CHROMATOGRAPHY,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
P. C. Jay, and J. M. Judd.
International Journal of Environmental Analytical Chemistry, Vol. 19, p 99-109, 1985. 3 Fig, 7 Tab, 13 Ref.

Descriptors: *Ion chromatography, *Eluent suppression, *Anions, *Chemical composition, Fluoride, Chloride, Phosphates, Nitrates, Sulfates, Natural waters, Surface waters, Groundwater.

The use of ion chromatography with eluent suppression is particularly suited to determine concentrations of F(-), Cl(-), PO4(-3), NO3(-) and SO4(-2) in natural surface and ground water samples. An automated system using hollow-fiber suppressors was developed. All anions yield linear responses up to the highest concentrations and the relative standard deviation is $<3\%$ in all determinations except the lowest F(-) and Cl(-) concentrations. Analytical precision for both standard anion solutions and samples is similar. Peak height and peak area quantification are compared and the effects of high Cl(-) content, pH, storage and filtration on sample analysis are determined. Recalibraton, using a standard anion solution inserted at every fifth position on the auto sampler holding tray, improves and maintains analytical precision. Recalibration is essential if high precision is sought in analysis by ion chromatography with eluent suppression. (Moore-IVI)
W86-01847

DETERMINATION OF NONIONIC SURFACTANTS IN WATER BY ATOMIC ABSORPTION SPECTROMETRY,

Antwerpse Waterwerken (Belgium).
F. M. Van Hoof, W. J. Van Craenenbroeck, and J. K. Dewaele.
International Journal of Environmental Analytical Chemistry, Vol. 19, p 155-164, 1985. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Surfactants, *Atomic absorption spectrometry, Sublation, Ion exchange, Pollutant identification, River Meuse, France, Belgium, Netherlands.

An analytical method for nonionic surfactants has been developed using sublation and ion-exchange for isolation of the surfactants and complex formation with potassium zinc tetrathiocyanate followed by atomic absorption spectrophotometric assay of zinc released from the complex through acid extraction. The detection limit for this method is 0.01 mg/l Triton X-100. Recoveries higher than 90% were obtained starting from samples spiked with 0.1 mg/l Triton X-100. The method has been applied to 70 surface water samples coming from a quality survey of the River Meuse in France, Belgium and The Netherlands organized by the RIWA-Cooperating Rhine and Meuse Water Supply Companies. The highest level (0.50 mg/l) was found below the outfall of a surfactant-producing firm. Downstream these discharge levels decreased rapidly. (Author's abstract)
W86-01848

VARIABILITY OF ALUMINUM CONCENTRATIONS IN ORGANS AND WHOLE BODIES OF SMALLMOUTH BASS (MICROPTERUS DOLOMIEUI),

Columbia National Fisheries Research Lab., MO.
W. G. Brumbaugh, and D. A. Kane.
Environmental Science and Technology, Vol. 19, No. 9, p 828-831, 1985. 6 Tab, 20 Ref.

Descriptors: *Aluminum, *Bass, Metals, Pollutant identification, *Fish, Atomic absorption spectrophotometry, Gills, Water pollution effects, Animal tissues.

Variability of aluminum concentrations in smallmouth bass (Micropterus dolomieui) was evaluated by analysis with graphite furnace atomic absorption spectrophotometry. Fish analyzed as whole bodies were compared to fish which had selected organs analyzed individually and separately from the carcass. Gastrointestinal tract contents contained highly variable amounts of aluminum and caused bias and increased variability when included in whole-body samples. Since aluminum concentrations in tissues of stomach and intestine were similar to those in the whole body (less gastrointestinal tract contents), the entire gastrointestinal tract and contents could be removed to reduce bias and variability without measurably altering the 'true' whole-body aluminum concentrations. Of the organs analyzed, gill filaments had the highest and most variable aluminum concentrations and may have contributed to within-fish whole-body variability because of incomplete homogenization. (Author's abstract)
W86-01872

BIOCONCENTRATION FACTORS OF SOME HALOGENATED ORGANICS FOR RAINBOW TROUT: LIMITATIONS IN THEIR USE FOR PREDICTION OF ENVIRONMENTAL RESIDUES,

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5C.
W86-01874

FRESHWATER AQUATIC MACROPHYTES AS HEAVY METAL MONITORS - THE OTTAWA RIVER EXPERIENCE,

National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
D. C. Mortimer.
Environmental Monitoring and Assessment, Vol. 5, No. 3, p 311-323, September, 1985. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Macrophytes, *Heavy metals, Monitoring, Seasonal variation, Plant growth, Lead, Mercury, Nickel, Copper, Aquatic plants, Ottawa River.

The ability of freshwater aquatic vascular plants to accumulate heavy metals was examined in some detail during a five year study. Differences in uptake rate were found to depend on the species of plant, the seasonal growth rate changes and the metal ion being absorbed. Lead and mercury were concentrated to a greater extent than the lighter nickel and copper. Laboratory experiments were designed to establish uptake rate constants which were used to calculate water concentrations of mercury from the analyses of plant samples from the river. 'Background' levels of mercury in aquatic plants of 35-50 ng/L dry weight corresponded to a water concentration near 15 ng/L of total mercury of which 25-30% was methyl-mercury. Higher concentrations of mercury in the plants indicated a proportional increase in the mercury level in the water. (Author's abstract)
W86-01887

AVOIDANCE TEST OF A FISH, MEDAKA (ORYZIAS LATIPES), TO AQUATIC CONTAMINANTS, WITH SPECIAL REFERENCE TO MONOCHLORAMINE,

Ehime Univ., Matsuyama (Japan). Dept. of Environment Conservation.
H. Hidaka, and R. Tatsukawa.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 565-571, September, 1985. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Fish behavior, *Monochloramine, *Avoidance, Medaka, Bioindicators, Toxicity, Chlorine, Surfactants, Residual chlorine, Chloramines, Water pollution effects.

The avoidance behavior of fish is a sensitive indicator for aquatic contaminants such as surfactants, pesticides, and residual chlorine. A monochloramine avoidance test was carried out using medaka (Oryzias latipes) in a small modular chamber system with a symmetrical parallel-flow. In the apparatus, the diluted toxicant solution and the control water run parallel with a distinct boundary at the center of the chamber. The significant avoidance concentration ($P = 0.05$) was 5.7 micro-g/L as combined residual chlorine, which is the lowest residual chlorine avoidance concentration reported in the literature. The avoidance curves for monochloramine exhibited a pattern similar to those for anionic surfactants. As the avoidance behavior of fish is a sensitive indicator, this avoidance test may be used as one of the standard methods for ecotoxicological studies. (Moore-IVI)
W86-01888

COLORIMETRIC DETERMINATION OF PROPOXUR RESIDUES IN VEGETABLES AND WATER,

Central Food Technological Research Inst., Mysore (India). Analytical Quality Control Lab.
K. M. Appaiah, M. A. Sreenivasa, and O. P. Kapur.
Bulletin of Environmental Contamination and Toxicology, Vol. 296-300, September, 1985. 2 Tab, 17 Ref.

Descriptors: *Propoxur, *Insecticides, *Colorimetry, India, Pollutant identification, Water analysis, Pesticide residues.

Propoxur is a non-systemic insecticide used on a large scale in India on field crops. Although gas and liquid chromatographic methods are ideal for detecting and quantifying propoxur residues their use is often limited by availability and cost of equipment. The advantages of the colorimetric method proposed are that it does not require elaborate clean-up technique, gives high recovery, produces a stable color and is as sensitive as the method which uses 4,4-diaminodiphenyl sulfone as the chromogenic reagent. The phenol obtained after alkaline hydrolysis of propoxur is treated with concentrated nitric and sulfuric acids to get nitrosophenol which is in the presence of excess of alcoholic ammonium hydroxide rearranges to form a highly colored quinoid salt. The color is stable for weeks. To check the adequacy of the method, water and vegetable samples were fortified with known amounts of propoxur and analyzed. Recov-

eries ranged from 95.1 to 98.0% for water samples, and 93.5 to 97.8% for vegetable samples. (Baker-IVI)
W86-01895

DAPHNIA MAGNA AS AN INDICATOR OF THE ACUTE TOXICITY OF WASTE WATERS,

National Board of Waters, Helsinki (Finland). Water Research Inst.
E. Nikunen, and V. Miettinen.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 368-374, September, 1985. 1 Tab, 21 Ref.

Descriptors: *Daphnia, *Toxicity, *Wastewater disposal, *Water pollution effects, *Bioindicators, Indicators, Zooplankton, Pulp wastes, Pulp and paper industry, Industrial wastewater.

The proposed Finnish standard for both chemical and wastewater testing is described and results obtained with different industrial wastewaters using the test method are presented. The wastewater samples taken for the experiments were mainly chosen by the local water authorities. The majority of the tested effluents were taken form the pulp and paper industry, which is the most important polluter of the Finnish waters. The tests conducted on Daphnia magna indicated that the proposed Finnish standard is a fairly rapid and easy method for measuring the acute lethal toxicity of waste water samples. Pulp and paper mills had clearly the biggest toxicity emission rates of the samples investigated. Just one other plant, producing viscose fibers, had a TER (toxicity emission rate) value which was in the same order of magnitude as the median values of wastewaters released from different pulp producing plants. (Baker-IVI)
W86-01905

MONITORING OF POLYCHLORINATED BIPHENYLS (PCBS) AND HEXCHLOROCYCLOHEXANES (HCH) IN FRESHWATER USING THE AQUATIC MOSS CINCLIDOTUS DANUBICUS,

Metz Univ. (France). Lab. d'Ecologie.
C. Mouvet, M. Galoux, and A. Bernes.
Science of the Total Environment, Vol. 44, p 253-267, 1985. 2 Fig, 6 Tab, 64 Ref.

Descriptors: *Monitoring, *Polychlorinated biphenyls, *Hexachlorocyclohexanes, *Mosses, *Bioindicators, Indicators, Organic compounds, Water pollution effects, Fate of pollutants, Pesticides.

The use of aquatic bryophytes for the monitoring of polychlorinated biphenyls (PCBs) and chlorinated pesticides alpha-, beta-, and gamma-HCH in freshwaters was investigated. Concentrations of alpha- and beta-HCH in Cinclidotus danubicus from the Saone (France) were below the detection limit. The contamination of the mosses by gamma-HCH did not vary much along the course of the river even though the site farthest downstream appeared less contaminated than the three other sites located in more agricultural areas. Polychlorinated biphenyls were detected at the four sites studied with no significant variation along the course of the river. Concentations of alpha-, beta- and gamma-HCH in water samples from Les Mees, 4 km downstream from a discharge site indicate the extreme contamination of the Durance. Polychlorinated biphenyl concentrations were below the detection limit. A progressive increase in the contaminant concentrations in C. danubicus transplanted to the polluted stretch of the river was observed. Polychlorinated biphenyls were detected in all moss samples with slight variations between sites and no significant change as a function of time. (Baker-IVI)
W86-01916

5B. Sources Of Pollution

INDICATORY ROLE OF SOME INVERTEBRATES FOR QUALITY OF WATER IN THE VISTULA RIVER AND IN SUBSEQUENT STAGES OF ITS TREATMENT,

Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 5A.
W86-01327

OCCURRENCE AND TRANSPORT OF ORGANIC MACROCONTAMINANTS IN THE DULUTH-SUPERIOR HARBOR,

Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. A. Bahnick, and T. P. Markee.
Journal of Great Lakes Research, Vol. 11, No. 2, p 143-155, 1985. 2 Fig, 7 Tab, 29 Ref. Dept. of Commerce grant NA 800AA-D-00086.

Descriptors: *Fate of pollutants, *Duluth-Superior Harbor, *Great Lakes, *Organic compounds, Pollutant transport, Lake sediments, Suspended sediments, Polychlorinated biphenyls, Aromatic hydrocarbons, Pentachlorophenol.

The Duluth-Superior harbor is a major Great Lakes port serving about 10,000 commercial and recreational vessels annually. The nature and magnitude of certain organic microcontaminants associated with harbor sediments and suspended particulate matter subject to transport to Lake Superior were investigated. The microcontaminants included polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAH), and pentachlorophenol (PCP). The results of initial screening of particulate samples obtained from Duluth harbor in 1980 identified about 200 compounds in four extract fractions. The compound types consisted mainly of hydrocarbons, organic acids, esters, and alcohols. In addition some amines, ketones, aldehydes and phenols were detected. These compounds appear to be primarily plant decomposition products. GC/MS analysis in 1982 suggests the presence of a very large number of compounds, particularly in sediment sample extracts. Most appear to be naturally occurring organics. Some PAH compounds were also identified. Dichlorobenzene was the only halogenated compound identified from this data. In 1983, particulates were sampled in yet another site. Five PAH compounds were identified by retention times. PCP was detected in sediments and particulates collected from sites 1 and 2 in Duluth Harbor in 1982. Particulate samples contained higher concentrations of PCBs than did sediments. This may be due to a larger surface area and a higher organic content. Considering the concentration of PCBs in water and particulates in conjunction with average suspended solids levels, it was calculated that 91% of the PCBs were dissolved in water and 19% associated with suspended particles. Suspended solid transport of PCBs and PAH to Lake Superior is less than 0.01% of airborne transport. (Baker-IVI)
W86-01346

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN SEDENTARY FISH FROM LAKE HURON AND LAKE SUPERIOR TRIBUTARIES AND EMBAYMENTS,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Jaffe, E. A. Stemmler, B. D. Eitzer, and R. A. Hites.
Journal of Great Lakes Research, Vol. 11, No. 2, p 156-162, 1985. 1 Fig, 2 Tab, 26 Ref. EPA grant R005737-01.

Descriptors: *Organic compounds, *Halogenated hydrocarbons, *Fish, *Water pollution sources, Lake Huron, Lake Superior, Great Lakes, Tributaries, Industrial wastes, Fate of pollutants, Pesticides, DDT.

Analyses were made on composite samples of fish taken from some of the major tributaries and embayments of Lake Superior and Lake Huron for halogenated xenobiotics. A good correlation was noted between the areas of industrial and urban development and the abundance, as well as variety, of industrial pollutants and pesticides in fish. Findings suggest that Saginaw Bay acts like a sink for pollutants from the area, especially for very hydrophobic compounds that are associated with suspended matter. The major source for PBBs seems to be located around the Pine River and Chippewa River areas, while PCBs are more abundant in the Chippewa, Tittabawassee, and Flint Rivers. The PCTs seems to have sources near the Flint and Saginaw rivers and, surprisingly, in the Keweenaw Bay area. A similar pattern was noted for the PCDEs except that they were also found in the Chippewa and Tittabawasee rivers but not in the Keweenaw Bay. It is interesting to note the high concentrations of total DDTs in the Pine River and Chippewa Rivers fish, as well as the presence of DDT itself in Pine River fish, indicating a possible source for these chemicals. (Baker-IVI)
W86-01347

ACIDIFICATION OF GEORGIAN BAY RIVERS ESTIMATED BY MODIFICATIONS OF THE WRIGHT-HENRIKSEN MODEL,

Department of Fisheries and Oceans, Owen Sound (Ontario). Great Lakes Fisheries Research Branch.
M. G. Johnson.
Journal of Great Lakes Research, Vol. 11, No. 2, p 163-170, 1985. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Georgian Bay, *Ontario, *Fate of pollutants, *Acidification, Acid rain, Alkalinity, Mathematical models, Anions, Organic compounds, Sulfates, Hydrogen ion concentration.

Major ion composition of fresh waters can be used to estimate temporal changes in alkalinity and pH caused by loadings of sulfuric acid from the atmosphere. In the Georgian Bay rivers organic anions must be considered, but road salt additions are considerably more important than minor sea-salt inputs. Nineteen rivers tributary to Georgia Bay of Lake Huron were sampled at the time of spring freshet in 1980-1983, and modified versions of the Henriksen-Wright model were used to measure acidificiation of these river systems by estimating loss of alkalinity and sulfate concentrations above background sulfate levels. Spring freshet data were used to assess acidification at times of extreme conditions, which likely are of more significance to aquatic life. While seasonal variations in acidification have not been examined, springtime discharges should be more representative of the acidification stress on these systems. Alkalinity estimates, averaged for all rivers, were 107-147 micro-eq/L for various modifications and net sulfate estimates averaged 108-125 micro-eq/L. Both measures of acidification increased with proximity to Sudbury. The decrease in alkalinity, 45-166 micro-eq/L for the 19 rivers, was related to the spatial variability in atmospheric acid loadings, while the pH decrease, 0.2-1.6 units, reflected as well the original buffering of each river. Organic anions were important in achieving cation-anion balances, in interpretation of pH, and in modification of the Wright-Henriksen model. (Baker-IVI)
W86-01348

TIME-DEPENDENT SOLUTION OF MULTI-SEGMENT MASS BALANCE MODELS OF CONTAMINANTS IN THE GREAT LAKES,

Argonne National Lab., IL. Environmental Research Div.
B. M. Lesht.
Journal of Great Lakes Research, Vol. 11, No. 2, p 182-189, 1985. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Phosphorus, *Mass balance, *Great Lakes, Seasonal variations, Linear programming, Model studies, Fate of pollutants, Lakes.

The application of the time-dependent multisegment mass balance model to the phosphorus balance of the Great lakes is one example of the utility of the technique. Simple mass balance models are widely used for a variety of purposes but are often restricted by the assumption of steady state. Although this assumption reduces the amount of information required by the models it also limits the information provided by the models. Formulating the model in time-dependent terms requires more input information but also provides more detailed output. The choice between the two formulations will depend on the purpose for which the model is developed. In the case of a model being developed as a synthesis of present understanding of a complicated environmental system, the time-dependent

multi-segment mass balance model can be a valuable tool. The time dependent solution may be used to evaluate year to year variations in the system response to time variable forcing, or to determine model uncertainty due to temporal variation in the model coefficients. (Baker-IVI)
W86-01350

ATMOSPHERIC SULFUR DIOXIDE AND RAINWATER AT A COASTAL LOCALITY IN N.W. ENGLAND,

Liverpool Univ. (England). Dept. of Geography.
A. J. Wharfe, and P. A. James.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 237-242, July, 1985. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Sulfates, *Rain, *England, North Merseyside, Hydrogen ion concentration, Acid rain, Water pollution sources, Sulfur dioxide.

The relationship between atmospheric sulfur dioxide concentrations and rainwater pH is examined for a coastal locality in North Merseyside, England for the period 1978 to 1982. There were appreciable differences between pH values for the sampling sites. There was no seasonal pattern in pH which is consistent for all the years, though a tendency does exist for a summer maximum. Sulfate shows a normal winter maximum. pH correlated significantly with time as measured through the 1978 to 1982 period. The Merseyside regional average sulfate levels declined markedly during the 1960's, the rate of decline decreasing in the mid-1970's. The lessening of acidity in the rainwater between 1978 and 1982 is noted. Over this same period local sulfate levels have decreased slightly. The significance of long range pollutant transport is recognized but there is evidence to suggest that sulfate concentrations at Formby are related to wind frequency and wind run from the direction of the Merseyside and Manchester conurbations. (Baker-IVI)
W86-01352

SURVIVAL OF BACILLUS THURINGIENSIS VAR. KURSTAKI IN WATERS,

Environmental Protection Service, Dartmouth (Nova Scotia).
A. S. Menon, and J. de Mestral.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 265-274, July, 1985. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Bacillus thuringiensis, *Nova Scotia, *Insecticides, Pesticides, Bacteria, Biocides, Path of pollutants, Drinking water, Chlorination.

In the summer of 1979 and 1980, the Nova Scotia Dept. of Lands and Forests conducted a pilot spray project on the use of Bacillus thuringiensis var. kurstaki for the control of spruce budworm infestation in Nova Scotia. Field and laboratory studies were conducted to assess the survival of B. t. var. kurstaki in waters. Lab studies showed that B. t. var. kurstaki can survive in fresh water and sea water for more than 70 and 40 days, respectively, at 20 C. A higher percentage of B. t. var. kurstaki was found surviving in lake water than in tap and distilled water for an extended period, probably due to the presence of more available nutrients in lake water for growth. B. t. var. kurstaki was found in the Parrsboro water sytem during the spray study, raising the suspicion that the amount of residual Cl normally applied to municipal drinking water supplies might not be sufficient to kill B. t. var. kurstaki. This is supported by the results of the laboratory studies that high Cl concentrations, 1.5 to 2.0 mg/L, and long contact time, 45 to 60 min, are needed to inactivate B. t. var. kurstaki completely. (Baker-IVI)
W86-01354

ACID PRECIPITATION AND SURFACE-WATER VULNERABILITY ON THE WESTERN SLOPE OF THE HIGH COLORADO ROCKIES,

California Univ., Berkeley Energy and Resources Group.
J. Harte, G. P. Lockett, R. A. Schneider, H. Michaels, and C. Blanchard.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 313-320, July, 1985. 2 Fig, 2 Tab, 16 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Rocky Mountains, *Colorado, *Acid rain, Alkalinity, Rainfall, Alpine lakes, Watersheds, Hydrogen ion concentration.

Increased fossil fuel consumption in California, the Great Basin, or the upper or lower Colorado River drainage regions could lead to increased acidity of precipitation in the Rockies. The occurrence of acid precipitation at a remote and sensitive location in the Colorado Rockies brought about a long term study of the precipitation and surface waters of the western slope. The site is distant from highways, point sources, and major urban areas, and receives consistently acidic precipitation. The resulting data provide a means of assessing the present sensitivity of watersheds in the region to acidification and ultimately will allow determination of trends. The volume-weighted average pH for summer events was 4.61, for winter events was 5.11 and for the entire period was 4.91. Within the watershed, both low- and medium-alkalinity surface waters exist. Weekly alkalinity measurements ranged from 10 to 70 micro-eq/l in the former and 100 to 900 micro-eq in the latter. The findings demonstrate the occurrence of acid precipitation and the susceptibility to acidification of alpine lakes in this area. (Baker-IVI)
W86-01356

PARTITIONING OF HEAVY METALS (FE, MN, CD, PB, CU, ZN, CO, NI AND AS) AND P INTO SELECTIVE CHEMICAL FRACTIONS IN SEDIMENTS FROM LAKE KOJIMA (IN JAPANESE),

S. Nakashima, M. Yagi, and I. Aoyama.
Nogaku Kenkyu, Vol. 60, No. 4, p 157-169, March, 1985. 12 Fig, 13 Ref.

Descriptors: *Lake Kojima, *Okayama Prefecture, *Japan, *Lake sediments, *Heavy metals, *Phosphorus, Iron, Manganese, Cadmium, Cadmium, Lead, Copper, Zinc, Cobalt, Nickel, Arsenic, Metals, Nutrients, Particle size, Clays, Organic matter, Silicates, Sulfides.

To investigate the mechanism of metal accumulation in the sediment of Lake Kojima, Okayama Prefecture, Japan, surface sediments (10 samples) were collected and analyzed for Fe, Mn, Cd, Pb, Cu, Zn, Co, Ni, As and P. Partitioning of these metals and P into mineral and organic fractions was determined with selective chemical leaching techniques for sediment samples. Iron, Ni, and to a lesser degree, Co and As were contained in larger amounts in the silicate fraction, than in the non-silicate fractions. Arsenic, Co and Ni were concentrated mainly in the hydrous Fe/Mn oxide, sulfide and organic phases, and Fe was concentrated in the hydrous oxide and sulfide phases. The contents of Mn, Cd, Pb, Cu, Zn and P were lower in the silicate fractions than the non-silicate fractions, especially that of Cd. Manganese was fairly well distributed in all fractions, being dominant in the exchangeable, hydrous oxide and carbonate fractions. A large proportion of Cd, Pb, Cu, Zn and P was concentrated in the exchangeable (especially Cd), hydrous oxide, sulfide and organic fractions. Particularly, the contents of these elements in these four fractions were higher in sediments from the mouths of the Rivers Kurashiki and Sasagase which flow into the lake than in sediments from the lake. The contents of Mn, Cd, Pb, Cu, Zn and P in the silicate fractions were nearly the same in both fine-textured and coarse-textured sediments. Heavy metals and P in the fine-textured sediments were more highly concentrated in the hydrous oxide, sulfide and organic fractions than the coarse sediments. As a result, the total contents of these elements were higher in fine-textured than in coarse-textured sediment. These results indicate that heavy metals and P released by human activity are carried by the rivers into Lake Kojima, are adsorbed on hydrous Fe/Mn oxides and/or clay, are associated with organic matter or absorbed by living things, and are then precipitated and fixed in the sediment. (Author's abstract)
W86-01362

ASSESSMENT OF POLLUTION HISTORY FROM RECENT SEDIMENTS IN LAKE VANAJAVESI, SOUTHERN FINLAND. I. SELECTION OF REPRESENTATIVE PROFILES, THEIR DATING AND CHEMOSTRATIGRAPHY,

Helsinki Univ. (Finland). Dept. of Zoology.
P. H. Kansanen, and T. Jaakkola.
Annales Zoologici Fennici, Vol. 22, No. 1, p 13-55, 1985. 29 Fig, 8 Tab, 135 Ref.

Descriptors: *Lake sediments, *Water pollution, *Lake Vanajavesi, *Finland, Radioactive dating, Wood wastes, Heavy metals, Industrial wastes, Copper, Zinc, Cesium radioisotopes, Plutonium, Cadmium.

Surficial sediments were sampled from eutrophic Lake Vanajavesi (Finland) using 79 short sediment cores. The lake has been subjected to waste water loading for 100 years mainly from the wood processing industry. Of the analyzed heavy metals, zinc, cadmium and copper showed clear enrichment in the selected profiles. For these elements the maximum cultural enrichment factors were 84.6, 6.1, and 2.9, respectively. Zinc was the best tracer for mapping the areal distribution and for giving historical records of industrial waste waters due to the high point source loading from the chemical industry that has occurred since 1943. Dehydroabietic acid content in sediment indicated an abrupt increase since the 1940s in the loading from the wood processing industry. Due to mixing, the peak of Cs-137 and Pu-239,240 was deeper than expected on the basis of mean sedimentation rate. The time scale derived from Cs-137 and Pu-239,240 distribution was in accordance with the zinc stratigraphy and known history of zinc loading. (Baker-IVI)
W86-01365

ASSESSMENT OF POLLUTION HISTORY FROM RECENT SEDIMENTS IN LAKE VANAJAVESI, SOUTHERN FINLAND. II. CHANGES IN THE CHIRONOMIDAE, CHAOBORIDAE AND CERATOPOGONIDAE (DIPTERA) FAUNA,

Helsinki Univ. (Finland). Dept. of Zoology.
P. H. Kansanen.
Annales Zoologici Fennici, Vol. 22, No. 1, p 57-90, 1985. 12 Fig, 11 Tab, 75 Ref.

Descriptors: *Lake Vanagavesi, *Finland, *Eutrophication, *Aquatic insects, Lake sediments, Population dynamics, Midges, Water pollution effects, Eutrophic lakes.

The present midge fauna of Lake Vanajavesi (Finland) was compared to subfossil remains from sediment profiles as part of a study of the development of Lake Vanajavesi during the industrial period of its history in the 19th and 20th Centuries. In Lake Vanajavesi eutrophication has led to the replacement of an oligotrophic Microspectra - Monodiamesa community by a eutrophic Chironomus anthracinus community in the first decades of this century. The replacement took place at a relatively low leading level; about 1/10-1/15 of the present total wastewater load. This is in accord with the established fact that Vanajavesi, like many other lakes in the clay area of southern Finland, was originally eutrophic. The dysoligotrophic features are due to a high humus load. Artificial lowering of the water levels also probably adversely affected the food availability for the midge fauna. A relatively slight cultural impact was needed to cause a return of the eutrophic conditions. In the further succession from a Chironomus anthracinus community to a Chironomus plumosus community, and finally to the disappearance of the deep water fauna, the key factor appears to have been the oxygen content of the water. The oxygen state of Lake Vanajavesi depends not only on the production level of the lake, but more on the direct impact of waste water loading having a high BOD. (Baker-IVI)
W86-01366

CHANCE-CONSTRAINED/STOCHASTIC LINEAR PROGRAMMING MODEL FOR ACID RAIN ABATEMENT - I. COMPLETE COLINEARITY AND NONCOLINEARITY,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
J. H. Ellis, E. A. McBean, and G. J. Farquhar.
Atmospheric Environment, Vol. 19, No. 6, p 925-927, 1985. 8 Fig, 5 Tab, 22 Ref.

Descriptors: *Acid rain, *Statistical analysis, *Computer programs, *Linear programming, *Model studies, Sulfur dioxide, Fate of pollutants, Path of pollutants, Water pollution prevention.

A Linear Programming model is presented for development of acid rain abatement strategies in eastern North America. For a system comprising of 235 large controllable point sources and 83 uncontrolled area sources, it determines the least-cost method of reducing SO2 emissions to satisfy maximum wet sulfur deposition limits at 20 sensitive receptor locations. The purely deterministic model is extended to a probabilistic form by incorporating the effects of meteorologic variability on the long-range pollutant transplant processes. These processes are represented by source-receptor-specific transfer coefficients. Experiments for quantifying the spatial variability of transfer coefficients showed their distributions to be approximately lognormal with logarithmic standard deviations consistently about unity. Three methods of incorporating second-moment random variable uncertainty into the deterministic LP framework are described: Two-Stage Programming Under Uncertainty (LPUU), Chance-Constrained Programming (CCP) and Stochastic Linear Programming (SLP). A composite CCP-SLP model is developed which embodies the two-dimensional characteristics of transfer coefficient uncertainty. Two probabilistic formulations are described involving complete colinearity and complete noncolinearity for the transfer coefficient covariance-correlation structure. Complete colinearity assumes complete dependence between transfer coefficients. Complete noncolinearity assumes complete independence. The completely colinear and noncolinear formulations are considered extreme bounds in a meteorologic sense and yield abatement strategies of largely didactic value. Such strategies can be characterized as having excessive costs and undesirable deposition results in the completely colinear case and absence of a clearly defined system risk level (other than expected-value) in the noncolinear formulation. (Author's abstract)
W86-01381

AEROSOL CHEMISTRY IN MINNESOTA AND WISCONSIN AND ITS RELATION TO RAINFALL CHEMISTRY,

Minnesota Univ., St. Paul. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2K.
W86-01382

CHEMICAL ZONATION IN GROUNDWATER OF THE CENTRAL PLAINS, CANTERBURY,

North Canterbury Catchment Board, Christchurch (New Zealand).
R. J. Burden.
Journal of Hydrology (New Zealand), Vol. 23, No. 2, p 100-119, 1984. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Central Plains, *Groundwater, *New Zealand, *Nitrates, Zones, Land use, Chlorides, Water pollution sources, Groundwater pollution, Leaching, Fertilizers, Pastures, Wastewater pollution.

The relationship between land use and nitrate levels in Central Plains (New Zealand) groundwater was studied. The principal sources of nitrate are quantified and the movement and accumulation of nitrate in groundwater are described. Groundwater samples were obtained from about 600 wells over the period 1977 to 1983. Major ion analyses were conducted on water from about 300 wells in the specific study area, mostly located near Christchurch City or near suspected point sources of contamination. The remainder were analyzed for both nitrate and chloride or nitrate alone. The Central Canterbury Plains consist of a vertical sequence of coalesced glacial outwash and postglacial alluvial fans deposited by the Rakaia, Selwyn and Waimakariri Rivers. Several sources contribute to nitrate concentrations in Central Plains groundwater. Dryland pasture is the principal source of nitrate affecting the quality of the groundwater. Cropping is widespread on the deeper soils on the Plains with the amount of nitrate leached from cropland being dependent on soil depth and the timing of irrigation and fertilizer applications. Domestic and industrial sewage from most of the Christchurch metropolitan area and from Lincoln township is disposed, via treatment plants, to surface water and therefore does not affect groundwater quality. The major point sources of waste and irrigated animal effluent together contribute only about 5% of the total nitrate load in Central Plains groundwater. The groundwater has been divided into three chemical zones. Zone 1 lies in regions of recharge from rivers; 2 includes unconfined and semi-confined groundwater down to 60 m below the water table, and some shallow confined groundwater, and 3 comprises all deep circulating groundwater. (Baker-IVI)
W86-01387

PREDICTION OF CHARACTERISTICS FOR VERTICAL ROUND BUOYANT JETS IN STABLY LINEAR STRATIFIED ENVIRONMENT,

Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
For primary bibliographic entry see Field 8B.
W86-01392

COPPER DISSOCIATION FROM ESTUARINE HUMIC MATERIALS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. L. Olson, and M. S. Shuman.
Geochimica et Cosmochimica Acta, Vol. 49, No. 6, p 1371-1375, 1985. 5 Fig, 2 Tab, 37 Ref. NSF grant OCE-7914592.

Descriptors: *Kinetics, *Copper, *Humic acids, *Estuarine environment, Metals, Chemical reactions, Organic matter, Chemical kinetics.

The kinetics of Cu-organic binding in an estuary is examined. Previous data analysis methods have been extended by developing a nonlinear kinetic model for the simultaneous, first order dissociation reactions of CuHM (Cu humic material). The model gives a kinetic spectrum which is used to examine how CuHM rate constants are distributed among bound Cu(II) and how they vary with molecular size and sampling site along a southeastern U.S. estuary. A significant portion of bound Cu(II), 28-54%, reacted with k > 40/sec. In general, variations were observed only between size fractions. Since a major portion of Cu(II) bound to HM is labile, it cannot be generally assumed that dissociation is so slow that complexes can be separated from free metal without disturbing the Cu(II)-HM equilibrium. The kinetic spectrum model, described as a set of independently and simultaneously reacting Cu(II) binding sites, can easily accommodate an unknown number of components and a wide range of constants. These features are critical for valid application to a metal-HM kinetic system and interpretation of data. The model also provides a means of optimizing the time range of kinetic measurements by inspection of preliminary data. (Baker-IVI)
W86-01395

PARTITIONING AND TRANSPORT OF METALS ACROSS THE O2/H2S INTERFACE IN A PERMANENTLY ANOXIC BASIN: FRAMVAREN FJORD, NORWAY,

Washington Univ., Seattle. School of Oceanography.
L. Jacobs, S. Emerson, and J. Skei.
Geochimica et Cosmochimica Acta, Vol. 49, No. 6, p 1433-1444, June, 1985. 7 Fig, 6 Tab, 23 Ref. NSF grant OCE 82-13927-1.

Descriptors: *Metals, *Transport, *Framvaren Fjord, *Norway, Anoxic conditions, Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Cadmium, Solubility, Sulfides, Marine waters.

The zonation of geochemical processes operating in anoxic basins provides a unique opportunity to weigh their relative importance in the solid aqueous phase partitioning and transport of metals across the O2/H2S interface. Water samples and suspended particulates were collected from Framvaren Fjord, Norway. The metals Mn, Fe, Co Ni, Cu, Zn, and Cd showed systematic variations in their response to the processes of metal sulfide precipitation and metal oxide O2/H2S interface cycling. For manganese sulfide a nearly constant ion activity product (IAP) is maintained throughout the water column. The calculated manganese sulfide IAP is undersaturated with respect to known pure phases, however, the existence of manganese as a trace component in framboidal pyrite (1%) may explain this undersaturation if solid solution equilibrium is assumed. Transition metals show involvement in both metal sulfide formation and metal oxide interface cycling. The intensity of this cycling is quantified with a box model, with the resulting hierarchy: Mn>Co>Fe>Ni. The Class B metals show no involvement in interface cycling and strong involvement in metal sulfide precipitation. The abrupt concentration drop across the O2/H2S interface observed for copper, zinc and cadmium translates to a residence time of one year for these metals in the oxic surface water. Surface concentrations and the common transport mechanism described for copper, zinc and cadmium are directly coupled to the sediment enrichments (relative to the lithogenic component) observed for these metals, suggesting that anoxic basins act as excellent Class B metal traps. The source of the sediment excess could be explained by atmospheric fallout for cadmium and zinc. (Baker-IVI)
W86-01396

ORGANOCHLORINE CHEMICAL RESIDUES IN WHITE PELICANS AND WESTERN GREBES FROM THE KLAMATH BASIN, CALIFORNIA,

California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 5C.
W86-01409

SODIUM IN DRINKING WATER IN SOUTH CAROLINA,

South Carolina State Dept. of Health and Environmental Control, Columbia. Div. of Chronic Disease.
For primary bibliographic entry see Field 5C.
W86-01411

FACTORS CONTROLLING PHOSPHORUS LIMITATION IN STREAM SEDIMENTS,

State Univ. of New York Coll. at Cortland. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W86-01417

COMPARISON OF TWO MODELS FOR PREDICTING RIVER WATER QUALITY,

Birmingham Univ. (England). Dept. of Civil Engineering.
C. F. Foster, R. W. Crabtree, C. P. Crockett, and I. D. Cluckie.
Effluent and Water Treatment Journal, Vol. 25, No. 5, p 161-164, May, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Model studies, *River flow, *Water quality control, Qual-II, Blackwater River, England, Water management, Flow, Dissolved oxygen, Ammonia, Nitrogen.

The two models which are examined include a general purpose model (Qual-II) and one which is river-specific. Each model was applied to the River Blackwater in order to make the comparison. The river specific model was developed to predict the possible effects of population and waste treatment changes in the Blackwater catchment (England). It is one dimensional and operates in a steady-state mode, although dissolved oxygen changes due to photosynthesis are modelled as on steady state, due to diurnal variation in light inten-

sity. The model requires an input of calculated hydraulic relationships for each reach as well as the relative plant density for each reach. The model is based on field work derived constants. The input requirements for Qual-II are 28 constants plus 16 parameter values for system identification. Neither model gave a perfect prediction. The results for Qual-II showed that the best modelled variables were BOD and ammoniacal nitrogen, followed by DO and nitrate-nitrogen. The order for the Blackwater model was ammoniacal nitrogen and BOD followed by DO and nitrate nitrogen. The fact that Qual-II gave better results for BOD, DO and nitrate-nitrogen but was slightly worse for ammoniacal-nitrogen, may be due to Qual-II using interactions with algal growth rather than Nitrosomonas bacteria. Although the major difficulty in applying either model to this river system was the availability of sufficient hydraulic data, particularly travel times, the regular use of Qual-II in the United Kingdom could be of real benefit to resource management on a catchment basis. (Baker-IVI)
W86-01438

HEAVY METAL OCCURRENCE AND GEOCHEMICAL FRACTIONATION: THE RELATIONSHIPS OF CATCHMENT SOILS TO ASSOCIATED ESTUARINE SEDIMENTS,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
M. A. Badri, and S. R. Aston.
Environmental Pollution (Series B), Vol. 10, p 61-75, 1985. 2 Fig, 8 Tab, 19 Ref.

Descriptors: *Heavy metals, *Path of pollutants, *Soils, *Estuarine sediments, Goechemistry, Leaching, Iron, Manganese, Cadmium, Copper, Lead, Zinc, Catchment area, England, Particle size.

There are several pathways by which metals from the catchment soils can eventually be removed for the soil matrix and deposited into the receiving estuarine system; data from this study indicate the possibility of a natural leaching process. Catchment soils and surface sediments from the associated estuary in Northwest England were analyzed for total Fe, Mn, Cd, Cu, Pb and Zn and the distribution of these metals between geochemical fractions. Three types of heavy metal analysis were performed: total concentrations, the concentrations in the non-residual fraction and the concentration in the exchangeable fraction. In general, metal behaviors in the catchment soils and estuarine surface sediments are different, with soils showing greater leaching tendency than sediments. For the soils, considerable variations in total metal and non-residual concentrations were found at different localities, while the same metal fractions in the sediments were uniformly distributed. The observed variations are not dependent on simple grain size distributions. The strong Cd/Mn association in terms of leachability indicates a potential for long-term release of Cd to the overlying waters. (Moore-IVI)
W86-01454

'MIXING-CELL' CONCEPT APPLIED TO TRANSPORT OF NON-REACTIVE AND REACTIVE COMPONENTS IN SOILS AND GROUNDWATER,

Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
H. C. Van Ommen.
Journal of Hydrology, Vol. 78, No. 3/4, p 201-213, June, 1985. 9 Fig, 2 Tab, 12 Ref.

Descriptors: *Path of pollutants, *Soil water, *Solute transport, Groundwater pollution, Mathematical equations, Tracer studies, Convection, Diffusion.

The one-dimensional stationary transport of a component is described and the relation between time step, cell size and flow velocity is derived. The mixing-cell concept is applied to a two-dimensional transport problem and the results are compared to other experimental work. It is concluded on the basis of a comparison between the analytical solution of the convection/diffusion-equation in one dimension and a solution provided by the mixing-cell concept that the latter applied to a two-dimensional groundwater quality problem gives a fair description of the experimentally obtained breakthrough curves and opens perspectives concerning the description of transport of reactive solutes in groundwater. Its simplicity, as compared to other methods, is attractive. (Baker-IVI)
W86-01469

ESTIMATING INTERFACE ADVANCE DUE TO ABRUPT CHANGES IN REPLENISHMENT IN UNCONFINED COASTAL AQUIFERS,

Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-01474

LONGITUDINAL DISPERSION IN A FOREST STREAM,

Universite Catholique de Louvain, Louvain-la-Neuve (Belgium). Dept. des Sciences du Sol.
C. Legrand-Marcq, and H. Laudelout.
Journal of Hydrology, Vol. 78, No. 3/4, p 317-324, June, 1985. 2 Fig, 14 Ref.

Descriptors: *Streams, *Dispersion, *Path of pollutants, Solute transport, Stream pollution, Differential equations, Stagnant water, Streamflow.

A forest stream typical of those found in SE Belgium and NE France has been studied with respect to the parameters determining the dispersion of a non-reactive solute in a streamflow with stagnant zones. Non-linear adjustment of an analytical solution of two partial differential equations describing longitudinal dispersion and solute exchange between main stream and stagnant water provided a set of parameters describing satisfactorily the experimental results. The dead-zone fraction diminished very rapidly as soon as the flow rate increased beyond a fairly low value and remained constant thereafter. The longitudinal dispersion coefficient followed an inverse pattern but in a somewhat less regular way. Attempts were made to correlate these changes with the Darcy-Weisbach friction factor. (Author's abstract)
W86-01476

DEGRADATION AND MINERALIZATION OF THE POLYCYCLIC AROMATIC HYDROCARBONS ANTHRACENE AND NAPHTHALENE IN INTERTIDAL MARINE SEDIMENTS,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. E. Bauer, and D. G. Capone.
Applied and Environmental Microbiology, Vol. 50, No. 1, p 81-90, July, 1985. 6 Fig, 6 Tab, 30 Ref.
EPA grant R809475011, NOAA grant NA-80-RAD00057, Hudson River Foundation grant 14/83B/12.

Descriptors: *Polycyclic aromatic hydrocarbons, *Anthracene, *Naphthalene, *Degradation, *Mineralization, *Marine sediments, Intertidal zone, Biodegradation, Acclimatization, Fate of pollutants, Aromatic compounds, Hydrocarbons, Microorganisms, Dissolved oxygen, Temperature effects.

The degradation of the polynuclear aromatic hydrocarbons (PAHs) anthracene and naphthalene by the microbiota of intertidal sediments as investigated in laboratory studies. No mineralization of either PAH was observed in the absence of oxygen. Both rates and total amounts of PAH mineralization were strongly controlled by oxygen content and temperature of the incubations. Inorganic nitrogen and glucose amendments had minimal effects on PAH mineralization. The rates and total amounts of PAH mineralized were directly related to compound concentration, pre-exposure time, and concentration. Maximum mineralization was observed at the higher concentrations (5 to 100 micro-g/g) of both PAHs. Optimal acclimation to anthracene and naphthalene (through pre-exposures to the compounds) occurred at the highest acclimation concentration (1,000 ppm). However, acclimation to a single concentration (100 ppm) resulted in initial relative mineralization rates over a range of re-exposure concentrations (1 to 1,000 ppm) being nearly identical. Maximum mineralization of both PAHs occurred after intermediate periods (1 to 2 weeks) of pre-exposure. The fraction of the total heterotrophic population capable of utilizing anthracene or naphthalene as sole carbon source was also greatest after 2 weeks. (Author's abstract)
W86-01481

RESPONSE OF THE MICROFLORA IN OUTDOOR EXPERIMENTAL STREAMS TO PENTACHLOROPHENOL: COMPARTMENTAL CONTRIBUTIONS,

Connecticut Agricultural Experiment Station, New Haven.
J. J. Pignatello, L. K. Johnson, M. M. Martinson, R. E. Carlson, and R. L. Crawford.
Applied and Environmental Microbiology, Vol. 50, No. 1, p 127-132, July, 1985. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Pentachlorophenol, *Microbial degradation, *Fate of pollutants, Stream pollution, Dissolved oxygen, Chlorinated phenols, Substrates.

Outdoor artificial streams were treated continuously with pentachlorophenol (PCP) for 88 days during the summer of 1983. The contributions of different stream compartments (microbial habitats) to microbial degradation of PCP were determined in a stream treated with 144 micro-g of PCP per liter. The 488-m long stream was composed of mud-bottomed pools alternating with gravel riffles. PCP loss in the stream attributable to microbial degradation after an adaptation period was in the range of 55 to 74%. Contributions to PCP loss were determined for rock surface (epilithic), macrophyte surface (epiphytic), sedimentary, and water column communities by measuring rates of PCP disappearance in stream water, containing ambient concentrations of PCP, in contact with representative compartmental samples. The specific capability, in units of micrograms of PCP per hour per square meter of stream cross-sectional area (macrophytes at maximum plant density, water column at mean depth, upper 10-cm layer of gravel), followed the order rock surface > macrophytes > sediment approximately = water column. The compartmental contribution to total stream losses in units of grams per hour followed the same order, although the differences were smaller. The rate of PCP disappearance in the water column above sediment cores followed the order oxygen-rich > oxygen-poor approximately = anaerobic > sorption-only conditions. The large difference in specific capability between the rock surface and sediment compartments could be attributed to oxygen deficiency (because of chemical and biological oxygen demand) in the sediments. Free-floating and particle-attached organisms in the water column were important to PCP biodegradation. (Author's abstract)
W86-01483

ACID RAIN: DOUSING COMMUNITY RESOURCES,

For primary bibliographic entry see Field 5G.
W86-01488

WATER QUALITY IN AN ESTUARINE ENVIRONMENT: ANNUAL CYCLE OF THE PHYSICAL AND CHEMICAL PARAMETERS OF THE WATER OF THE LOIRE ESTUARY (QUALITE DES EAUX EN MILIEU ESTUARIEN: SUIVI ANNUEL DE CRITERES PHYSIQUES ET CHIMIQUES DANS LES EAUX DE L'ESTUAIRE DE LA LOIRE),

Nantes Univ. (France). Lab. de Biologie Marine.
For primary bibliographic entry see Field 2L.
W86-01505

ESTIMATES OF AVERAGE MAJOR ION CONCENTRATIONS IN BULK PRECIPITATION AT TWO HIGH-ALTITUDE SITES NEAR THE CONTINENTAL DIVIDE IN SOUTHWESTERN COLORADO,

Geological Survey, Lakewood, CO.

M. M. Reddy, and H. C. Classen.
Atmospheric Environment, Vol. 19, No. 7, p 1199-1203, 1985. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Precipitation chemistry, *Altitude, *Colorado, Calcium, Sulfates, Nitrates, Seasonal variation, Atmospheric deposition.

The composition of bulk precipitation from two high-altitude sites, established in 1971 near the Continental Divide in southwestern Colorado, has been monitored by season during the past decade. Calcium ions are the predominant cationic species; sulfate is the major anionic constituent. Bulk precipitation major ion concentrations exhibit log-normal distributions. Representative mean and standard deviation values for the major inorganic ionic species present in bulk precipitation have been calculated for three years of consecutive seasons. Standard deviations for all species, except nitrate, are similar. For two years of data grouped into quarters, deviations from mean values fall well within the plus or minus two standard deviation limit. There does not seem to be a systematic deviation from the mean concentration values, with respect to either ionic component or season. (Author's abstract)
W86-01515

LEVELS OF HEAVY METALS IN THE TIDAL ELBE AND ITS ESTUARY AND THE HEAVY METAL INPUT INTO THE SEA,

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
L. Mart, H. W. Nurnberg, and H. Rutzel.
Science of the Total Environment, Vol. 44, No. 1, p 35-49, July, 1985. 10 Fig, 2 Tab, 25 Ref. Federal Minister of Research and Technology (Bonn) contract MT 405 g/Aut 03, EEC contracts 173/77 ENVD ENVD690-D.

Descriptors: *Heavy metals, *Elbe River, *Estuaries, *Germany (Federal Republic), Water pollution, Copper, Cadmium, Lead, Nickel, Cobalt, Resuspension, Turbidity, Fate of pollutants.

Surface water samples were collected during missions in 1977, 1978, 1980 and 1983 at different sampling stations along the tidal Elbe, from river km 632 downstream from Hamburg to the outer end of the estuary. Special care was taken to minimize contamination during sampling, handling and analysis. Within the tidal Elbe five distinct zones of substantial anthropogenic heavy metal pollution inputs can be detected. An attempt is made to define anthropogenic background levels, which are extremely low for the dissolved trace metals Cd and Pb; 35 and 65 ng/kg, respectively. The level of dissolved Cu is 2200 ng/kg. Total baseline levels of Cd, Pb and Cu are, respectively, 120, 2500 and 4200 ng/kg. In the five river zones affected by anthropogenic trace metal inputs, distinctly larger maximum levels can occur. They decrease to the background values after mixing with the main water body. More elevated levels caused by re-suspension in the mixing zone with maximum turbidity can be assumed. Nickel and Co data are from one mission only. The order of magnitude of the trace metal input from the Elbe into the sea is evaluated. (Author's abstract)
W86-01516

FATE OF THE PYRETHROID INSECTICIDE DELTAMETHRIN IN SMALL PONDS: A MASS BALANCE STUDY,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, G. P. Rawn, and N. P. Grift.
Journal of Agriculture and Food Chemistry, Vol. 33, No. 4, p 603-609, July/August, 1985. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Insecticides, *Deltamethrin, *Ponds, Fish, Plants, Aquatic plants, Degradation products, Sediments, Water analysis, Pyrethrins.

A quantitative determination was made of the relative importance of various pathways of pollutants such as volatilization, degradation in water and sediment, and uptake by fish and plants, following application of C-14 labeled deltamethrin to water under field conditions. A single application of the insecticide was made at 10 g/ha to two small outdoor ponds, 17 sq m in surface area. Initial concentrations of the insecticide in filtered water ranged from 1.28 to 2.50 microg/L. Deltamethrin rapidly partitioned into suspended solids, plants, sediment, and air, with a half life of 2-4 hr in water. Duckweed and a submerged pondweed accumulated deltamethrin concentrations ranging from 253 to 1021 ng/g, respectively, at 24 hr posttreatment. Sediments were the major sink for radioactivity at 306 days posttreatment, and intact deltamethrin was present at concentrations ranging from 3 to 5 ng/g. Deltamethrin levels in air above the water ranged from 10-100 ng/cu m during a 48 hr monitoring period following application. Fathead minnows accumulated levels of extractable radioactivity 248-907-fold higher than concentrations in water at 24 hr posttreatment, but no fish mortality was observed. (Baker-IVI)
W86-01526

SURVEY OF 2,3,7,8-TETRACHLOROBIDENZO-P-DIOXIN IN FISH FROM THE GREAT LAKES AND SELECTED MICHIGAN RIVERS,

Food and Drug Administration, Detroit, MI. Pesticide and Industrial Chemical Research Center.
N. V. Fehringer, S. M. Walters, R. J. Kozara, and L. F. Schneider.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 4, p 626-630, 1985. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Great Lakes, *Michigan, *Rivers, *Pesticide residues, *Tetrachlorodibenzo-p-dioxin, Saginaw Bay, Lake Huron, Tittabawassee River, Lake Ontario, Dioxin.

Residues of 2,3,7,8-tatrachlorodibenzo-p-dioxin (TCDD) were measured in fish taken from the Great Lakes. Fish from the Saginaw Bay (Lake Huron), the Tittabawassee River in Michigan, and Lake Ontario contained the highest levels of contamination. No TCDD residues at or above the minimum confirmable level of 10 ppt were found in fish from Michigan rivers other than the Tittabawassee. Comparison of the current findings with the results of an earlier study, 1983, suggests a decrease in residue levels with time. Detectable levels of TCDD were found only in carp, catfish, salmon, white perch and trout. No residues at or above the 10 ppt level were found in sucker, whitefish, yellow perch, walleye, bullhead, crappie, bowfin, rockbass, buffalo, white bass, and sheepshead. (Baker-IVI)
W86-01527

EXCHANGE OF WATER IN FJORDS: THE EFFLUX/REFLUX THEORY OF ADVECTIVE REACHES SEPARATED BY MIXING ZONES,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W86-01536

SOME CONSIDERATIONS IN MODELING THE FATE AND TRANSPORT OF TOXICANTS IN SURFACE WATER SYSTEMS,

Lawler, Matusky and Skelly Engineers, Pearl River, NY.
J. P. Lawler.
Northeastern Environmental Science, Vol. 3, No. 2, p 90-123, 1984. 3 Fig, 31 Ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Martin Creek Lake, *Texas, Selenium, Chlorine, Polychlorinated biphenyls, Metals, Chlorinated hydrocarbons.

Simple, analytical models provide a basis for conceptualizing the important physical, chemical, and biological mechanisms that control the fate and transport of toxic substances in surface water sytems. Mechanisms influencing fate and transport of pollutants in three case studies are described through the use of this modeling approach. In all three studies, the models were employed to provide initial insights to the issues to be addressed. The total selenium concentrations in the water and sediments of Martin Creek Lake (Tatum, Texas) caused by discharges from a lignite-fired steam electric generating station were estimated and the potential effects of these concentrations on the biota of Martin Creek Lake were evaluated. Simple, analytical models were employed to provide insights to the chlorine decay process; these results were then utilized to modify several complex numerical solution computer models of hydrodynamic and conservative water quality behavior to include chlorine decay processes. Simple models of the sorption-desorption process were employed to outline a research proposal for investigation of these processes as they influence polychlorinated biphenyl (PCB) fate and transport in the Hudson River (New York). Levels of certainty and precision in understanding will depend on the quality and extensiveness of the data and the extent of refinement in the model equations; however, in the absence of extensive data or model refinement, much can be learned conceptually and directionally by utilizing the approach of the simple, analytical model. (Collier-IVI)
W86-01552

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PCB PROBLEM: A REVIEW,

Cornell Univ., Ithaca, NY. Ecosystems Research Center.
K. E. Limburg.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 122-136, 1984. 8 Fig, 4 Tab, 50 Ref.

Descriptors: *Environmental impact assessment, *Environmental effects, *Polychlorinated biphenyls, *Hudson River, *New York, Chlorinated hydrocarbons, Fate of pollutants, Path of pollutants, Model studies, Dredging, Estuarine environment.

Despite a general agreement to deal with the Hudson River (New York) PCB problem as rapidly as possible following the 1976 PCB Settlement, remedial action planning has spanned more than eight years. During this period, monitoring, field observation, and experimental work have created an extensive data base for temporal trend analysis. The emerging treads change or modify what was previously understood about PCB dynamics in the Hudson ecosystem, and a review is provided. The original estimate of PCBs released into the Hudson (150 tons) is now thought to be low by a factor of 2.5. PCBs have been declining in the system as they solubilize, volatilize, enter the biota, and wash out. Volatilization may be a more important avenue of escape than previously suspected, as evidenced by a marked decline in lower-chlorinated forms. A second major issue concerns the physical transport mechanisms for PCBs, and two alternative models have been proposed but not validated. The issue of transport has critical management implications, for if one of the proposed mechanisms is the correct one, then dredging of the Thompson Island pool (River Mile 190) could potentially remove the source of most PCB contamination of the estuary. The impact of PCBs was examined in terms of what has been learned about fate, transport, and effects of these substances. (Author's abstract)
W86-01553

HUDSON RIVER PCB RELATIONSHIPS BETWEEN RESIDENT FISH, WATER AND SEDIMENT,

New York State Dept. of Environmental Conservation, Albany.
For primary bibliographic entry see Field 5C.
W86-01554

POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER: THE VALUE OF INDIVIDUAL PACKED-COLUMN PEAK ANALYSIS,

Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 5A.
W86-01556

PCB TRANSFORMATIONS IN UPPER HUDSON SEDIMENTS,

General Electric Co., Schenectady, NY. Research and Development Center.
J. F. Brown, R. E. Wagner, D. L. Bedard, M. J. Brennan, and J. C. Carnahan.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 166-178. 2 Fig, 6 Tab, 3 Ref.

Descriptors: *Polychlorinated biphenyl, *Fate of pollutants, *Hudson River, *New York, *Sediments, Chlorinated hydrocarbons, Path of pollutants, Sediment transport, Biodegradation, Bacteria, Anaerobic bacteria, Degradation, Congeners.

Capillary gas chromatography and mass spectrometry have been used to characterize the PCB congener distribution patterns in: (a) the commercial Aroclors discharged into the upper Hudson, (b) Aroclor specimens altered by bidegradation by microbial cultures isolated from upper Hudson sediments or by water-extraction, and (c) environmental PCB specimens recovered from upper Hudson fish or sediments. The top layers of the sediments were found to contain at least two classes of aerobic bacteria capable of oxidatively biodegrading PCBs. The commonest of these, represented by Corynebacterium sp MBI attack PCB molecules having unsubstituted 2,3 (or 5,6) positions. The second most commonly encountered aerobic group, represented by Alcaligenes eutrophus HB50, attacks those PCBs having open 3,4 (or 4,5) positions. The modest changes in PCB congener distribution pattern (from that of Aroclor 1242) exhibited by most of the surface sediments, and the larger changes exhibited by the fish, appeared generally more similar to those effected by the first of these two aerobic bacterial groups. Totally different PCB congener distribution patterns were exhibited by the lower layers of the sediments. These patterns indicated that the PCBs there were being reductively dechlorinated, probably by several different populations of anaerobic bacteria, to give several distinguishable distributions of dechlorination products. These products consisted mainly of mono- and dichlorobiphenyls, which are readily biodegradable. Every significant congeneric constituent of the Aroclor 1242 discharged into the upper Hudson was found to be degradable by one or more of the oxidative or reductive agents detected in the Hudson environment. (Author's abstract)
W86-01557

PERSISTENCE OF PCB COMPONENTS IN SEDIMENTS OF THE LOWER HUDSON,

Lamont-Doherty Geological Observatory, Palisades, NY.
R. F. Bopp, H. J. Simpson, B. L. Beck, and N. Kostyk.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 179-183. 8 Fig, 1 Tab, 7 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Hudson River, *Fate of pollutants, Degradation, Chlorinated hydrocarbons, Congeners, Chromatography.

In contrast to recent findings in the upper Hudson (New York), no evidence was found of significant PCB congener alteration in sediments of the lower Hudson. In the lower Hudson, chromatograms of extracts of sediments that have been buried for up to twenty years are very similar to chromatograms of the most used commercial PCB mixtures, while extracts of subsurface samples of the upper Hudson sediments often have compositions totally unlike any commercial PCB mixture. Both of these observations are clearly demonstrated by an examination of PCB standard and sediment extract chromatograms. Analysis of capillary chromatograms provides no evidence that significant degradation of specific PCB congeners occurs in the sediments of the lower Hudson. (Author's abstract)
W86-01558

TRANSPORT OF PCB IN HUDSON RIVER BEDLOAD SEDIMENTS,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Civil Engineering.
T. F. Zimmie.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 190-196. 5 Fig, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Fate of pollutants, *Bed load, *Hudson River, *Sediment transport, Chlorinated hydrocarbons, Path of pollutants, Particle size.

In order to measure the transport of a contaminant on river sediments, the sediment transport relations must be determined. In this project, bedload sediment transport in the upper Hudson River was first determined. The bedload samples were analyzed for PCB concentrations, which enabled the determination of PCB transport via the bedload sediments. This is one of a very few investigations that deal with the transport of a toxic contaminant via bedload sediments. Two different types of bedload samplers were utilized: the Helley-Smith bedload sampler, which is a sampler often used by the U.S. Geological Survey; and a Bogardi type bedload sampler, which was developed for studies in New York State rivers and steams. The two samplers complemented each other, and it was possible to obtain satisfactory bedload samples at all times, even under extreme flood flow conditions. During the study period, a wide range of flows were encountered in the Hudson River, enabling the determination of a very satisfactory bedload sediment-discharge relationship. The PCB transport-discharge relation does not correlate as well as the sediment-discharge relation, but this is as expected. The various size fractions of the bedload samples were analyzed for PCB and percent volatiles. There was no correlation between PCB concentration and grain size. However, there was a tendency for higher PCB concentrations to occur in the larger sizes, the opposite of what one might expect. This is attributed to the organics in the sediments, a conclusion borne out by the observation that PCB concentration correlates well with percent volatiles. (Author's abstract)
W86-01560

TRENDS IN PCB TRANSPORT IN THE UPPER HUDSON RIVER,

Lawler, Matusky and Skelly Engineers, Pearl River, NY.
G. Apicelle.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 196-201. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Fate of pollutants, *Sediments, Chlorinated hydrocarbons, Sediment transport, River flow, Model studies, Water pollution sources.

Because of the high affinity of polychlorinated biphenyls (PCBs) for sediment, PCB movement is controlled essentially by the hydraulic changes that affect sediment transport. The transport of PCBs was analyzed for the Upper Hudson River (New York) based on data collected by the U.S. Geological Survey (USGS) from 1976 to 1983 - the period following the major abatement of PCB discharges. Data for temporal trends in PCB concentration at Waterford, New York, were analyzed while accounting for the year-to-year variability in observed flows. A linear regression of PCB concentration vs flow was made using data that are separated into low- and high-flow ranges, that is, below and above 10,000 cfs. The regressions account for the dependence of PCB concentration on the flow at the time of the sampling and enables a comparison among years of PCB data that are normalized for flow. Decreases in PCB concentration over time are found for both flow ranges, suggesting that the riverbed source releases diminishing amounts of PCB to the overlying water. A multiple regression analysis was conducted with PCB concentration as the dependent variable and flow, time, and suspended sediment concentration as candidate independent variables. Results of this analysis confirm a significant trend toward decreasing PCB concentration with time. In addition to time, river flow is a second factor in determining PCB concentration. Suspended sediment concentration does not improve the regression equation significantly because its effect essentially duplicates that of flow, which is already included. An analytical framework for evaluating PCB transport through the Upper Hudson River was developed based on previously collected data. Evaluation procedures comprise extending the analyses of Waterford data to other sampling stations and integrating river flow, which has a long-term cycle of 20 years, into the computation of PCB transport. The effect of the cycle - which will soon enter a phase of generally increasing flow - on the driving force on PCB transport can be evaluated using these analytical approaches. (Author's abstract)
W86-01561

PCB TRANSPORT IN THE FT. EDWARD AREA,

New York State Dept. of Environmental Conservation, Albany.
T. J. Tofflemire.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 203-208. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Fort Edwards, *Sediments, *River beds, Chlorinated hydrocarbons, Organic carbon, Fate of pollutants, Path of pollutants, Water pollution sources.

Removal of the Ft. Edwards dam on the Hudson River (New York) in 1973 exposed coarse trashy sediment containing polychlorinated biphenyls (PCBs) and other contaminants. The fate of PCBs in the Ft. Edward area was analyzed with data on river water transport, air transport and dredging transport. The water transport of PCB's at Roger's Island is decreasing with time, although a small unidentified source of PCB north of Area 1 of the remnant deposits may still be present. From water sampling studies at low flow, it was shown that only 25% of the PCB's passing Rogers Island were coming from the east bank or channel. About 40% of the PCB's were coming from sources north of Area 1, with the remainder coming from the broad river bottom areas which are mostly rock. These upstream sources should be located an sampled by some type of integrating and concentrating systems that integrate PCB from water over several weeks. The remnant deposits appear to be scouring much less than before 1979. PCBs have been volatilizing from the remnant deposit sediments; air PCB values over the remnant areas are decreasing with time. The last sampling was in 1982. Depletion of PCB from the surface layer and the build up of organic carbon in the top soil due to increased vegetation on Areas 4 and 5 probably aids this process. (Collier-IVI)
W86-01562

EFFECTS OF DREDGING OPERATIONS ON NUTRIENT AND SUSPENDED SEDIMENT CONCENTRATIONS,

Army Engineer District, New York.
J. F. Tavolaro, and J. M. Mansky.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 208-216. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Dredging, *Nutrients, *Suspended sediments, *Raritan Bay, *New York Bay, *New Jersey, Source of pollutants, Nitrates, Environmental effects, Ammonia, Phosphates.

In response to concerns about the potential impact of dredging operations to water quality, two monitoring efforts were undertaken. Concentrations of dissolved nutrients were monitored for hopper dredging operations in Raritan Bay, NY/NJ and concentrations of suspended sediment were monitored for clamshell dredging operations in the Upper Bay of New York Harbor. Concentrations of TKN, nitrate and total ammonia did not appear to be affected in the vicinity of the dredging. Total phosphate and orthophosphate appeared to decrease while nitrite appeared to increase, although the overall nitrite concentrations were low. Flumes of higher than ambient concentrations of suspended sediment did not persist more than 24 hours after dredging ceased. Maximum concentration ranged from several hundred milligrams per liter on the bottom to less than 100 mg/l on the surface within 60 meters of the dredge. Surface and bottom concentrations decreased rapidly with distance from the dredge and ranged from 20 to 30

mg/l at a distance between 210 meters and 350 meters. Ambient conditions were established within 480 meters on the surface and 570 meters on the bottom. (Author's abstract)
W86-01563

ORIGIN OF HIGH CADMIUM CONCENTRATIONS IN HUDSON RIVER BLUE CRAB (CALLINECTES SAPIDUS RATHBUN),

New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
For primary bibliographic entry see Field 5C.
W86-01565

BACKGROUND LEVELS OF DISSOLVED/DISPERSED PETROLEUM RESIDUES IN THE GULF OF ST. LAWRENCE, 1970-79,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
E. M. Levy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 544-555, March, 1985. 3 Fig, 8 Tab, 16 Ref.

Descriptors: *Gulf of St. Lawrence, *St. Lawrence Estuary, *Saguenay Fjord, *Water pollution sources, *Path of pollutants, *Hydrocarbons, Model studies, Fate of pollutants, Monitoring, Mixing.

A 10-yr program of monitoring the incidence and distribution of dissolved/dispersed petroleum residues in the Gulf of St. Lawrence confirmed that the major source is the Atlantic water that enters through Cabot Strait and demonstrated that a substantial decline in the background levels occurred during the mid-1970's. A model was developed to interpret the geographical distribution of the petroleum residues. The incidence and distribution of dissolved/dispersed petroleum residues in the waters of the Gulf of St. Lawrence and adjoining areas during the period 1970-79 could be interpreted in terms of general background levels pertaining to 'boxes' of water defined solely on the basis of oceanographic/geographic regimes. Since no relationship could be found between the concentration of these substances and depth or any of the other commonly measured oceanographic parameters and because the apparent differences between the concentration levels in neighboring boxes often were not significant, the background levels in the Gulf region at the time of each cruise could be accounted for by a simple model with four or five compartments. The present level, about 0.4 microg/L, is similar to those of other unpolluted areas off the east coast of Canada and in the Arctic where it appears that the input from atmospheric deposition exceeds those from accidental spills, deliberate discharges, and other point sources. Although small spills occur occasionally, their effects are usually local and short-term and have little lasting impact on the regional levels. Inputs of petroleum residues from land-based sources around the Gulf are presently insignificant except at the extreme upper reaches of the St. Lawrence Estuary and the Saguenay Fjord; even there the effect is highly localized because of dilution, sedimentation, and other processes of removal associated with the mixing of fresh and saline waters, and therefore, these sources do not make a significant contribution to the background level in the Gulf region as a whole. (Collier-IVI)
W86-01588

STORMWATER RUNOFF FROM HIGHWAYS,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
E. J. Hoffman, J. S. Latimer, C. D. Hunt, G. L. Mills, and J. G. Quinn.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 349-364, August, 1985. 3 Fig, 8 Tab, 29 Ref. NOAA grant NA80RAD00047 and EPA grant 68-04-1002.

Descriptors: *Runoff, *Storm runoff, *Highway effects, *Pawtuxet River, *Rhode Island, Highways, Water pollution sources, Hydrocarbons, Trace metals, Metals, Urban runoff, Water quality management.

During four rain events, stormwater runoff samples from Interstate Highway 95 in Rhode Island were collected and analyzed for petroleum hydrocarbons, 14 polycyclic aromatic hydrocarbons (PAHs) and a variety of trace metals. The concentrations were variable throughout the storm events and some of the components responded similarly and others differently depending on the source and form of the component in the runoff. Loading factors as a function of area and traffic volume were developed from the concentration and flow data. Application of the highway runoff loading factors to the Pawtuxet River adjacent to this interstate highway suggests that highway runoff could be the source of over 50% of the annual pollutant loads of solids, PAHs, Pb, and Zn entering this river. It is recommended that highways as a source of non-point pollution to receiving waterbodies should be included as a part of any river and estuarine water quality management planning exercise. (Author's abstract)
W86-01605

IMPACT OF ALKALINE PARTICULATES ON PH OF RAIN WATER IN INDIA,

Indian Inst. of Tropical Meteorology, Poona.
L. T. Khemani, G. A. Momin, M. S. Naik, P. S. Prakasa Rao, and R. Kumar.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 365-376, August, 1985. 3 Fig, 9 Tab, 47 Ref.

Descriptors: *Precipitation chemistry, *Particulate matter, *Hydrogen ion concentration, *Alkalies, *India, Water pollution sources, Chemical composition, Acid rain, Calcium, Soil.

Rain water samples were collected over a period of a decade from 1974 in Pune, India, a city which is relatively free from industrial pollution. They were also collected at 4 places during 1974 in the region of Bombay which is highly industrialized. The samples were analyzed for major chemical components and pH. The ionic balance was computed. Samples were collected at Delhi during 1965 and 1966 and were analyzed for pH. The values were compared with those reported for 1978. The total suspended particles (TSP) were measured at Delhi during 1980 and analyzed for water soluble components. The rain water at all the places except near the industrial source was not acidic and was characterized by the presence of excess cations, particularly Ca. The acid rain near the industrial source was associated with excess anions, especially sulfate. The difference between the cations and anions was inversely proportional to the H(+) ion concentration. The pH of rain water at Delhi which was in the alkaline range during 1965 and 1966 remained alkaline after a period of 12 yr when the city developed industrially. The TSP in the region was rich with the basic components, mainly Ca, suggesting that the alkaline property of the soil dust is mainly responsible for neutralizing the acidic effects resulting from the anthropogenic gaseous pollutants. (Author's abstract)
W86-01606

CATALYTIC EFFECT OF VARIOUS METAL IONS ON THE METHYLATION OF MERCURY IN THE PRESENCE OF HUMIC SUBSTANCES,

Swedish Environmental Research Inst., Goeteborg.
Y.-H. Lee, H. Hultberg, and I. Andersson.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 391-400, August, 1985. 6 Fig, 3 Tab, 30 Ref.

Descriptors: *Methylation, *Mercury, *Path of pollutants, *Humic substances, *Metals, Heavy metals, Fulvic acid, Manganese, Aluminum, Iron, Copper, Catalysis, Hydrogen ion concentration.

Methylation of Hg(2+) (Hg(NO3)2) in the presence of fulvic acid (FA) and various metal ions has been studied. The concentrations of Hg(2+) and FA ranged from 5 to 200 mg/L and 171 to 285 mg/L dissolved organic carbon respectively. The pH range was 3 to 6.5. FA was isolated from an acid brown-water lake by XAD-8 polymeric adsorbent. Methylmercury production in the dark during 2 to 4 days incubation at 30 C increased with increasing concentrations of Hg(2+) ion and FA as well as with additions of metal ions (0.00005 mole/L). The observed catalytic activity of metal ions followed the order Fe(3+) (Fe(2+)) > Cu(2+) approximately = Mn(2+) > Al(3+). The production of methylmercury had a pH-optimum around 4 to 4.5 at the conditions tested. (Author's abstract)
W86-01607

POLYCHLORINATED BIPHENYLS IN THE HUDSON RIVER,

New York State Dept. of Environmental Conservation, Albany.
M. P. Brown, M. B. Werner, R. J. Sloan, and K. W. Simpson.
Environmental Science and Technology, Vol. 19, No. 8, p 656-661, August, 1985. 4 Fig, 41 Ref. EPA grant C-36-1167-01.

Descriptors: *Monitoring, *Polychlorinated biphenyls, *Hudson River, Fate of pollutants, Fish, Invertebrates, Rivers, Organic compounds, Sediments.

As part of a fish-monitoring program conducted in 1977, resident and migrant fish species have been collected at sites throughout the upper and lower portions of the Hudson River. PCBs have been analyzed in aquatic macroinvertebrates collected from the Hudson since 1977. Between 1978 and 1981 zooplankton samples were collected at 13 sites in the lower Hudson and analyzed for PCBs. Between 1977 and 1981 five monitoring stations were maintained in the upper and lower portions of the river. In 1976 and 1977 an extensive program of sediment sampling and mapping that involved collection of more than 100 grab and core samples was conducted in the upper Hudson River. The processes largely responsible for the decline in surficial sediment concentrations in the lower Hudson are dilution and burial by relatively cleaner sediments recently derived from soils in the watershed. Any relaxation of the 1976 restrictions placed on commercial and recreational fishing in the Hudson River will depend on the FDA limitation and on the continued decline of PCB concentrations in fish. The differential processing in the environment of PCB congeners, in addition to the continued decline in PCB concentrations in fish, will impose greater difficulty with the use of Aroclor-based analyses to support future environmental management decisions. (Baker-IVI)
W86-01616

CALCIUM CHEMISTRY AND DEPOSITION IN IONICALLY ENRICHED ONONDAGA LAKE, NEW YORK,

Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and C. T. Driscoll.
Environmental Science and Technology, Vol. 19, No. 8, p 716-720, August, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Calcium, *Fate of pollutants, *Onondaga Lake, *New York, Particulate matter, Primary productivity, Saturation, Calcium carbonate, Phosphorus, Epilimnion, Light attenuation.

The chemistry of aqueous calcium and the deposition of particulate calcium were studied in the epilimnion of calcium-polluted Onondaga Lake, NY, over a productive 7-month period. To evaluate calcium transformations, the water column was monitored for a number of pertinent water-quality parameters, and sediment traps were used to collect particulate material that settled from the epilimnion. Thermodynamic calculations indicate that the epilimnion of Onondaga Lake was oversaturated with respect to the solubility of CaCO3 (pK sub 80 = 8.48) for the entire period of summer stratification. The extent of oversaturation with respect to the solubility of CaCO3, and particulate calcium deposition, was significantly correlated with primary productivity. In-lake formation of CaCO3 not only influences calcium transport but also appears to enhance the downward transport of phosphorus and organic carbon, and contributes to light attenuation. (Author's abstract)
W86-01618

METHYLATION OF TIN AND LEAD IN THE ENVIRONMENT: OXIDATIVE METHYL TRANSFER AS A MODEL FOR ENVIRONMENTAL REACTIONS,

Leicester Polytechnic (England). School of Chemistry.
P. J. Craig, and S. Rapsomanikis.
Environmental Science and Technology, Vol. 19, No. 8, p 726-730, August, 1985. 4 Tab, 31 Ref.

Descriptors: *Lead compounds, *Tin compounds, *Methylation, *Fate of pollutants, Oxidation, Methyllead, Methyltin, Chemical reactions, Metals.

Methyltin and methyllead compounds (whose origin may not be gasoline anti-knock compounds) have been found in natural waters; these may be derived from environmental methylation. Reactions of tin and lead compounds with methyl carbonium ion donors were investigated because these metals are capable of undergoing oxidative addition reactions to the IV valence state. Tin(II) and lead(II) compounds were converted to methyltin and methyllead derivatives under conditions that model the natural environment, demonstrating the feasibility of environmental methylation for these elements and their compounds. Methylating agents that transfer methyl groups by oxidative addition and that occur environmentally were used (viz., CH3I, (CH3)3S(+)I(-), and (CH3)3N(+)CH2COO(-)). The reactions occurred at ambient temperatures in aqueous media. The results in general demonstrate that a mechanism does exist that can explain the observed detection of methyltin and (non-gasoline derived) methyllead compounds in the environment. Three natural methylating agents are capable of environmental methylation, and these are models for other naturally occurring methylating agents. (Moore-IVI)
W86-01619

CHEMICAL COMPOSITION OF FOGWATER COLLECTED ALONG THE CALIFORNIA COAST,

California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
D. J. Jacob, J. M. Waldman, J. W. Munger, and M. R. Hoffmann.
Environmental Science and Technology, Vol. 19, No. 8, p 730-736, 1985. 2 Fig, 6 Tab, 40 Ref. California Air Resources Board contract A2-048-32.

Descriptors: *Fog, *Chemical composition, *Acidity, *California, Coastal areas, Fogwater, Acid deposition, Chlorides, Nitrates, Air pollution, Water pollution sources, Urban areas.

Fogs are frequent seasonal occurrences along the California coast, and fogwater may have important local implications for acid deposition. Fogwater was sampled at eight coastal sites and one island site, using a rotating arm collector. Fogwater collected at both urban and nonurban coastal sites was found to be consistently acidic. Millimolar concentrations of NO3(-), and fogwater pH values below 3, were observed at sites downwind of the Los Angeles basin. Fogwater pH dropped down to 1.69 at a site downwind of the Los Angeles basin during a high sulfate pollution episode. The marine, continental, and anthropogenic contributions to the fogwater composition were determined from a source apportionment matrix for primary California aerosol. Fogwater composition at remote sites showed evidence of substantial continental and anthropogenic contributions. Acid-neutralizing capacities in coastal air were found to be very low and insufficient to neutralize even small acid inputs. Chloride loss in fogwater relative to its sea salt contribution was observed at sites furthest from anthropogenic sources. (Moore-IVI)
W86-01620

IDENTIFICATION OF NEW, FLUORINATED BIPHENYLS IN THE NIAGARA RIVER-LAKE ONTARIO AREA,

Indiana Univ., Bloomington. Dept. of Chemistry.
R. Jaffe, and R. A. Hites.
Environmental Science and Technology, Vol. 19, No. 8. p 736-740, August, 1985. 5 Fig, 1 Tab, 33 Ref. EPA grant 808961.

Descriptors: *Water pollution sources, *Fluorinated biphenyls, *Niagara River, *Lake Ontario, *Niagara Falls, *New York, Halogenated hydrocarbons, Fish, Sediments, Hazardous wastes, Waste dumps.

Bloody Run is a small creek that drains the Hyde Park hazardous waste dump in Niagara Falls (New York). Bloody Run Creek flows into the Niagara River, which is the major water source for Lake Ontario. Lake Ontario sediment cores were taken from the major sedimentation basins; sediment grab samples were collected from Bloody Run Creek, and the creek system adjacent to the Love Canal. Fish were sampled for the Niagara River, Lake Ontario, and the Little Niagara River. Sediment and fish samples were analyzed by capillary gas chromatographic mass spectrometry using negative ion methane chemical ionization. A series of bis(trifluoromethyl)-substituted polychlorinated biphenyls was discovered. These compounds were present in fish as well as in sediments, and their major source seems to be the Hyde Park dump in the city of Niagara Falls, NY. The concentrations of all compounds are 4-6 orders of magnitude higher in the Bloody Run Creek sediment than in Lake Ontario. (Moore-IVI)
W86-01621

COMBINED EFFECT OF GEOLOGY, PHOSPHATE SOURCES AND RUNOFF ON PHOSPHATE EXPORT FROM DRAINAGE BASIN,

Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
D. C. Grobler, and M. J. Silberbauer.
Water Research, Vol. 19, No. 8, p 975-981, 1985. 2 Fig, 2 Tab, 27 Ref.

Descriptors: *Phosphates, *Geological formations, *Runoff, *South Africa, Catchment areas, Water pollution sources, Non-point pollution sources, Bioavailability, Particulate matter.

A large degree of uncertainty is usually associated with phosphate loads estimated by means of export coefficients. Methods of reducing this uncertainty were investigated. Soluble and total phosphate export coefficients were calculated for 7 South African catchments over periods covering 3-5 years. Spatial variance in the export coefficients could largely be accounted for if catchments were grouped according to their geological characteristics; those in the upper Limpopo River drainage basin having igneous and those in the Vaal River drainage basin having sedimentary geological formations. A secondary, but nonetheless important factor contributing to the spatial variance of export coefficients was whether or not a particular catchment contained mainly point or mainly non-point sources. After catchments were grouped according to these two factors, 74%-99% of temporal variance of export coefficients could be explained by fitting linear regression equations to phosphate export vs runoff. The possible link between the bio-availability of particulate phosphorus and catchment geology is discussed. The significance of such a link, with regard to phosphate load estimates and making projections of future trophic status, is emphasized. (Author's abstract)
W86-01639

NITRATE BEHAVIOUR IN STREAMFLOW FROM A GRASSLAND CATCHMENT IN DEVON, U.K.,

Exeter Univ. (England). Dept. of Geography.
B. W. Webb, and D. E. Walling.
Water Research, Vol. 19, No. 8, p 1005-1016, 1985. 12 Fig, 3 Tab, 25 Ref.

Descriptors: *Nitrates, *Grasslands, *River Dart, *Devon, *England, Runoff, Seasonal variation, Storm runoff, Magnesium, Pollution load, Streams, Catchment area.

NO3-N levels and loadings in the River Dart, Devon, U.K. have been intensively monitored during the study period February 1975-January 1983, and NO3-N behavior in streamflow is compared with that of Mg which has predominantly contrasting origins and controls in runoff. A strongly developed annual regime characterizes daily mean NO3-N concentrations which peak at 4.5 mg/l in December and reach a minimum of 1.1 mg/l in early autumn, and this regime is reflected in a positive relationship between NO3-N concentration and discharge. Storm-period NO3-N behavior also exhibits a marked seasonal variation, and 'dilution' responses are typical of the winter period whereas a 'concentration' effect is more characteristic of summer months and is attributed to the influence of soil throughflow. Spring and autumn are associated with a transition in storm-period behavior, and the reaction of NO3-N concentrations during individual events or over a sequence of storms at any time of the year may also vary in response to a complex interplay of factors. NO3-N transport is more strongly biased towards storm events than is Mg, and more than 50% of the total NO3-N load was removed in only 10% of the study period. The mean annual NO3-N load for the study basin (24 kg/ha) is higher than that recorded in many grassland catchments of the U.K. but does not reflect an unusually high rate of fertilizer application. Unlike several other arable and grassland drainage basins studied in Britain, there is no evidence in the River Dart of a significant upward trend in NO3-N concentrations and loads since 1975. (Author's abstract)
W86-01642

ROLE OF MN(2+)-RICH HYDROUS MANGANESE OXIDE IN THE ACCUMULATION OF ARSENIC IN LAKE SEDIMENTS,

National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
T. Takamatsu, M. Kawashima, and M. Koyama.
Water Research, Vol. 19, No. 8, p 1029-1032, 1985. 4 Fig, 20 Ref.

Descriptors: *Arsenic, *Hydrous manganese oxide, *Lake sediments, Lake Biwa, Japan, Adsorption, Sediments, Manganese, Fate of pollutants.

The adsorption of As onto synthetic HMO and the association of Mn and As in the sediment cores from samples taken from Lake Biwa were examined. Arsenic has accumulated to high concentrations in the thin surface layers. The sedimentation rate suggests that the As-rich layers were deposited within the 4 years prior to sampling but no dramatic increase of As in flow to the lake was noted for that period. On the other hand, the coincident depth profiles of As and Mn concentrations in the cores and As concentrations up to 721 mg/kg in Mn concretions suggest that the surface accumulation of As may result from a dissolution-deposition cycle within the sedimentary column associated with that known to occur for Mn. In the absence of a divalent cation, no appreciable adsorption of arsenate onto HMO occurred between pH 6 and 8, a range often encountered in aquatic environments. There was a substantial increase in the amount of arsenate adsorbed by HMO in the presence of the divalent cations of Mn, Sr, Ba, and Ni. Hydrous Mn oxides, positively charged from the adsorption of Mn(2+) ions, could play a significant role in the accumulation of As on the surface of lake sediments. (Baker-IVI)
W86-01645

DIAGENETIC REMOBILIZATION OF MANGANESE, IRON, COPPER AND LEAD IN ANOXIC SEDIMENT OF A FRESHWATER POND,

Central Research Inst. of Electric Power Industry, Tokyo (Japan).
For primary bibliographic entry see Field 2H.
W86-01646

CHEMICAL CHARACTERIZATION OF STRATUS CLOUDWATER AND ITS ROLE AS A VECTOR FOR POLLUTANT DEPOSITION IN A LOS ANGELES PINE FOREST,

California Inst. of Tech. Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. M. Waldman, J. W. Munger, D. J. Jacob, and M. R. Hoffmann.
Tellus, Vol. 37B, No. 2, p 91-108, April, 1985. 8

Fig, 4 Tab, 55 Ref. California Air Resources Board contract A2-048-32.

Descriptors: *Cloudwater, *Acid deposition, *Forests, *Los Angeles, *Acid rain, *California, Hydrogen ion concentration, Pine trees, Nitrates, Sulfates, Rain, Fog precipitation, Calcium, Potassium.

Highly concentrated, acidic stratus cloudwater was monitored as it intercepted a pine forest (Henninger Flats) 25 km northeast of Los Angeles, California. Observed pH values ranged from 2.06 to 3.87 for over 100 samples collected in 1982 and 1983 with a median value below pH 3. The ratio of nitrate/sulfate in cloudwater samples was between 1.5 and 2; rainwater at the same site had a ratio of approximately 1. The solute deposition accompanying several light, spring rains (summing to about 1% of annual rainfall) was a disproportionate fraction of the annual total: H(+), NO3(-) and SO4(2-) were about 20% or more. Based on a reasonable estimate of fog precipitation, deposition of sulfate, nitrate and free acidity due to intercepting stratus clouds may be of comparable magnitude as that due to the incident rainfall at Henninger Flats. Cloudwater that had deposited on local pine needles was collected. It was in general more concentrated than ambient cloudwater but with comparable acidity. Enrichment of K(+) and Ca(2+) in those samples and in through fall is believed to be due to leaching from foliar surfaces. Injury to sensitive plant tissue has been noted in the literature when prolonged exposure to this severe kind of micro-environment has been imposed. (Author's abstract)
W86-01652

MODEL FOR NITRATE LEACHING IN UNDISTURBED STRUCTURED CLAY SOIL DURING UNSTEADY FLOW,

Oxford Univ. (England). Soil Science Lab.
R. E. White.
Journal of Hydrology, Vol. 79, No. 1/2, p 37-51, July, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Nitrates, *Leaching, *Unsteady flow, *Clay, Mixing, Model studies, Unsaturated flow, Solute transport, Diffusion, Chlorides, Nitrification, Soil water, Mathematical equations.

A two-domain mixing model is described for predicting nitrate leaching during unsteady unsaturated flow through soil. The model assumes that water infiltrating the soil surface mixes incompletely with resident water to form a miscible transport volume, the size of which can vary with time. Changes in solute storage within the transport volume can occur by diffusion and biological transformations. Output from the transport volume is by drainage from a lower surface in the soil. The model's output was tested against the measured amounts of NO3-N leached from large undisturbed cores of structured clay soil during constant flux irrigation with 10 mM CaCl2. The average concentration of NO3(-) and Cl(-) in the soil solution was determined by extraction of small cores taken around the large cores prior to leaching. The rate of nitrification in the soil was also measured. The change in the transport volume with time was calculated from equations for the mass balance of water and Cl(-) in the transport volume. Knowing the transport volume, analogous equations in terms of NO3(-) were solved to predict the NO3(-) concentration in the effluent. Good agreement between predicted and observed NO3-N leached was obtained for cores showing divergent trends in NO3(-) leaching. A large difference between cores in the fraction of soil NO3-N leached (0.34 compared to 0.13) was attributed to the difference in the volume of high-nitrate soil water that mixed with infiltrating water to form the transport volume, and to differences in the distribution of NO3(-) between ped faces and ped interiors. The merit of incorporating the concept of a variable transport volume into a transfer function model for predicting NO3(-) leaching is briefly discussed. (Author's abstract)
W86-01655

LEACHING FRACTION BEYOND DEPTH X, CAUSED BY PERCOLATION OF A SOIL PROFILE WITH AN INITIAL SALT ACCMULATION AT ITS SURFACE,

Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 2G.
W86-01662

GEOCHEMICAL MASS BALANCE OF A VOLCANIC CRATER LAKE IN AUSTRALIA,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-01663

DISPERSAL PATHWAYS FOR PARTICLE-ASSOCIATED POLLUTANTS,

Exxon Production Research Co., Houston, TX.
R. A. Young, D. J. P. Swift, T. L. Clarke, G. R. Harvey, and P. R. Betzer.
Science, Vol. 229, No. 4712, p 431-435, August, 1985. 5 Fig, 27 Ref.

Descriptors: *Dispersion, *Path of pollutants, *Fate of pollutants, *New York Bight, *New York, *Particulates, Water pollution sources, Ocean dumping, Coastal waters, Model studies, Estuarine environment, Sediment transport, Particulate transport.

A prototype study of the effects of dumping of anthropogenic wastes into the ocean has been the New York Bight Program of the National Oceanic and Atmospheric Administration. Particle-associated pollutants (totaling 10 to the 7th power metric tons per year) are introduced into the New York Bight by ocean dumping, estuarine discharge, sewage outfalls, eolian transport, and shipping waste and spillage. Because pollutants are associated with fine sediment particles, their fate in the New York Bight is intimately related to sediment transport processes. Sediment transport in the Bight is not a simple function of fluid transport. A combined flow boundary layer model was developed to improve near-bottom sediment transport predictions, and semiempirical relations were derived to predict resuspension of the small amounts of pollutant-bearing mud dispersed in the sand-dominated substrate. Oceanic and estuarine circulation processes dilute and transport the particles by a natural dispersal system that also tends to be highly distributive; particle-associated pollutants apparently seek the same sinks in the Hudson River shelf valley and intracoastal wetlands, regardless of their point of introduction. These sinks are inferred to be largely within the intracoastal zone of marshes, estuaries, and lagoons, and it is these areas that may determine the pollutant-related assimilative capacity of the New York Bight Apex as a whole. (Collier-IVI)
W86-01677

GROUND WATER QUALITY ANOMALIES ENCOUNTERED DURING WELL CONSTRUCTION, SAMPLING AND ANALYSIS IN THE ENVIRONS OF A HAZARDOUS WASTE MANAGEMENT FACILITY,

Woodward-Clyde Consultants, Walnut Creek, CA. Environmental and Engineering Services.
For primary bibliographic entry see Field 5A.
W86-01700

BIOGEOCHEMISTRY OF LEAD IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,

Oak Ridge National Lab., TN.
R. S. Turner, A. H. Johnson, and D. Wang.
Journal of Environmental Quality, Vol. 14, No. 3, p 305-314, 1985. 8 Fig, 7 Tab, 38 Ref. U.S. Dep. of Energy contract DE-ACO5-840R21400.

Descriptors: *Geochemistry, *Biochemistry, *Lead, *McDonalds Branch watershed, *Pine Barrens, *New Jersey, *Heavy metals, Metals, Fate of pollutants, Atmospheric deposition, Water pollution sources, Air pollution, Precipitation, Plant tissues, Forest soils, Soil horizons.

Lead concentrations, fluxes, and storage were measured in the vegetation, forest floor, and acid, sandy mineral soil (Quartzip-samments) of a forested watershed watershed in the New Jersey Pine Barrens. Atmospherically deposited Pb at the McDonalds Branch Watershed was 140 g/ha/yr (8 micro-g/L in bulk precipitation) in 1980 to 1982, a substantial reduction from 350 g/ha/yr (17 micro-g/L in bulk precipitation) in 1978 and 1979. Virtually all Pb falling on the uplands was retained - 75% by the organic forest floor and 25% by mineral soils, especially in B and C soil horizons. Total Pb content of the forest floor was 7.6 kg/ha, with an accumulation rate of 100 g/ha/yr (1980-1982), or 1.3% of the forest floor pool. Estimated mean residence time of Pb in the forest floor was 220 yr. About 35 g Pb/ha/yr moved out of the forest floor in solution through the E horizon and was correlated strongly with dissolved organic matter. Approximately 30 g Pb/ha/yr accumulated in the B and C soil horizons. Less than 1 g Pb/ha/yr percolated past a depth of 2 m. Lowland muck soils and vegetation accumulated 98% of incoming Pb, with only 3.2 g Pb/ha/yr exported in the stream. Lead concentrations in the stream were correlated positively with dissolved organic matter and water level in the swamps. Lead in biota was contained mainly in the bark, fine roots, and foliage. Concentrations were: Fine roots (18 mg/kg) > bark (15 mg/kg) > foliage (4 mg/kg) > wood (0.5 mg/kg). Although Pb concentrations in herbs, mosses, and lichens ranged from 10 to 60 mg/kg, these plants accounted for very little biomass. Total Pb content of biota was 355 g/ha, about 4% of the forest floor Pb content. (Author's abstract)
W86-01703

BIOGEOCHEMISTRY OF ALUMINUM IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,

Oak Ridge National Lab., TN.
R. S. Turner, A. H. Johnson, and D. Wang.
Journal of Environmental Quality, Vol. 14, No. 3, p 314-323, 1985. 7 Fig, 5 Tab, 42 Ref.

Descriptors: *Biochemistry, *Geochemistry, *Aluminum, *McDonalds Branch watershed, *Pine Barrens, *New Jersey, *Trace metals, *Fate of pollutants, Acid precipitation, Forest soils, Plant tissues, Soil horizons, Soil water, Hydrogen ion concentration, Metals, Water pollution effects.

Aluminum concentrations, fluxes, and storage were measured in the vegetation, forest floor, and acid, sandy mineral soil of a forested watershed in the New Jersey Pine Barrens. Volume-weighted mean Al concentrations in solution increased as water passed through the upland ecosystem, from 0.012 mg/L in bulk precipitation to 0.14 mg/L in throughfall to 0.45 mg/L in E horizon mineral soil, 0.60 mg/L in the B horizon, and 0.73 mg/L in the C horizon. Weighted mean Al concentration of the stream water was 0.15 mg/L. Solution Al concentrations in different compartments of the ecosystem were related to the magnitude of moisture flux, dissolved organic carbon concentration, and pH. Soil solution and stream water Al concentrations were high in the winter and spring and low in the summer and fall, inversely following solution pH. Soil solution and stream pH were independent of precipitation pH because of internal control of H(+) concentration by the soil and an apparent 0.5-yr time lag in flushing of atmospherically deposited acids through the soil. Aluminum was partitioned strongly into the lower mineral soil horizons, but large stores of potentially labile Al were found in the upper mineral horizons and forest floor. Standing vegetation represented a relatively small pool of Al but cycled substantial amounts of Al between mineral soil and the forest floor. (Author's abstract)
W86-01704

LEAD DISTRIBUTION AND FLUXES IN A HIGH-ELEVATION FOREST IN NORTHERN VERMONT,

Pennsylvania Univ., Philadelphia.
A. J. Friedland, and A. H. Johnson.
Journal of Environmental Quality, Vol. 14, No. 3, p 332-336, 1985. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Lead, *Vermont, *Forests, *Forest soils, *Heavy metals, *Fate of pollutants, Coniferous forests, Atmospheric deposition, Water pollution sources, Metals, Leaching, Residence time, Trees, Plant tissues, Streams.

High-elevation forests receive large amounts of atmospheric lead (Pb) and accumulate it in the forest floor. In order to determine Pb partitioning in a montane, coniferous forest, forest floor and mineral soil (Haplorthods and Fragiorthods) and vegetation parts (leaves, twigs, bark, wood) were analyzed for their Pb content. Soil and stream water were sampled to estimate Pb flux. Mean Pb concentration in trees, in mg/kg, was root bark (33.0), twigs (28.3), bark (23.0) > root wood (10.4) > foliage (3), wood (3). Total Pb in above-ground biomass (trees + shrubs + herbs) was 0.89 kg/ha. Lead in the organic horizon (forest floor) was 20 kg/ha while Pb in the mineral horizon (E + B) was 63 kg/ha. Monitoring of soil water for one year yielded volume-weighted mean Pb concentrations of 3.7, 1.8, 1.1 and 1.0 micro-g/L at 3-, 12-, 25-, and 40-cm depth, respectively. Stream Pb concentration averaged 0.6 micro-g/L. Annual Pb input is estimated to be > 700 g/ha/yr. Estimated output from the forest in stream water was < 12 g/ha/yr. Annual accumulation in the forest floor is approximately 3% of the current forest floor Pb amount. At current accumulation rates, forest floor Pb amount will double in 30 to 40 yr. At current leaching rates, mean residence time of Pb in the forest floor is approximately 500 yr. The ratio of Pb input to output for the forest is 60:1. (Author's abstract)
W86-01706

REDUCTIVE DECHLORINATION OF THE PESTICIDES 2,4-D, 2,4,5-T, AND PENTACHLOROPHENOL IN ANAEROBIC SLUDGES,

Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5D.
W86-01707

DISSIPATION OF CARBARYL AND THE 1-NAPHTHOL METABOLITE IN FLOODED RICE FIELDS,

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
L. E. Deuel, K. W. Brown, J. D. Price, and F. T. Turner.
Journal of Environmental Quality, Vol. 14, No. 3, p 349-354, 1985. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Carbaryl, *Napthol, *Rice fields, *Fate of pollutants, Irrigation management, Pesticides, Insecticides, Rainfall, Crop production.

Field and laboratory experiments were conducted under flooded rice (Oryza sativa L.) culture to evaluate persistence of carbaryl (1-napthyl-N-methyl carbamate) and the 1-naphthol metabolite. Treatments consisted of two rates of carbaryl (1.12 and 5.60 kg/ha) super-imposed on two irrigation management schemes (ie, intermittent and continuous flow) to determine their potential for environmental contamination. Results showed that foliarly applied carbaryl was washed from the rice canopy into plot water and subsequently degraded via chemical and biological mechanisms. Time of sample collection and application rate had a highly significant influence on the residual levels of carbaryl in the flood water for each of the 3 yr tested. The effect of irrigation management was statistically significant in two of the three seasons studied, with greater levels of carbaryl residues observed for the intermittent irrigation scheme. Carbaryl residues in plot water were greatest in those years when a rainfall event occurred within 24 h following the foliar spray application. A significant first order interaction between time and application rate was observed in 1973 and 1975, when measurable rainfall was recorded prior to the 24-h sampling period. The 1-Naphthol recovered in the plot water was proportional to the contamination level of the carbaryl spray formulation did not reflect the quantities of dissipated carbaryl. Field results and laboratory experiments suggested that 1-naphthol was degraded more rapidly under flooded soil conditions than carbaryl. (Author's abstract)
W86-01708

NUTRIENT RUNOFF LOSSES AS PREDICTED BY ANNUAL AND MONTHLY SOIL SAMPLING,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, S. J. Smith, W. A. Berg, and J. R. Williams.
Journal of Environmental Quality, Vol. 14, No. 3, p 354-360, 1985. 4 Fig, 6 Tab, 24 Ref.

Descriptors: *Nutrients, *Runoff, *Soil sampling, *Prediction, Phosphorus, Nitrogen, Grasslands, Nutrient transport.

The transport of soluble and particulate P and N in runoff from several cropped and grassed watersheds in Oklahoma and Texas was related to the nutrient content of surface soil (0-50 mm) sampled monthly and annually (March) over a 2-yr period in an effort to improve the prediction of nutrient transport. For both monthly and annual soil samplings, the prediction of soluble P was good for events > 0.75 mm runoff (r values ranged from 0.57 to 0.92), but smaller events were poorly predicted. The nitrite content of runoff was not closely related to surface soil content (r values ranged from 0.17 to 0.58), precluding its accurate prediction in runoff. Prediction of both particulate P and total N concentrations of individual runoff events was improved using separate equations for grassed and cropped watersheds compared to a general equation. Even so, predicted mean annual flow-weighted concentrations and amounts of soluble P, particulate P, and total N using either monthly or annual soil nutrient data were significantly related to measured values at the 0.01 level and above (r values ranged from 0.57 to 0.97). Results indicate that seasonal variation in soil nutrient content had less effect on the predictive equations than rainfall and management characteristics. Consequently, these characteristics must be accounted for before the transport equations can be reliably used on an individual runoff event basis. (Author's abstract)
W86-01709

DESCRIPTION AND APPLICATION OF AN ANIMAL WASTE PHOSPHORUS LOADING MODEL,

Wisconsin Univ.-Madison.
I. C. Moore, and F. W. Madison.
Journal of Environmental Quality, Vol. 14, No. 3, p 364-369, 1985. 6 Tab, 30 Ref.

Descriptors: *Animal wastes, *Phosphorus loading, *Nutrients, Manure, Model studies, Fate of pollutants, Water pollution sources.

An animal waste loading model was developed to estimate total phosphorus (P) loadings from winter-spread manure, barnyards and feedlots, and aboveground manure storage facilities. Literature studies were used to establish the percentage of manure P which could potentially be carried in runoff from a specific manure source. Likewise, a critical distance over which manure polluted runoff must travel as overland flow in order for P to be reduced to background levels was established. The model was tested on a 328-ha watershed in Shawano County, WI, which is devoted to dairy agriculture and where surface water was monitored and intensive land use inventories were completed. For the years 1974 to 1976, the model predicted total P loadings from animal wastes of 96.0 kg/yr, of which 24.6 kg/yr or 26% was attributed to winter spreading, and the balance of 71.4 kg/yr or 74% to runoff from barnyards and above-ground storage facilities. The animal waste model was linked to a model estimating cropland losses of total P to develop a prediction of total P losses from the watershed. Comparison between predicted and monitored values suggested that the animal waste model was a useful tool for estimating total P losses from various waste handling practices on a long-term basis. As such, it will serve as a valuable planning tool for nonpoint source abatement programs. (Author's abstract)
W86-01710

SORPTION AND TRANSPORT OF HYDROPHOBIC ORGANIC CHEMICALS IN AQUEOUS AND MIXED SOLVENT SYSTEMS: MODEL DEVELOPMENT AND PRELIMINARY EVALUATION,

Florida Univ., Gainesville. Dept. of Physics.
P. S. C. Rao, A. G. Hornsby, D. P. Kilcrease, and P. Nkedi-Kizza.
Journal of Environmental Quality, Vol. 14, No. 3, p 376-383, 1985. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Pollutant transport, *Sorption, *Organic chemicals, *Model studies, *Fate of pollutants, Solubility, Waste disposal, Solvophobic theory.

A theoretical approach, based upon the assumption of predominance of solvophobic interactions, was formulated to quantitatively describe the sorption and transport of hydrophobic organic chemicals (HOC) from aqueous and aqueous-organic-solvent mixtures. In the theoretical approach, solvent-sorbate interactions (solubility) are specifically considered in order to predict sorbate-sorbent interactions (sorption). For HOC sorption from a single solvent, the HOC sorption coefficient was shown to increase loglinearly with the hydrocarbonaceous surface area (HSA) of the sorbate. For HOC sorption from aqueous-organic binary solvent mixtures, the sorption coefficient is predicted to decrease exponentially as the fraction of organic cosolvent increases. This is a direct consequence of increased HOC solubility in the binary solvent. Because sorption and mobility of HOC are inversely related, a decrease in sorption coefficient leads to an enhanced HOC mobility as the fraction of organic cosolvent is increased. A preliminary verification of the theory was performed by an analysis of published data for (i) HOC sorption by soils and sediments from water, (ii) HOC retention by reversed-phase chromatographic sorbents during isocratic elution with methanol-water binary solvent mixture, and (iii) HOC mobility on soil-TLC plates eluted with ethanol-water mixtures. (Author's abstract)
W86-01711

USING CREAMS AND ECONOMIC MODELING TO EVALUATE CONSERVATION PRACTICES: AN APPLICATION,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
B. M. Crowder, H. B. Pionke, D. J. Epp, and C. E. Young.
Journal of Environmental Quality, Vol. 14, No. 3, p 428-434, 1985. 1 Fig, 2 Tab, 21 Ref. Pennsylvania Agricultural Exp. Stn. project 2587.

Descriptors: *Soil conservation, *Model studies, *Economic aspects, Nutrient loss, Conservation, Erosion, Agricultural runoff, Nonpoint pollution sources, Conservation tillage.

Economic modeling of the impacts of soil loss from agricultural activities traditionally has been based on the Universal Soil Loss Equation (USLE). Most studies have not considered the effects of agricultural production on N, P, and pesticides in runoff. This study, involving a representative Pennsylvania dairy farm, uses the CREAMS model (Chemicals, Runoff, and Erosion from Agricultural Management Systems) to estimate surface runoff losses of soil, plant nutrients, and pesticides. The CREAMS is a continuous simulation model that allows the user to compare the effectiveness of management practices for reducing these losses in a consistent and comprehensive manner. The usefulness of the CREAMS simulation model is demonstrated for analysis of agricultural cropping activities and their impacts on losses of chemicals and soil in runoff. Linear programming was used to simulate the impacts of farm-level water pollution restrictions on farm income. Nonpoint source pollution can be reduced without necessarily reducing farm income. Farm income levels could be maintained by adopting conservation tillage practices or by changing crop rotation. Conservation tillage was found to be the most effective method for maintaining income when water pollution restrictions were imposed. Two years of corn (Zea mays) followed by 3 yr of alfalfa (Medicago sativa) was a profitable and effective rotation for controlling runoff losses. Continuous corn, at the other extreme, caused substan-

tial losses of income when restrictions were imposed. (Author's abstract)
W86-01715

REDISTRIBUTION OF BROMIDE BY RAINFALL INFILTRATION INTO A CECIL SANDY LOAM LANDSCAPE,

Agricultural Research Service, Watkinsville, GA.
R. R. Bruce, R. A. Leonard, A. W. Thomas, and W. A. Jackson.
Journal of Environmental Quality, Vol. 14, No. 3, p 439-445, 1985. 13 Fig, 3 Tab, 12 Ref.

Descriptors: *Bromide, *Rainfall, *Infiltration, *Soil types, Solute transport, Leaching, Erosion, Topography, Permeability coefficient.

The redistribution of bromide applied to the soil surface at selected position in a sample Cecil sandy loam (clayey, kaolinitic, thermic Typic Hapludults) landscape was measured in relation to rainfall and pedon characteristics. Three bromide application sites were located in drainageway positions and three on slope positions exhibiting different degrees of erosion. Observations of nearly 4 yr measured 4.7 m of rainfall to show that rainfall was more effective in transporting Br through drainageway pedons than those on the slopes. After 1000 mm of rainfall, half of the applied Br was above 0.6 m on the slope sites and above 1.0 m on the drainageway sites. This difference seems to relate closely to the higher hydraulic conductivity in the Bt horizon above the 1.2 m in the drainageway pedons than in the slope pedons. Also, the maximum clay zones in the Bt horizons of the drainageway sites were significantly lower than those on the slope sites and occurred about 0.5 m deeper. At the completion of this study, an elevated Br level was measured in a drainageway site between 1.5 and 2.4 m with no evidence of Br below 3.8 m. These data provide a basis for assigning solute transport characteristics to the identified variability in this and similar landscapes. (Author's abstract)
W86-01716

SIMULTANEOUS IN-STREAM NITROGEN AND D.O. BALANCING,

Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
For primary bibliographic entry see Field 2H.
W86-01722

NITROGEN ACCOUNTABILITY FOR FERTILE STREAMS,

Texas Univ. at Dallas, Richardson. Callier Center for Communication Disorders.
For primary bibliographic entry see Field 2H.
W86-01723

OUTFALL DILUTION: THE ROLE OF A FAR-FIELD MODEL,

Miami Univ., Coral Gables, FL. Dept. of Civil and Architectural Engineering.
D. A. Chin.
Journal of Environmental Engineering, Vol. 111, No. 4, p 473-486, August, 1985. 10 Fig, 6 Ref.

Descriptors: *Outfall, *Far-field models, *Model studies, *Dilution, Wastewater outfall, Near-field mixing, Far-field mixing, Fate of pollutants, Path of pollutants, Coastal waters.

Effluent dilutions predicted by near-field models do not realistically reflect near-field conditions in tidally influenced coastal waters since they neglect the advection of the pollutant cloud over the source. A theoretical solution has been developed for the case in which a conservative pollutant is released from a line source into a uniform unsteady flowing ambient where diffusion is only significant in the cross-stream direction. Considering the case of a sinusoidal variation of velocity along the streamwise principal axis, it has been shown that the expected concentration at a source located in a typical flow field may increase by as much as 15% per cycle over that predicted by the near-field model. A hypothetical outfall was analyzed using real data and a dispersion model which accounts for the near-, as well as far-field mixing. The near-field model was found to underestimate the average dilution at the source by about 21%. Extreme values were also underestimated. The results of this study indicate that a complete dispersion model should be used in predicting dilutions in outfall mixing zones of coastal regions. (Author's abstract)
W86-01727

SIMULATION OF TWO-FLUID RESPONSE IN VICINITY OF RECOVERY WELLS,

Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-01733

OCCURRENCE AND DISSIPATION OF HIGH LEAD LEVEL EPISODES IN THE LOWER MISSISSIPPI RIVER,

Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
I. A. Kahwa, and E. J. Newchurch.
Journal of Environmental Sciences and Health, Vol. A20, No. 4, p 395-417, 1985. 8 Fig, 1 Tab, 11 Ref.

Descriptors: *Lead, *Heavy metals, *Mississippi River, Water pollution, Path of pollutants, Metals, Fate of pollutants.

Previous investigations involving lead in the lower Mississipi River generally reported low levels, prompting the conclusion that human activity has not resulted in undesirable lead levels in the river water. Our studies reveal that of 435 samples collected between 1978 and mid-1983 from stations at river miles 266, 202, 147, 120, 75 and 49, about 9% had total lead levels exceeding the EPA allowable for drinking water. These values include one of 10,000 micro-g/l and 5 larger than 500 micro-g/l (10 times the EPA allowable). On the basis of the observed variability of lead levels in time and distance, it is concluded that (a) the high lead levels are associated with the Lutcher-Luling-Belle Chasse river stretch (i.e., river miles 147-75); (b) the problem is a result of human activity; and (c) there are mechanisms for the relatively rapid removal of lead and/or dilution of high-lead episodes as the river water flows down stream. (Author's abstract)
W86-01735

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA; 1. THE NONREACTIVE CASE,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W86-01775

EXPERIMENTAL INVESTIGATION OF SOLUTE TRANSPORT IN STRATIFIED POROUS MEDIA 2. THE REACTIVE CASE,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W86-01776

STREAMFLOW NITROGEN LOSS FOLLOWING FOREST FERTILIZATION IN A SOUTHERN VANCOUVER ISLAND WATERSHED,

Pacific Forest Research Centre, Victoria (British Columbia).
E. D. Hetherington.
Canadian Journal of Forest Research, Vol. 15, No. 1, p 34-41, February, 1985. 5 Fig, 6 Tab, 33 Ref.

Descriptors: *Fertilization, *Nitrogen, *Forest watersheds, *Vancouver Island, *British Columbia, Fir trees, Water quality, Urea, Ammonia, Nitrates, Fate of pollutants, Nitrification, Streams.

Water quality was monitored in the Lens Creek watershed on southern Vancouver Island (British Columbia) to determine nitrogen loss following fall application of 224 kg N/ha urea fertilizer on a second-growth Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) forest. Peak nitrogen concentrations measured in two small tributary streams were 14 mg/L as urea, 1.9 mg/L as ammonia, and 9.3 mg/L as nitrate. For the first 14 months, estimated nitrogen outputs in excess of background amounts were 5.9 and 14.5% of the total applied nitrogen for the two subsidiary watersheds with 46 and 80% of their drainage areas fertilized, respectively. These losses were considerably higher than amounts of less than 1% previously reported for western North America. Increased levels of urea N and ammonia N were short-lived, while nitrate N remained above background levels for the study duration. Reasons for the high nitrogen loss include nitrification of the urea during 7 weeks of mild, dry weather following fertilization, presence of alder and swampy areas adjacent to the streams, high soil permeability, steep slopes, and abundant, above average early winter rainfall. The watersheds had been previously fertilized, but any influence of this first fertilization on nitrogen loss during the present study in unknown. Lens Creek water quality was not adversely affected by the fertilization in terms of drinking water standards or toxicity to fish. (Author's abstract)
W86-01784

DISTRIBUTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE SURFICIAL SEDIMENTS OF PENOBSCOT BAY (MAINE, USA) IN RELATION TO POSSIBLE SOURCES AND TO OTHER SITES WORLDWIDE,

Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
A. C. Johnson, P. F. Larsen, D. F. Gadbois, and A. W. Humason.
Marine Environmental Research, Vol. 15, p 1-16, 1985. 2 Fig, 2 Tab, 31 Ref. NOAA-NMFS contract NA-80-FA-C-0008.

Descriptors: *Polycyclic aromatic hydrocarbons, *Sediments, *Penobscot Bay, *Maine, Hydrocarbons, Aromatic compounds, Air pollution, Particulate matter, Combustion products, Water pollution sources.

Sediments from the Penobscot Bay region of the Gulf of Maine were analyzed by high pressure liquid chromatography and gas chromatography-mass spectrometry for polycyclic aromatic hydrocarbons (PAHs). Total PAH concentrations ranged from 286 to 8794 ppb (dry weight) and formed a distinct gradient decreasing seaward from the head. Gradients of decreasing concentration were also measured in the various harbors in the bay. PAH composition was uniform throughout Penobscot Bay. Atmospherically transported particulate combustion products are hypothesized as a major source of PAH contamination. Sedimentary PAH concentrations from around the world which have been reported in the literature are compiled in a table. PAH levels in Penobscot Bay sediments fall within the range found in industrialized regions throughout the world and are significantly higher than would be expected for an area previously considered to be uncontaminated. (Author's abstract)
W86-01795

TRACE METALS AND HYDROCARBONS IN SEDIMENTS FROM THE SOUTHAMPTON WATER REGION, WITH PARTICULAR REFERENCE TO THE INFLUENCE OF OIL REFINERY EFFLUENT,

Southampton Univ. (England). Dept. of Oceanography.
H. Armannsson, J. D. Burton, G. B. Jones, and A. H. Knap.
Marine Environmental Research, Vol. 15, p 31-44, 1985. 2 Fig, 2 Tab, 35 Ref.

Descriptors: *Trace metals, *Hydrocarbons, *Sediments, *Southampton Water, *England, Estuarine environment, Oil refineries, Effluents, Cobalt, Nickel, Copper, Zinc, Silver, Cadmium, Mercury, Water pollution sources.

The concentrations of a number of trace metals (Co, Ni, Cu, Zn, Ag, Cd and Hg) have been determined in sediments from cores collected in the Southampton Water region (England). Meas-

urements of total hydrocarbons were also made on several of the cores. Markedly elevated concentrations of copper, up to 362 micro-g/g dry wt, were found in sediments which were collected close to the discharge points of oil refinery outfalls and which also showed concentrations of total hydrocarbons considerably greater than the background levels for the estuary. The results of selective chemical extractions showed that much of the copper was present in the non-lattice fraction of the sediment. Although the concentrations of Co, Ni, Zn, and Cd were significantly correlated with those of copper in the core showing the highest concentrations of this element, these metals were not enhanced in comparison with the levels found in several other parts of the estuary. Variations in concentrations of metals in sediments throughout the estuary were not correlated with differences in organic carbon content. (Author's abstract)
W86-01797

SULFIDE CONTROL OF CADMIUM AND COPPER CONCENTRATIONS IN ANAEROBIC ESTUARINE SEDIMENTS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
R. J. Davies-Colley, P. O. Nelson, and K. J. Williamson.
Marine Chemistry, Vol. 16, No. 2, p 173-186, 1985. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Sulfides, *Cadmium, *Copper, *Anaerobic conditions, *Sediments, *Estuarine environment, Geochemistry, Chemical reactions, Trace metals, Heavy metals, Iron sulfide, Metals, Pore water, Fate of pollutants.

Equilibrium concentrations of the toxic trace metals copper and cadmium were calculated for the physco-chemical conditions characterizing pore waters of anaerobic estuarine sediments using available thermodynamic data and assuming simple sulfide minerals control solubilities. Polysulfide complexes are responsible for the solubility of copper in the cuprous (Cu(I)) oxidation state. Predicated copper concentrations, assuming covellite (CuS) is the controlling solid phase, are in reasonable agreement with copper analyses in a wide range of sulfidic waters and sediment pore waters. In the absence of thermodynamic data, no account could be taken of possible polysulfide complexes of cadmium. However, bisulfide complexes appear to account satisfactorily for observed solubilities assuming the existence of greenockite (CdS) as the controlling solid phase. Anaerobic estuarine sediments may act as a sink for copper and cadmium in the common situation in which free sulfide concentrations are controlled by the coexistence of iron sulfide and iron oxide minerals. However, where free sulfides reach high concentrations of 0.001 M or more the concomitant increase in concentration of bisulfide and polysulfide complexes may result in the sediments acting as a source of copper and cadmium. (Author's abstract)
W86-01800

SELF-SIMILAR CHARACTER OF THE PROPAGATION OF A DENSITY FRONT IN A SHALLOW WATER BODY,

Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
A. G. Kostyanoi, and G. I. Shapiro.
Water Resources, Vol. 11, No. 4, p 335-342, July-August, 1984. 6 Fig, 14 Ref. Translated from Vodnye Resursy, No. 4, p 82-89, July-August 1984.

Descriptors: *Water intrusions, *Density fronts, *Plumes, *Heated water, *Power plants, Thermal pollution, Laminar flow, Viscosity, Shallow water.

Currents caused by differences in the density of contracting water masses occur during discharge of warm waters by electric power stations and industrial enterprises, penetration of sea water as a salt wedge into river estuaries and for other reasons. All cited works on slow intrusions, both experimental and theoretical, pertain to the case of a deep water body, when the viscous boundary layer does not have time to spread to the bottom during the characteristics time of evolution of the front, so that all changes in the velocity of the fluid are concentrated near the intrusion layer. More complex is the case of slow fluid flows in a shallow water body, when the boundary layers spread relatively rapidly, so that the vertical velocity gradients in any layer and bottom friction can no longer be neglected. Such a case was theoretically examined on a model of a two-layer stratified fluid. If the frontal surface intersects the free surface of the fluid or the bottom, forming a front, then the equations describing the evolution of the frontal surface are essentially nonlinear, since in the zone of the front the thickness of the corresponding fluid layer vanishes. Therefore the deviations of the frontal surface from an equilibrium position are comparable with the thickness of one of the layers and they cannot be considered small. Consequently linearization of the equations near the front is inadmissible. Nevertheless, in certain cases it is possible to obtain a number of results analytically and to compare theory and experiment. Particular concern in this work centers on the slow plane-parallel flows of a viscous incompressible two-layer density-stratified fluid in a shallow water body. (Baker-IVI)
W86-01807

EFFECT OF THE CONTENT OF ORGANIC MATTER IN SOIL ON LEACHING OF CHEMICAL FERTILIZERS INTO THE ZONE OF AERATION AND GROUNDWATERS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. V. Lola, N. P. Akhmet'eva, and Yu. A. Medovar.
Water Resources, Vol. 11, No. 3, p 223-227, May-June, 1984. 2 Fig, 4 Tab, 4 Ref. Translated from Vodnye Resursy, No. 3, p 68-72, May-June, 1984.

Descriptors: *Organic matter, *Soil, *Leaching, *Fertilizers, Groundwater pollution, Aeration zone, Nitrogen, Potassium, Phosphorus, Sediments.

To study the possibility of the penetration of fertilizer components into groundwaters, experiments were conducted on the application of fertilizers at rates of 100 kg/ha of active ingredient of each fertilizer. In field experiments, increasing rates of organic sediments, from 50 to 2000-3000 tons/ha, were applied to the soil. The yield of barley grain increased, and simultaneously the mobility of biogenic elements in the soil decreased. The soil application of organic sediments in amounts greater than 500 tons/ha is economically unprofitable, and technically difficult to accomplish. Application rates of organic sediments less than 500 tons/ha do not produce sufficiently high yields. The effect of organic sediments applied to the soil on its adsorbing capacity for chemical fertilizers was studied. An increase in the content of organic matter in soil led to retention of ammonium and nitrate nitrogen in the zone of aeration. Without the application of bottom sediments, the concentration of nitrate nitrogen was at the usual level found in unfertilized soil. Generally, an increase in the content of nitrogen, phosphorus, and potassium was observed in the plow layer with increased application rates of organic matter. The exception was water soluble potassium, the content of which was minimum in the variant with the maximum application rate of organic matter. A decrease in leaching of biogenic elements was noted with an increase of application rate of organic sediments, except nitrate nitrogen. (Baker-IVI)
W86-01822

PHOTOCHEMICAL BEHAVIOR OF CHLORSULFURON IN WATER AND IN ADSORBED PHASE,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
M. Herrmann, D. Kotzias, and F. Korte.
Chemosphere, Vol. 14, No. 1, p 3-8, 1985. 3 Fig, 15 Ref.

Descriptors: *Photochemistry, *Chlorsulfuron, *Fate of pollutants, Herbicides, Natural waters, Solar radiation, Ultraviolet radiation, Photosensitivity, Fate of pollutants.

The photochemistry of the herbicide chlorsulfuron (2-chloro-N-((4-methoxy-6-methyl-1,3,5-triazinyl-2-amino)carbonyl)benzene sulfonamide) was investigated in methanol, distilled water, natural creek-water, on silica gel and on montmorillonite surfaces. Two major photoproducts were identified in all cases. Under indoor conditions half-lives of chlorsulfuron were 92 hr in methanol, 78 hr in distilled water but only 18 hr in natural creek water. On silica gel the half-life was 60 hr while on montmorillonite powder the half-life was slightly prolonged (66 hr). This ranking of the photostability in different media was confirmed by a series of outdoor experiments under solar radiation conditions. Assuming first order kinetics the half-life times were calculated as 186 hr for distilled water, 31 hr for creek water, 136 hr for silica gel and 115 hr for montmorillonite. The stability of chlorsulfuron in methanol or water can be easily explained by the ultraviolet spectra of the compound. The significant accelerated breakdown rate in creek water samples must be due to their content of photosensitizing agents or to the generation of OH-radicals and other reactive species. (Moore-IVI)
W86-01849

RING TEST OF A METHOD FOR ASSESSING THE PHOTOTRANSFORMATION OF CHEMICALS IN WATER,

European Chemical Industry Ecology and T9oxicology Centre, Brussels (Belgium).
J. Lemaire, J. A. Guth, O. Klais, J. Leahey, and W. Merz.
Chemosphere, Vol. 14, No. 1, p 53-77, 1985. 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Photochemistry, *Pentachlorophenol, *Dichlorophenol, *Dichloroaniline, *Nitrophenol, Phenols, Anilines, Fate of pollutants, Computers.

Seven types of apparatus have been used to measure the quantum yields for direct phototransformation in water of 4 chemicals (pentachlorophenol; 2,4-dichlorophenol; 3,4-dichloroaniline; 4-nitrophenol) under polychromatic (12 laboratories) and monochromatic (3 laboratories) light, according to a common test protocol. The results with both types of light were in good agreement. The reproducibility and accuracy of quantum yields obtained with the ECETOC/University of Clermont-Ferrand apparatus with polychromatic light (6 laboratories) were similar to or better than those obtained with monochromatic light. A disadvantage of the method with polychromatic light is that the calculation is more complicated, but this can be overcome by the use of a desk-top computer. On the other hand experiments with polychromatic light permit the determination of quantum yields of substances of low photo-reactivity. (Author's abstract)
W86-01850

EFFECT OF HYDROCARBON MIXTURES ON ADSORPTION OF SUBSTITUTED NAPHTHALENES BY CLAY AND SEDIMENT FROM WATER,

Virginia Inst. of Marine Science, Gloucester Point.
W. G. MacIntyre, and P. O. deFur.
Chemosphere, Vol. 14, No. 1, p 103-111, 1985. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Naphthalenes, *Hydrocarbons, *Adsorption, Clay, Sediments, Fuel, Fate of pollutants, Mixtures, Isotherms.

Similarity of adsorption coefficients for a compound from hydrocarbon mixtures in water solution and from the single compounds in water solution would indicate that different hydrocarbons at low concentrations do not compete for adsorption sites when surface coverage is imcomplete, and that the hydrocarbons do not interact in aqueous solution. Adsorption of methyl and dimethyl napthalenes, and of these compounds as components of JP8 aviation fuel and synthetic jet fuel mixtures, was measured on two sediments and montmorillonite clay in water. Isotherms were linear, and hydrocarbons of similar structure gave similar adsorption coefficients on a particular clay or sediment. Individual component adsorption co-

efficients were dependent upon mixture composition, but coefficients usually varied by less than a factor of two. This implies that single component adsorption coefficients may be adequate for use in environmental fate models of hydrocarbon mixtures. It is probable that results obtained pertain to mixtures containing other non-polar solutes such as chlorinated hydrocarbons. (Moore-IVI)
W86-01852

FATE AND TOXICITY OF HIGH DENSITY MISSILE FUELS RJ-5 AND JP-9 IN AQUATIC TEST SYSTEMS,

Georgia State Univ., Atlanta. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-01854

EFFECT OF FLOOD CONDITIONS ON THE GROUNDWATER QUALITY OF A BOREHOLE AT BARODA NEAR CRADOCK, EASTERN CAPE PROVINCE,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
E. A. W. Tordiffe, W. A. Van Der Westhuizen, and H. De Bruiyn.
Water S. A., Vol. 11, No. 1, p 33-34, January, 1985. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Floods, *Groundwater pollution, *Baroda, *South Africa, Irrigation effects, Chlorides, Sulfates, Sodium, Salts.

Analyses of groundwater samples taken at various time intervals over a period of several months from a single borehole, proved that significant changes in the inorganic quality occurred after periods of extreme flood conditions. The main changes which occurred, one and a half months after devastating floods, were an increase in the Cl(-), SO4(2-) and Na(+) concentration, while only a slight decrease in the HCO3(-) concentration was detected. This phenomenon is attributed to accumulation of salts in the soils and rocks above the groundwater table during normal conditions and the flushing thereof due to extremely wet conditions. The present practice of over-irrigation in the area due to readily available Orange River water could simulate similar flood conditions. (Author's abstract)
W86-01860

WATER QUALITY OF A SMALL URBAN CATCHMENT NEAR DURBAN, SOUTH AFRICA,

Durban-Westville Univ. (South Africa). Dept. of Geography.
G. du T. De Villiers, and E. Malan.
Water S. A., Vol. 11, No. 1, p 35-40, January, 1985. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Water pollution sources, *Catchment area, *Urban areas, *South Africa, Water quality, Wastewater pollution, Dissolved solids, Sodium, Chlorides, Ammonium, Industrial wastes, Swimming pools.

A preliminary study of baseflow water quality was conducted at a small urban catchment about 15 km northwest of Durban, South Africa. An attempt was made to explain the variations in anion and cation concentrations through on site inspections and discussions with the relevant local authorities. The geological formations in the catchment, consisting mainly of Table Mountain Sandstone, have a limited effect on the water quality. Pollution in the catchment is rather the determining agent. Mineralization of the surface waters is still reasonably low, with the mean total dissolved solids for the period at all the sampling points at 185 mg/l. The waters are dominated by sodium with the relative concentrations Na>Ca>Mg>K. The relatively high chloride content measured at some stations in a residential area could possibly be attributed to swimming pool effluent. The high SO4 concentration at one station is due to spillage by at least two industrial concerns. The relatively high NH4-N concentration at some sampling stations could be due to spillage from an industry and seepage from sewerage overflow. (Moore-IVI)
W86-01861

CHEMICAL COMPOSITION OF TRANSKEI RIVER WATER,

Durban-Westville Univ. (South Africa). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-01862

DEPOSITION AND PROCESSING OF AIRBORNE NITROGEN POLLUTANTS IN MEDITERRANEAN-TYPE ECOSYSTEMS OF SOUTHERN CALIFORNIA,

Pacific Southwest Forest and Range Experiment Station, Riverside, CA.
P. J. Riggan, R. N. Lockwood, and E. N. Lopez.
Environmental Science and Technology, Vol. 19, No. 9, p 781-789, 1985. 5 Fig, 5 Tab, 42 Ref.

Descriptors: *Air pollution, *Nitrates, *Atmospheric deposition, *California, Water pollution sources, Groundwater pollution, Streamflow, Throughfall, Precipitation, Fire, Chaparral, Grasslands.

Atmospheric nitrogen deposition, associated with chronic urban air pollution, has produced stream water nitrate concentrations as high as 7.0 mg of N/L in chaperral watersheds in the San Gabriel Mountains of Los Angeles County, CA. Stream water NO3(-) concentration and discharge were greatest at high flow and may contribute significantly to existing groundwater NO3(-) pollution. Annual NO3(-) discharge ranged from 0.04 to 10.0 kg of N/ha over 4 years. Canopy throughfall and precipitation inputs of 23.3 and 8.2 kg of N/ha/year were high relative to other undisturbed ecosystems nationwide. Dry deposition was apparently a major source of the throughfall nitrogen. NO3(-) concentrations from nearby, relatively unpolluted watersheds were lower by 1-3 orders of magnitude. NO3(-) yield was elevated on watersheds where chaparral was converted to grassland in 1960 and may be greatly accelerated after wildfire because of high postfire NH4(+) concentrations and rapid nitrification in terrestrial and aquatic ecosystems. (Author's abstract)
W86-01868

SORBENT CONCENTRATION EFFECTS IN LIQUID/SOLID PARTITIONING,

Michigan State Univ., East Lansing. Dept. of Civil and Environmental Engineering.
T. C. Voice, and W. J. Weber.
Environmental Science and Technology, Vol. 19, No. 9, p 789-796, 1985. 8 Fig, 4 Tab, 22 Ref.

Descriptors: *Lake sediments, *Sorption, *Model studies, *Partition coefficients, Lake Michigan, Hexachlorobiphenyl, Trichlorobiphenyl, Naphthalene, Chlorobenzene, Organic matter.

Partition coefficients developed in laboratory sorption studies have been observed to vary inversely with the concentration of sorbent solids utilized in the experimental system. A model was developed that relates this phenomenon to the complexation, or binding, of the solute by nonseparable organic matter in the liquid phase, and the subsequent sorption of both free and bound solute. It can be shown that linear partitioning in the resulting bisolute system can produce the nonlinear sorption anomalies that have been observed in isotherm studies. The model was calibrated to previously reported sorption data involving four hydrophobic environmental contaminants - 2,4,5,2',4',5'-hexachlorobiphenyl, 2,5,2'-trichlorobiphenyl, naphthalene, and chlorobenzene - and three Lake Michigan sediment samples. The strengths and weaknesses of the model along with its environmental implications are discussed. (Author's abstract)
W86-01869

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, W. L. Reichert, J. E. Stein, D. W. Brown, and H. R. Sanborn.
Environmental Science and Technology, Vol. 19, No. 9, p 836-841, 1985. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Benthic fauna, *Bioavailability, *Biotransformation, *Aromatic compounds, *Hydrocarbons, Estuarine environment, Sediments, Urban areas, Benzo(a)pyrene, Crustaceans, Clams, Shrimp, Fish, Metabolism.

Phylogenetically diverse benthic organisms (amphipods (Rhepoxynius abronius and Eohaustorius washingtonianus); clams (Macoma nasuta); shrimp (Pandalus platyceros); fish (Parophrys vetulus)) were exposed to an urban estuarine sediment (16 ppm of two to six benzenoid ring aromatic hydrocarbons (AHs)) to which trace amounts of (H-3)benzo(a)pyrene (BaP) were added. The techniques used to assess uptake and metabolism of AHs were gas chromatography/mass spectrometry (GS/MS) for AHs, high-pressure liquid chromatography/fluorescence spectrometry for AH metabolites in fish bile, and radiometric analyses for biotransformation of (H-3)BaP. Generally, the extent of metabolism of (H-3)BaP (M. nasuta < E. washingtonianus < R. abronius < or = P. platyceros approximately = P. vetulus) was negatively correlated to tissue concentrations of AHs (three to six ring), except that amphipod species accumulated higher concentrations of AHs than did clams, indicating, that other factors (e.g., feeding strategy and rate of excretion) also influenced accumulation of AHs. Radiometric and GC analyses for BaP in both sediment and tissues suggested that not all of the BaP (and presumably other AHs) extracted chemically from sediment was bioavailable. (Author's abstract)
W86-01873

CHLORINATED HYDROCARBON CYCLING IN THE BENTHIC NEPHELOID LAYER OF LAKE SUPERIOR,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. E. Baker, and S. J. Eisenreich.
Environmental Science and Technology, Vol. 19, No. 9, p 854-861, 1985. 6 Fig, 2 Tab, 31 Ref. NOAA project R/CI-10, NOAA grant NA83AA-D-00056, EPA grant Cr 810274.

Descriptors: *Benthic nepheloid layer, *Chlorinated hydrocarbons, *Lake Superior, Path of pollutants, Polychlorinated biphenyls, DDE, Hexachlorobenzene, Resuspension, Lake sediments.

The dynamics and composition of the benthic nepheloid layer (BNL) in western Lake Superior were studied with respect to the cycling of trace hydrophobic organic compounds. The BNL was enriched in t-PCB, p,p'-DDE, and hexachlorobenzene (HCB) but deficient in dissolved organic carbon relative to surface waters. Resuspension events in midsummer resulted in a 50% increase in the PCB burden in the water column. Seasonal cycling of PCB congeners was strongly dependent on their degree of chlorination, with heavier chlorinated congeners lost from the water column (t1/2 = 17-28 days at two sites). Steady-state t-PCB concentrations in the BNL were maintained over the summer by transport of lighter chlorinated congeners from the underlying sediments. DDE is an effective tracer of sediment resuspension in Lake Superior. Recycling of trace organic pollutants in the BNL serves to increase their residence times in the lake. (Author's abstract)
W86-01875

LAGRANGIAN MULTI-LEVEL MODEL OF TRANSPORT, TRANSFORMATION AND DEPOSITION OF ATMOSPHERIC SULFUR DIOXIDE AND SULFATE,

Akademie der Wissenschaften der DDR, Leipzig. Forschungsstelle fuer Chemische Toxikologie.
E. Renner, U. Ratzlaff, and W. Rolle.
Atmospheric Environment, Vol. 19, No. 8, p 1351-1359, 1985. 6 Fig, 3 Tab, 16 Ref, 1 Append.

Descriptors: *Lagrangian transport model, *Path of pollutants, *Sulfur dioxide, *Acid deposition, *Acid rain, Model studies, Sulfates, Precipitation, Air pollution, Water pollution sources.

A multi-level Lagrangian atmospheric model for transport, transformation and dry and wet deposition of sulfur dioxide and sulfate is described. All processes are assumed to be reactions of the first order. The rate constants vary diurnally and seasonally with different meteorological conditions. The variability of the concentration in the surface layer was demonstrated by two examples, near the source. In one, dispersion within 100 km of a source is considered and in the other the variation in airborne fraction of S during long-range transport is calculated. This gives some insight into the necessarily complex considerations required in order to obtain optimal arrangements for environmental protection when near- and far-field source regions are operating at the same time. The model can be used in a simple programmable desk calculator without too much expense. (Baker-IVI)
W86-01883

RADIO-TELEMETRY AS AN AID TO ENVIRONMENTAL CONTAMINANT EVALUATION OF MOBILE WILDLIFE SPECIES,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 7B.
W86-01886

CONTAMINANT RESIDUES IN FISH AND SEDIMENTS FROM LAKES IN THE ATCHAFALAYA RIVER BASIN (LOUISIANA),

Columbia National Fisheries Research Lab., MO.
R. V. Winger, and J. K. Andreasen.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 15, p 579-586, September, 1985. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Fish, *Lake sediments, *Pesticide residues, *Metals, *Atchafalaya River Basin, *Louisiana, Land use, Agriculture, Overflow, DDT, BHC, Polychlorinated biphenyls, Water pollution sources, Animal tissues.

Conversion of bottomland hardwood forests to agricultural land has reduced habitat and water quality in many lakes in the floodplain of the lower Mississippi River. The objectives of this study were to ascertain current contaminant residue concentrations in fish and sediment from lakes in the Atchafalaya River Basin and to determine the influence of overflow and agricultural land use on contaminant levels. Fish and sediment samples were collected from eight lakes that differed in overflow (no overflow, headwater overflow, backwater overflow) and land-use characteristics (presence or absence of agricultural land). Residue analysis of 24 sediment and 82 fish samples collected from the study lakes showed that contaminant residues were uniformly low. Total DDT concentrations, consisting mainly of DDE, were found in 98% of the fish samples and generally were the highest residues though they rarely exceeded 0.05 micro-g/g. Dieldrin, alpha-BHC and gamma-BHC, in concentrations rarely exceeding 0.05 micro-g/g, were detected in about 50% of fish samples. Total organochlorine pesticide and PCB residues were less than 2.00 micro-g/g in all fish from all lakes, except for a 3.46 micro-g/g total in spotted gar (Lepisosteus oculatus) from one lake. Sediments were free from pesticide residues except for occasional traces (0.01 micro-g/g) of alpha-BHC. Metal residue concentrations in fish and sediment samples were typical of uncontaminated areas. Lake systems in the Atchafalaya River Basin appeared to be relatively uncontaminated by agricultural pesticides, but metal and organic residues in fish were similar from lakes with the same land-use and overflow characteristics. (Author's abstract)
W86-01890

CONTAMINANTS IN FISH FROM GREAT LAKES HARBORS AND TRIBUTARY MOUTHS,

Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office.
D. S. DeVault.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 587-594, September, 1985. 4 Tab, 16 Ref.

Descriptors: *Great Lakes, *Pesticides, *Priority pollutants, *Fish, Polychlorinated biphenyls, Chlorinated hydrocarbons, Aromatic compounds, Aliphatic compounds, Benzene compounds, Rivers, Tributaries, Harbors.

Composite fish samples collected from Great Lakes harbors and tributaries between 1980 and 1981 were analyzed by gas chromatography and gas chromatography-mass spectrometry for a wide range of pesticides and priority pollutants. Severe polychlorobiphenyl (PCBs) contamination was observed in Sheboygan River fish with moderate to severe PCB contamination in samples from the Milwaukee, Kinnickinnic, Fox, and Ashtabula Rivers. The Ashtabula River samples also contained several chlorinated aromatic and aliphatic hydrocarbons. Polynuclear aromatic hydrocarbons were detected in fish from the Black, Kinnickinnic and Menominnee Rivers, while a number of benzene derivatives were observed in samples from the Fox and Wolf Rivers. (Author's abstract)
W86-01891

TEMEPHOS RESIDUES IN STAGNANT PONDS AFTER MOSQUITO LARVICIDE APPLICATIONS BY HELICOPTER,

Environmental Research Lab., Gulf Breeze, FL.
E. M. Lores, J. C. Moore, P. Moody, J. Clark, and J. Forester.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 308-311, September, 1985. 2 Fig, 10 Ref.

Descriptors: *Temephos, *Pesticide residues, *Water analysis, *Water pollution effects, Water pollution sources, Insecticides, Organophosphorus compounds, Organic compounds.

The concentrations of temephos in water were measured so that the application rates could be confirmed for this organophosphate insecticide to control mosquito larvae. Results are reported from residue analysis of water from two stagnant ponds following actual field applications of larvicide by helicopter at treetop level in South Florida. Site 1 was less than 0.05 ha in surface area, less than 10 cm deep, and completely covered by a tree canopy. Site 2 was greater than 0.5 ha in surface area, less than 10 cm deep and the canopy was open in the middle. The recommended application rate on the label of the 4-E formulation for mosquito larvae control is 0.5 to 1.5 fl oz/acre. Calculated residue concentrations for the intended 1 oz/acre application rate used in the study range from 250 micro-g/l for water that is 1 inch deep to 42 micro-g/l for waters that are 6 inches deep. These calculations predict concentrations of temephos that are very close to the measured concentration found immediately after the sprays. Field test results indicate that the pesticide remains intact in water up to 48 hours, and residues as high as 62 micro-g/l are found. A problem of stabilization in this study was overcome by using mineral oil as an extracting solvent until the samples could be returned to the laboratory. (Baker-IVI)
W86-01897

ORGANOCHLORINE HYDROCARBON RESIDUES IN SEDIMENTS OF TWO DIFFERENT LAGOONS OF NORTHWEST MEXICO,

Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnologia.
M. T. L. Rosales, R. L. Escalona, R. M. Alarcon, and V. Zamora.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 322-330, September, 1985. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Lagoons, *Mexico, *Yavaros lagoon system, *Huizache-Caimanero lagoon system, *Sediments, *Organic compounds, *Chlorinated hydrocarbons, Hydrocarbons, Salinity, Seasonal variation, Pesticide residues, DDT.

Sediment samples were collected seasonally during a 21 month period from the Yavaros lagoon system in Sonora Mexico and the Huizache-Caimaneros lagoon system in Sinaloa Mexico. The concentration of organochlorine residues at each sampling station was determined. Higher concentrations of organochlorine compounds in the Yavaros area were usually found from October to January. However there was not a clear distribution pattern. The highest values observed were: HCH 10.45, heptachlor 5.4, aldrin 1.85, heptachlor epoxide 4.29, dieldrin 5.85, and total DDT 7.62 micro-g/kg. The values are higher in Moroncarit lagoon and in the estero linking Moroncarit and Yavaros lagoons. Yavaros lagoon has a uniform salinity of about 37% which reflects a high marine influence. Organochlorine hydrocarbons concentration in the Huizache-Caimanero system is higher in July. The concentration of these compounds apparently follows an annual cycle which is related to the evaporation-precipitation cycle of these lagoons. The persistence of HCH in submerged tropical soils is not very long due to the microflora degradation of this compound. The cycling presence of DDT in the Huizache-Zaimanero system was unexpected. The levels of organochlorine compounds determined in the areas studied are within the same order of magnitude as those reported earlier. Total DDT values ranged from 3 to 21 micro-g/kg. (Baker-IVI)
W86-01899

EFFECTS OF GUT SEDIMENT CONTENTS ON MEASUREMENT OF METAL LEVELS IN BENTHIC INVERTEBRATES - A CAUTIONARY NOTE,

E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman.
Bulletin of Environmental Contamination and Toxicoloy, Vol. 35, No. 3, p 345-347, September, 1985. 1 Tab, 5 Ref.

Descriptors: *Sediments, *Metals, *Invertebrates, *Benthic fauna, Copper, Zinc, Lead, Iron, Manganese, Nickel, Cobalt, Tubificids, Larvae, Lampreys, Midges.

Sediments were collected subtidally in the Lower Fraser River, British Columbia for metal analysis. Three groups of organisms were collected in sufficient biomass for heavy metals analysis. Gut sediment weight of tubificids averaged 14.99% of total weight, however the metal load contributed by the gut sediment varied from a mean value of 16.4% for zinc to a mean value of 39.7% for nickel. In the case of ammocoetes larvae, average gut sediment weight was less than that for tubificids, but the metal load contributed by this sediment was much higher than in tubificids. Values varied from a mean of 20.7% for zinc to a mean of 62.0% for lead. Chironomid larvae were only occasionally collected so the sample size is small, but gut sediment metal contents also comprised a high percentage of the total metal load. It is important that digestions of whole benthic animals for tissue metal analysis include a gut sediment correction. (Baker-IV)
W86-01902

SUPERFICIAL ACCUMULATION OF HEAVY METALS IN NEAR SHORE MARINE SEDIMENTS: AN OBJECTIVE INDEX OF ENVIRONMENTAL POLLUTION,

Instituto de Investigaciones Pesqueras, Cadiz (Spain).
R. Establier, A. Gomez-Parra, and J. Blasco.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 348-353, September, 1985. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Bay of Cadiz, *Spain, *Heavy metals, *Marine sediments, *Sediments, Vertical distribution, Fate of pollutants, Zinc, Manganese, Iron, Copper, Lead, Cadmium, Salt ponds, Aquaculture.

The effect of civilization has been evaluated in the Bay of Cadiz, Spain. This area represents a densely populated and relatively enclosed coastal zone having a special interest due to the use of its salt ponds as fish farms. The vertical distribution of six heavy metals and other complementary parameters were studied at a few sampling-stations, chosen as representative sedimentary environments of this zone. A Superficial Enrichment Factor was established. In general, the content of organic carbon

and heavy metals in the sediments of this zone appeared to be determined by the granulometry of the bottom, although the vertical trend of these parameters is conditioned by the proximity of the sample station to the outlets of the urban and industrial effluents of the area. The most pronounced concentration gradients of metals correspond to the northern area, where the greater number of effluents are located. The progressive reduction with depth of typically polluting metals occurs to some extent in all the sampling stations, and an extremely complex situation was found in the more superficial layer, mainly due to changes in the redox conditions of the environment. The Superficial Enrichment Factors Values are quite variable depending on the metal and the sampling station considered. The quantities of iron and manganese have not increased greatly in recent years. In the salt ponds the influence of anthropogenic activity was similar to other places where the movement of the water is not restricted. The complex hydrodynamics of the area may give rise to anomalous distributions for some heavy metals. (Baker-IVI)
W86-01903

ABSORPTION OF CU++ BY LONG-TERM CULTURES OF DUNALIELLA SALINA, D. TERTIOLECTA, AND D. VIRIDIS,

Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-01904

ATRAZINE HYDROLYSIS IN SOILS: CATALYSIS BY THE ACIDIC FUNCTIONAL GROUPS OF FULVIC ACID,

Department of Agriculture, Ottawa (Ontario). Chemistry and Biology Research Inst.
D. S. Gamble, and S. U. Khan.
Canadian Journal of Soil Science, Vol. 65, No. 3, p 435-443, August, 1985. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Atrazine, *Hydrolysis, *Fulvic acid, *Soil water, *Fate of pollutants, Herbicides, Humic substances, Soil solution, Mathematical equations.

The catalysis of atrazine hydrolysis at 25.0 C by the types of acidic functional groups found in humic materials has been investigated. No evidence of catalysis by carboxylate ions was observed. From a knowledge of the types and number of acid functional groups in a quantitatively characterized fulvic acid, and the distributions of their KA values it was found that hydrogen ions and undissociated carboxyl groups were the only catalytic agents. The carboxyl groups have a second-order k sub AH of 7.88/days/M. Weakly acidic functional groups having Ka approximately = 10 to the 10th power showed no catalysis. A predictive equation has been produced for the half-life of atrazine in fulvic acid solutions at 25.0 C. It represents a general class of equations which should permit the practical prediction of atrazine persistence in soil solutions and other natural waters. (Author's abstract)
W86-01907

DISSOLVED COLOURED COMPOUNDS AND SUSPENDED MATTER IN THE WATERS OF THE MIDDLE WAIKATO RIVER,

Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
M. H. Timperley.
New Zealand Journal of Marine and Freshwater Research, Vol. 19, No. 1, p 63-70, 1985. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Suspended solids, *Color, *Waikato River, *New Zealand, Aromatic compounds, Turbidity, Hydroelectric plants, Organic compounds, Industrial wastewater, Pulp wastes.

Concentrations of suspended matter and filtrable hydroxylated aromatic compounds (HAC) together with turbidity and light absorbance measurements at 270 and 750 nm are reported for monthly samples, over one year, of water from the tailraces of the nine hydroelectric power stations on the Waikato River, North Island, New Zealand. Between Lakes Aratiatia and Karapiro the suspended matter concentrations increase 3-fold. The concentrations of HAC increase only slightly in all lakes except Lake Maraetai where a 3-fold increase occurs because of Kraft bleach effluent from the New Zealand Forest Products Limited, Kinleith Mill. This effluent also causes a marked increase in the absorbance at 270 nm, a measure of the brown color attributable to dissolved organic compounds. The HAC in the effluent are linearly related to absorbance at 270 nm. The use of these easily measured parameters for detecting changes in water appearance, i.e., color and clarity, are discussed. Measurements of light scattering, either turbidity or absorbance, appear to have sufficient sensitivity to detect changes in relative water clarity. The ratio of inorganic to organic suspended matter increases down the river and measurements of these two components could be used to detect changes in water appearance resulting from changes in the suspended matter composition. The absorbance at 270 nm of filtered water is a convenient and sensitive indicator of dissolved color but a range of unidentified compounds contribute to this absorbance and for control of the brown coloration caused by timber processing effluents, limits on the discharge of HAC may be more useful. (Author's abstract)
W86-01912

LEACHING STUDY OF OIL SHALE IN KENTUCKY WITH A SECTION ON HYDROLOGIC RECONNAISSANCE OF THE OIL SHALE OUTCROP IN KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
S. S. Leung, D. W. Leist, R. W. Davis, and S. Cordivola.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4073, 1984. 68 p, 18 fig, 23 tab, 48 ref.

Descriptors: *Oil shale, *Leaching, *Groundwater, *Surface water, *Water quality, Geology, *Kentucky, Knobs physiographic region, Groundwater movement, *Water pollution sources.

Oil shales in Kentucky are rocks of predominantly Devonian age. The most prominant are the Ohio, Chattanooga, and New Albany Shales. A leaching study was done on six fresh oil shale samples and one retorted oil shale sample. Leaching reagents were distilled water, 0.0005 N sulfuric acid, and 0.05 N sulfuric acid. The concentration of constituents in the leachates were highly variable. The concentration of sodium, manganese, and zinc in the retorted shale leachate was several orders of magnitude higher than those of the leachates of fresh shale samples. The major oil shale outcrop covers approximately 1,000 square miles in a horseshoe pattern from Vanceburg, Lewis County, in the east, to Louisville, Jefferson County, in the west. The Kentucky, Red, and Licking Rivers cross the outcrop belt, the Rolling Fork River flows along the strike of the shale in the southwest part of the outcrop, and the Ohio River flows past the outcrop at the ends of the horseshoe. Oil shale does not appear to significantly alter the water quality of these streams. Oil shale is not an aquifer, but seeps and springs found in the shale indicate that water moves through it. Ground water quality is highly variable. (USGS)
W86-01918

GROUND-WATER QUALITY IN WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-01919

5C. Effects Of Pollution

EVALUATION ON POLLUTION IN THE XIANG JIANG RIVER BY USING ZOOBENTHOS,

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 7B.
W86-01323

SPECIES DIVERSITY OF ALGAL FLORA IN VISHWAMITRI RIVER, BARODA (INDIA),

S.S.V.P. Santha's Science Coll., Dhule (India). P.G. Dept. of Botany.
For primary bibliographic entry see Field 5A.
W86-01325

RECONSTRUCTION OF LONG-TERM TIME SERIES FOR COMMERCIAL FISHERIES ABUNDANCE AND ESTUARINE POLLUTION LOADINGS,

Martin Marietta Environmental Systems, Columbia, MD.
J. K. Summers, T. T. Polgar, J. A. Tarr, K. A. Rose, and D. G. Heimbuch.
Estuaries, Vol. 8, No. 2A, p 114-124, June, 1985. 7 Fig, 2 Tab, 37 Ref.

Descriptors: *Estuaries, *Fish populations, *Water pollution effects, *Fisheries, Time series analysis, Climate, Statistical studies.

Time series were developed for five target estuaries and 35 target fisheries using as much of the existing data as can be found on commercial landings, fishing effort, pollution loadings, developmental activities, and habitat alterations. Missing data points from climatic and pollution time series were estimated by statistical modeling, interpolation, and assumption. A probabilistic method was developed to estimate relative stock abundance for each target species-estuary combination using estuarine-specific landings, regional landings, regional catch-by-gear, and regional effort. Based on overall literature, ecological and economic effects on commercial fisheries and fishing resources probably result from climatic variations. (Baker-IVI)
W86-01331

INVESTIGATION OF RELATIONSHIPS AMONG POLLUTANT LOADINGS AND FISH STOCK LEVELS IN NORTHEASTERN ESTUARIES,

Martin Marietta Environmental Systems, Columbia, MD.
T. T. Polgar, J. K. Summers, R. A. Cummings, K. A. Rose, and D. G. Heimbuch.
Estuaries, Vol. 8, No. 2A, p 125-135, June, 1985. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Potomac River, *Fish populations, *Time series analysis, *Water pollution effects, Estuaries, Fish, Climates.

Time series analysis by regression of categorical variables seems promising for investigating pollutant effects on stocks. The method developed here is attractive in that it yields comparative and probabilistic measures of pollutant effects relative to other population control factors. Additionally, categorical regression models seem to explain a respectable amount of stock variability, given the limited reliability of landings, effort, and pollutant data. These types of analyses will be extended to other species, pollutants, and estuaries as the project progresses. In the current study the categorical time series regressions were used to derive preliminary relationships among previous levels of stock size, climatic variables, and pollution indicators. The analysis technique evaluated hypotheses on the effects of human population changes and dredging activity on stock histories of the Potomac estuary's striped bass and American shad, for the period 1929 through 1976. While climatic factors dominate striped bass dynamics compared to the two pollution variates tested, the American shad stock showed strong dependence on human population levels, but not on dredging activity, compared to climatic factors. (Baker-IVI)
W86-01332

ABUNDANCE FLUCTUATIONS AMONG BENTHIC INVERTEBRATES IN TWO PACIFIC ESTUARIES,

Geological Survey, Menlo Park, CA.
F. H. Nichols.
Estuaries, Vol. 8, No. 2A, p 136-144, June, 1985. 4 Fig, 40 Ref. DOE contract DE-AT06-76EV-75026-96.

Descriptors: *Estuaries, *Invertebrates, *Benthic animals, Population dynamics, Water pollution effects, Puget Sound, San Francisco Bay.

Contrasting time scales and mechanisms of structural variations within two benthic communities were examined using long term studies. The usefulness of such long data sets for evaluating human impact on a given area were also examined. Large short-term variations in species abundances within a community composed predominantly of opportunistic species were revealed in a 10 year study of a San Francisco Bay mudflat. This particular study site is located in a highly urbanized estuary where it is influenced by a nearby sewage treatment facility. Rapid changes in population size of the common species impedes the detection of anthropogenic influences on community composition. Only very long term data sets may provide evidence of progressive changes. Numerical abundance of the common species also change markedly as evidence by data collected for a 20 year period on the benthic community at 200 m depths in the main basin of Puget Sound. This environment is subject to little apparent habitat disturbance. Numerical dominance shifts from one species to another at irregular, multiyear intervals. Recent increases in two heretofore rare species, and a significant increase in total numbers of individuals suggest that long term changes may be occurring in this community. The importance of measuring both the amplitude and the periodicity of fluctuations in population size of aquatic species as well as long term fluctuations and patterns in environmental factors before attempting to demonstrate the effect of anthropogenic influences on aquatic communities is demonstrated by these two long term data sets. The usefulness of long term data sets for revealing the potential importance of interactions among species in determining abundance patterns in the soft-bottom benthos is demonstrated. (Baker-IVI)
W86-01333

EUTROPHICATION AND MANAGEMENT INITIATIVES FOR THE CONTROL OF NUTRIENT INPUTS TO RHODE ISLAND COASTAL LAGOONS,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
V. Lee, and S. Olsen.
Estuaries, Vol. 8, No. 2B, p 191-202, June, 1985. 2 Fig, 7 Tab, 60 Ref. NOAA grant NA-79AA-D-00096, Federal Regional Council Grant FRC-JF-01-11.

Descriptors: *Eutrophication, *Lagoons, *Coastal waters, *Rhode Island, Nutrients, Water pollution control, Fisheries, Water pollution effects, Groundwater pollution.

The eutrophication of large coastal lagoons in Rhode Island is discussed including definition of the extent of the problem, identification of the sources of nutrient inputs and development of management initiatives. The lagoons, known locally as salt ponds, lie on the glacial outwash plain of Rhode Island's south shore and are separated from the sea by narrow coastal barriers. The nitrogen loadings per unit area of the salt ponds are 240-770 mml N per sq m per year. Nutrient enrichment of these lagoons has led to increased growth of marine macroalgae. This increased growth appears to alter the benthic habitat and shift it from a grazing to detrital food chain which is impacting on important shell fisheries. The major sources of nitrogen inputs to the salt ponds are identified as inorganic nitrogen inputs from streamflow, groundwater, runoff, precipitation and tidal inflow from offshore. The groundwater is the dominant pathway by which nitrogen enters the salt ponds. A series of management initiatives are proposed to limit inputs from present and potential development within the watersheds of the lagoons. These initiatives focus on two issues. The first is to reduce nutrient loadings from already densely developed areas. The second is to reduce the potential for further development in as yet sparsely developed areas within the watershed. The plans call for an aggressive program to maintain existing septic systems and to replace failing systems; to build and maintain settling basins for major sources of surface runoff; to limit extension of sewers into already densely developed areas, to restrict extension of water supply systems to within pond watershed boundaries so that future tie-ins do not withdraw substantial amounts of freshwater influx from one pond and divert it to another; to require buffer strips of natural vegetation around the shoreline of the ponds to minimize runoff and protect intertidal habitat; and to mount a sustained educational campaign to promote public appreciation for the problems and the need to support these measures. (Baker-IVI)
W86-01337

IMPACT OF DISCHARGES FROM SEAFOOD PROCESSING ON SOUTHEASTERN ESTUARIES,

Georgia Univ., Brunswick. Marine Extension Service.
K. W. Gates, B. E. Perkins, J. G. EuDaly, A. S. Harrison, and W. A. Bough.
Estuaries, Vol. 28, No. 2B, p 244-251, June, 1985. 2 Fig, 5 Tab, 20 Ref. National Sea Grant Program grant 04-8-M01-175.

Descriptors: *Georgia, *Food processing wastes, *Estuarine environment, Industrial wastes, Water pollution effects, Nutrients.

The effects of effluents on two of Georgia's estuarine systems were studied. The systems included a relatively undeveloped area consisting of three small estuarine creeks, two of which are normally exposed to seafood packing by-products, and a large commercially and industrially developed estuary that receives effluents from a seafood processing plant and three packing houses. The environmental impact of current seafood processing wastes on estuaries in Georgia appears to be minimal when compared with the natural organic load. The large estuary demonstrated a high residual capacity to receive processing effluents without significant change. The BOD load from shrimp thawing, peeling, sorting, and cleaning operations at the large seafood processing plant was shown to be equivalent to the organic material generated by a 302 sq m plot of salt marsh. NH4-N levels were greater than, but the same order of magnitude as, natural runoff from marsh land. (Baker-IVI)
W86-01340

EFFECTS OF CONTAMINANTS ON TOXICITY OF THE LAMPRICIDES TFM AND BAYER 73 TO THREE SPECIES OF FISH,

National Fishery Research Lab., La Crosse, WI.
L. L. Marking, and T. D. Bills.
Journal of Great Lakes Research, Vol. 11, No. 2, p 171-178, 1985. 4 Tab, 24 Ref.

Descriptors: *Great Lakes, *Lampricides, *Fish, *TFM, *Bayer 73, *Water pollution effects, Synergism, Fish management, Pesticides, Organic compounds, Pesticides, Metals, Industrial wastes, Tannic acid.

Nontarget fish were exposed to combinations of lampricides and contaminants that may be present in the Great Lakes basin, with the objectives of quantifying the additive toxicity of certain paired mixtures, demonstrating the effects of combining two or more selected pesticides, and calling attention to the potential hazards of applying chemicals in aquatic environments where contaminants already exist. The toxicities of combinations of lampricides with organic pesticides, metal, industrial or municipal pollutants, and tannic acid were mostly additive. The toxicity of a combination of TFM, Delnav, and malathion was synergistic, and extremely small quantities of each chemical became lethal when mixed. Toxicities of the pesticides in the combination also increased commensurately. The triple combination of chemicals produced extraordinary synergism and effectively demonstrated the hazards that may result if certain chemical combinations occur in the aquatic environment. Synergism is not the only kind of toxic action that produces hazards to aquatic organisms. All three types of toxic action are of concern because toxic units produced by contaminant chemicals add to the toxic units of applied management chemicals. Since the toxicity of the majority of chemical combinations is simply additive, this cumulative toxic action contributes more total units to aquatic environments than the extreme actions of less than additive and synergism. The toxicity of the lampricide TFM, as well as other management chemicals, is reinforced by the presence of any contaminant that contributes additional units of toxicity. (Baker-IVI)
W86-01349

NUTRIENT ENRICHMENT OF ESTUARINE SUBMERSED VASCULAR PLANT COMMUNITIES. 1. ALGAL GROWTH AND EFFECTS ON PRODUCTION OF PLANTS AND ASSOCIATED COMMUNITIES,

Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W86-01351

EFFECTS OF ENVIRONMENTAL AND BIOLOGICAL VARIABLES ON THE TOXICITY OF MERCURIC CHLORIDE,

D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
S. R. Verma, R. Chand, and I. P. Tonk.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 243-248, July, 1985. 4 Tab, 31 Ref.

Descriptors: *Toxicity, *Mercuric chloride, *Fish, Water pollution effects, Temperature effects, Dissolved oxygen, Acidity, Fish populations.

The effects of environmental and biological variables on the toxicity of mercuric chloride to the fish Notopterus notopterus were evaluated. Temperature, dissolved oxygen concentrations, acidity, and fish size play a major role in the toxicity of mercuric chloride, especially in bioassay tests. Thus these variables need special attention whenever the results of bioassay are given with reference to chemicals. This will also help in determining a more reliable tool for calculation of the maximum allowable toxicant concentration and application factor for chemicals to be used in the field. (Baker-IVI)
W86-01353

EFFECTS OF EFFLUENT OF MUNICIPAL WASTEWATER ON THE GROWTH OF PORPHYRA YEZOENSIS IN THE CASE OF STATIC CULTURE (IN JAPANESE),

Tokyo Univ. of Fisheries (Japan).
T. Maruyama, A. Miura, and T. Yoshida.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 51, No. 2, p 315-320, February, 1985. 9 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Porphyra, *Macrophytes, *Activated sludge, Salinity, Plant physiology, Plant growth, Absorbance spectra, Spectroscopy.

The effects of unchlorinated activated sludge effluent from a municipal sewage treatment plant on the growth of Porphyra yezoensis were investigated for different effluent dosages with different degrees of salinity by means of in vitro static culture. To clarify the effect of the effluent on the Porphyra thalli, the length of thalli and the absorbance spectra of living thalli were measured every two days. The number of dead cells in a thallus were counted using a microscope 10 days after the start of the culture, followed by a erythrosine staining. While increasing the effluent dosage to about 5% by volume, the relative length of thalli decreased rapidly and the number of dead cells quickly increased, and they were enhanced with the lower salinity. When the effluent dosages was above 5%, the relative length of thalli and the number of dead cell had a definite value for each degree of salinity. The absorbance spectra (350-750 nm) and absorbance ratio (567 nm/676 nm) of living thalli increased when the effluent dosage and

exposure time were increased. The above mentioned results suggest that the activated sludge effluent of municipal wastewater may have an adverse effect on the growth of Porphyra thalli. (Author's abstract)
W86-01363

INVESTIGATIONS ON PARAQUAT TOXICITY IN FISHES,

Jozsef Attila Univ., Szeged (Hungary). Dept. of Biochemistry.
J. Nemcsok, L. Orban, B. Asztalos, Z. Buzas, and A. Nemeth.
Water International, Vol. 1, No. 2, p 79-81, June, 1985. 5 Fig, 12 Ref.

Descriptors: *Herbicides, *Paraquat, *Fish, *Toxicity, Organic compounds, Agricultural chemicals, Water pollution effects, Enzymes.

The sensitivity of three fish species with different feeding habits to paraquat contamination was examined. Treatments with 1 and 10 ppm paraquat, respectively, increased the transaminase enzyme activity of all three fish species investigated to about the same extent. The treatment with 100 ppm (which due to its deadly effect lasted less than 15 minutes) did not result in measurable transaminase increase in any of the species. LDH and blood glucose level proportionally increased with respective paraquat concentration applied, including the lethal 100 ppm treatment. Asphyxia was one of the accompanying symptoms of the sudden death of fishes due to high paraquat concentration. Preceding their death, fish were air-breathing with difficulty and tried to jump out of the aquaria. Scarlet red discoloration of abdominal veins could be noted during post motem examination. The change of serum cholinesterase activity on paraquat treatment of various concentrations differed in two of the fish species; 10 ppm paraquat decreased it by 40% in carp and by 30% in silver carp. The 100 ppm lethal dose also decreased serum cholinesterase activity. The points of paraquat's attack and results of attack include injury of liver and kidneys, reduction of oxygen uptake capacity by damaging the epithelial cells of the gill, and inhibition of cholinesterase enzyme activity, thus causing serious problems to the nervous system. (Baker-IVI)
W86-01378

ACUTE AND SUBLETHAL EFFECTS OF ORGANOTIN COMPOUNDS ON AQUATIC BIOTA: AN INTERPRETATIVE LITERATURE EVALUATION,

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
L. W. Hall, and A. E. Pinkney.
Critical Reviews in Toxicology, Vol. 14, No. 2, p 159-209, 1985. 5 Tab, 101 Ref.

Descriptors: *Toxicity, *Water pollution effects, *Reviews, *Organotin compounds, Organic compounds, Metals, Tin, Aquatic life, Zooplankton, Fish, Invertebrates, Phytoplankton, Marine environment, Estuarine environment, Bioaccumulation.

The objectives of this review were to collect, synthesize, and interpret acute and sublethal organotin toxicity data in both freshwater and estuarine-marine ecosystems; to present environmental water column and sediment concentrations of organotin compounds in both freshwater and estuarine-marine systems to facilitate interpretation of toxicity data; and to identify deficiencies in available data to recommend future research for assessing ecological effects of organotin compounds in aquatic systems. Organotin toxicity data were available with 4 phytoplankton species, 5 zooplankton species, 19 species of macroinvertebrates, and 11 fish species. Acute organotin toxicity was found to range from 0.0004 to 0.004 mg/l bis (tributyltin) oxide (TBTO) for several zooplankton species. Acute mortality data for macroinvertebrates ranged from 0.0005 mg/l TBTO for juvenile mysid shrimp, Metamysidopsis elongata, to 0.29 mg/l TBTO for the pacific oyster, Crassostrea gigas. Imposex occurred in the mud snail at TBTO concentrations below the LC50. Bioconcentration-depuration studies with macroinvertebrates were conducted with mud crabs and oysters. Mud crabs exposed to TBTO through both food and water accumulated higher concentrations when compared with exposure through water. The effects of interacting environmental parameters such as temperature and salinity on the toxicity of organotin compounds to macroinvertebrates was also evaluated. Ninety-six hour LC50s for adult estuarine and marine fish ranged fom 0.005 mg/l TBTO for sheepshead minnows to 0.036 mg/l TBTO for the sole. Bioconcentration-depuration studies with sheepshead minnow showed that TBTO did not reach equilibrium in various tissues after 58 days of exposure. Ninety-six hour LC50s for all trophic groups were found to range from 0.0004 to 0.29 mg/l TBTO. Zooplankton were the most sensitive group; bivalves the most resistant. Environmental concentrations of organotin compounds in estuarine and marine water ranged from not detectable to 0.00 mg/l. Higher concentrations of organotin compounds were found in harbor and marina areas. (Baker-IVI)
W86-01400

MORPHOMETRIC ANALYSIS OF THE RESPONSE OF ANABAENA FLOS-AQUAE AND ANABAENA VARIABILIS (CYANOPHYCEAE) TO SELECTED CONCENTRATIONS OF ZINC,

Herbert H. Lehman Coll., Bronx, NY. Dept. of Biological Sciences.
J. W. Rachlin, T. E. Jensen, and B. E. Warkentine.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 395-402, July, 1985. 3 Fig, 4 Tab, 31 Ref.

Descriptors: *Anabaena, *Cyanophyta, *Zinc, *Metals, *Toxicity, *Algae, Water pollution effects, Electron microscopy, Plant physiology.

The toxicological responses of the fresh-water cyanophycean algae Anabaena flos-aquae and A. variabilis, to select concentrations of the essential cation zinc, were quantified by the techniques of stereological electron microscopic morphometry. The cation concentrations used were 20.6, 52.0, and 114.7 micro-M, which represented the 96-hr EC50 dose for A. variabilis and an equal bisection of a log scale above and below this concentration. The results indicated that the surface area of the thylakoids of A. flos-aquae were significantly increased after exposure to 114.7 micro-M Zn, and that there was a significant increase in the number of lipid bodies per cell. All test concentrations caused a significant reduction in both the numbers and relative volume of the cell's cyanophycin granules, but resulted in an increase in the cell's membrane limited crystalline inclusions. Both 52.0 and 114.7 micro-M Zn caused a significant increase in the surface area of the thylakoids of A. variabilis, but only the highest concentration caused an increase in the volume of the interthylakoidal spaces. The relative volume and numbers of lipid bodies of A. variabilis cells were increased by exposure to 52.0 micro-M Zn, and 114.7 micro-M Zn caused a significant increase in the relative volume and numbers of the cell's polyphosphate bodies. The significance of these results are discussed in terms of potential cellular detoxification mechanisms, which are important in the cell's ability to cope with the anthropogenic introduction into the aquatic environment of metal and industrial pollutants. (Author's abstract)
W86-01405

IDENTIFICATION OF FERRITIN AS A MAJOR HIGH MOLECULAR WEIGHT ZINC-BINDING PROTEIN IN THE TROPICAL ROCK OYSTER, SACCOSTREA CUCCULLATA,

Murdoch Univ. (Western Australia). School of Mathematical and Physical Sciences.
J. Webb, D. J. Macey, and V. Talbot.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 403-407, July, 1985. 3 Fig, 1 Tab, 25 Ref.

Descriptors: *Ferritin, *Zinc, *Proteins, *Animal physiology, *Oyster, *Water pollution effects, *Dampier, *Western Australia, *Australia, Mollusks, Iron, Copper, Metals.

The metal-binding proteins of the body mass of the tropical rock oyster Saccostrea cuccullata from the iron-ore shipping terminals near Dampier, Western Australia, have been separated by gel chromatography and analyzed for Zn, Fe, and Cu. Appreciable amounts of Zn (40%) and Cu (25%) were eluted in association with high molecular weight fraction (> 60,000 daltons), the major component of which was identified as the heat stable Fe-binding protein, ferritin (approx, mol. wt. 550,000), which also contains 95% of the Fe detected. Ferritin thus accounts for significant amounts of protein-bound Zn in this species and most probably in other bivalves containing elevated tissue levels of Zn. (Author's abstract)
W86-01406

MICROBIAL ASSAY FOR DETERMINING THE INFLUENCE OF PHYSICOCHEMICAL ENVIRONMENTAL FACTORS ON THE TOXICITY OF ORGANICS: PHENOL,

New York Univ., NY. Lab. of Microbial Ecology.
H. Babich, and G. Stotzky.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 409-415, July, 1985. 8 Fig, 31 Ref.

Descriptors: *Toxicity, *Phenol, *Fungi, *Physicochemical characteristics, Water pollution effects, Hydrogen ion concentration, Hardness, Salinity, Water temperature, Synergistic effects, Pesticides, Toxaphene, Cresols, Endrin aldehyde.

The toxicity of phenol to filamentous fungi was unaffected by pH or water hardness, but it was potentiated by salinity at levels comparable to those occurring in estuarine and off-shore marine waters. The effect of temperature on the response of the fungi to phenol was highly variable: depending on the fungus, the toxicity of phenol was either not affected, increased, or decreased as the temperature was raised from 22 to 32 C. The toxicity of phenol was not affected by heavy metals. The mediating influences of these abiotic environmental factors on the toxicity of phenol to filamentous fungi were similar to those reported for aquatic macrobiota. This similarity, which has also been noted with the effects of environmental factors on the toxicity of heavy metals, strengthens the concept of using microbial assays to evaluate initially the potential mediating influence of physicochemical factors of natural environments on the toxicity of organic pollutants. An antagonistic interaction in toxicity occurred between phenol and endrin aldehyde or p-chloro-m-cresol, and an additive interaction occurred between phenol and toxaphene, but no interactions were apparent between phenol and other phenolic compounds and pesticides. (Author's abstract)
W86-01407

COMPARATIVE ACUTE SENSITIVITIES OF EARLY LIFE STAGES OF ATHERINID FISHES TO CHLORPYRIFOS AND THIOBENCARB,

Environmental Research Lab., Gulf Breeze, FL.
P. W. Borthwick, J. M. Patrick, and D. P. Middaugh.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 465-473, July, 1985. 1 Fig, 6 Tab, 40 Ref.

Descriptors: *Grunion, *Silver-side, *Fish, *Toxicity, *Chlorpyrifos, *Thiobencarb, *Organophosphorus pesticides, Pesticides, Insecticides, Water pollution effects, Growth stages.

Sensitivity, expressed as the 96-hr LC50 derived from acute lethality tests, was compared for four ages (day-of-hatch, 7-day, and 28-day) of three atherinid fishes: Leuresthes tenuis (California grunion), Menidia menidia (Atlantic silver-side), and Menidia peninsulae (tidewater silver-side). Responses of each age-species combination exposed to the organophosphate insecticide chloropyrifos and the carbamate herbicide thiobencarb were compared in both static and flowing seawater toxicity tests. Chlorpyrifos was highly toxic to all atherinids (96-hr LC50's ranged from 0.4 to 6.7 micro-g/L); toxicity of thiobencarb was approximately two orders of magnitude lower (LC50 values from 199 to 1,405 micro-g/L). Responses to

each pesticide were similar among the three species. Sensitivity was generally highest for 7-day and 14-day age groups, and flowing water tests were more sensitive measures of toxicity than static tests, especially for chlorpyrifos. Comparisons of three computational methods indicate that probit and moving average methods calculate comparable LC50 estimates with the binomial method being the least uniform point estimator. (Author's abstract)
W86-01408

ORGANOCHLORINE CHEMICAL RESIDUES IN WHITE PELICANS AND WESTERN GREBES FROM THE KLAMATH BASIN, CALIFORNIA,

California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
D. E. Boellstorff, H. M. Ohlendorf, D. W. Anderson, E. J. O'Neill, and J. O. Keith.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 485-493, July, 1985. 1 Fig, 6 Tab, 39 Ref.

Descriptors: *Pelicans, *Grebes, *Klamath Basin, *Clear Lake, *California, *Animal tissues, *Birds, *Chlorinated hydrocarbons, DDT, DDD, Dieldrin, Polychlorinated biphenyls, Endrin, Pesticides, Insecticides, Eggs, Wildlife habitats.

Samples were analyzed for 12 organochlorine chemicals. Concentrations of DDT + DDD and dieldrin in American white pelican (Pelecanus erythrorhynchos) eggs collected at the Klamath Basin National Wildlife Refuges decreased from 1969 to 1981; DDE and polychlorobiphenyl (PCB) residues did not significantly change. Differences between PCB residues in eggs collected from Lower Klamath and Clear Lake colonies in 1969 suggest different migration routes or wintering areas between populations nesting at these two locations. White pelican and western grebe (Aechmophorus occidentalis) PCB/DDE ratios were 0.13 and 1.58, respectively, suggesting different exposure patterns. White pelican eggshell thickness increased between 1969 and 1981, but remained significantly less than pre-1947 values. Western grebe shell thickness was not significantly different from pre-1947 values. Endrin caused some of the pelican mortalities in the Klamath Basin from 1975 to 1981. Pelicans may have acquired endrin in California, but possibly from areas outside of the Klamath Basin. (Author's abstract)
W86-01409

EFFECT OF LETHAL COPPER SOLUTIONS ON THE BEHAVIOR OF RAINBOW TROUT, SALMO GAIRDNERI,

Concordia Univ., Sir George Williams Campus, Montreal (Quebec). Water Pollution Research Lab.
S. C. J. Pedder, and E. J. Maly.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 4, p 501-507, July, 1985. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Copper, *Metals, *Trout, *Fish, *Toxicity, *Fish behavior, Behavior, Water pollution effects, Fish food.

Experiments were performed on flow-through artificial stream apparatus to determine the attraction-avoidance responses of rainbow trout, Salmo gairdneri to lethal copper solutions (0.5, 0.75, 1.0, 2.0, 3.0 and 4.0 mg/L) when food was provided at a single source in the more contaminated water and when food was provided throughout the stream. Preference of groups of twenty test individuals for the experimental or control water was recorded at hourly intervals over 96 hr. At all concentrations, there was an initial attraction period for and subsequenct avoidance of the more highly contaminated waters. Attraction was greatest in tests employing higher concentrations (3.0 and 4.0 mg/L); this attraction led to high mortality. Belated avoidance of copper solutions was observed at all levels above 0.5 mg/L maximizing at 1.0 mg/L. The EC50-96-hr value for avoidance was between 0.5 and 0.75 mg/L. With food provided only in contaminated water, fish exhibited a prolonged and intense attraction period at the lower levels (0.5 to 2.0 mg/L) when compared to dispersed feeding. No significant differences between the feeding regimes existed at the higher copper levels. Mortality curves were similar in both feeding routines. Injured fish were found in the least contaminated waters. Tagging experiments indicate a movement pattern initially toward the toxicant, with subsequent reverse migration to cleaner waters. Little movement occurred during attraction and avoidance stages. Initial avoidance was not observed at any of the tested copper concentrations. Results indicate initial attraction at all concentrations may orientate fish toward the contaminant source, and subsequent avoidance behavior had little effect on survivorship rates. Observed trout behavior subsequent to copper discharges contributed to high mortality; behavioral response of organisms to toxicants must be incorporated into work attempting to set reasonable water-quality standards in natural water bodies. (Author's abstract)
W86-01410

SODIUM IN DRINKING WATER IN SOUTH CAROLINA,

South Carolina State Dept. of Health and Environmental Control, Columbia. Div. of Chronic Disease.
D. T. Lackland, M. C. Weinrich, F. C. Wheeler, and D. M. Shepard.
American Journal of Public Health, Vol. 75, No. 7, p 772-774, July, 1985. 2 Tab, 22 Ref. National Heart, Lung, and Blood Institute contract N01-HV-72987.

Descriptors: *Sodium, *Drinking water, *South Carolina, *Hypertension, Diet, Public health. Chemical composition, Calcium, Minerals, Blood pressure, Water quality.

Because of the reported variability between individuals in the percent of dietary sodium contributed by drinking water, the potential contribution of drinking water sodium to total consumption and to blood pressure levels was explored in a South Carolina population-based survey. The Carolina Health Survey was implemented in 1982 to obtain information on hypertension, health status, and health behaviors of non-institutionalized South Carolinians 18 age or older. For each of the 825 participating households, a 50 ml water sample was taken from the water source used for drinking and cooking purposes; sodium analysis was determined by the flame emission technique. Drinking water consumption was estimated at one liter per day. In the field, interviewers took blood pressure measurements from one adult in each household and administered a diet questionnaire. Most (96 per cent) of the population was served by drinking water containing < 100 mg/l Na (median 14.8 mg/l). For households with water sources containing > or = 100 mg/l Na, drinking water accounted for approximately 8.5 per cent of total estimated consumption. After adjustment for age, sex, race, body mass index, education, and dietary sodium, a negative association between diastolic blood pressure and drinking water sodium levels was found. No significant associations of dietary sodium with either systolic or diastolic BP were found. The linear discriminant analysis to assess drinking water and dietary sodium as identifiers of hypertensives showed no contribution for dietary sodium, but a statistically significant contribution for drinking water sodium ($p<.05$). It is suggested that the observed negative association between systolic and diastolic BPs and drinking water sodium is not simply due to chance but the association is causally improbable; the observed association may result from confounding by other minerals such as calcium. (Collier-IVI)
W86-01411

SOLUBILZATION EFFECTS OF SIMULATED ACID RAIN ON THE ORGANIC MATTER OF FOREST SOIL; PRELIMINARY RESULTS,

Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
G. W. Hay, J. H. James, and G. W. vanLoon.
Soil Science, Vol. 139, No. 5, p 422-430, May, 1985. 6 Fig, 3 Tab, 34 Ref. Canada Department of Supplies and Services contract ISU80-00350.

Descriptors: *Acid rain, *Water pollution effects, *Forest soils, *Organic matter, *Solubilization, Chemistry of precipitation, Acidity, Hydrogen ion concentration, Organic carbon, Nitrogen.

The concentrations of total organic carbon, total carbohydrate, fulvic acid, and ammonium-plus-amino nitrogen were determined in leachates from columns of a Canadian shield podzol soil at depths of approximately 10 and 20 cm after treatment with aqueous solutions of pH 5.7, 3.5, and 2.0. Sampling was carried out in the laboratory over a 16-d period during which the soil received a total accumulation of 935 mm of simulated rainfall, equivalent to 1 year's precipitation. Highest concentrations of each of total organic carbon, total carbohydrate, and fulvic acid were obtained after the pH 5.7 treatment; the concentrations were greater at the 10-cm depth than at 20 cm. The pH 2.0 solution dissolved the least amounts of these components. The opposite trend was observed in the analyses of ammonium-plus-amino nitrogen. The soil exhibited considerable buffering action in terms of regulating leachate pH. (Author's abstract)
W86-01421

UPTAKE AND RELEASE OF SOME TRACE METALS BY AQUATIC BRYOPHYTES IN ACIDIFIED WATERS IN SCOTLAND,

Freshwater Fisheries Lab., Pitlochry (Scotland).
For primary bibliographic entry see Field 7B.
W86-01452

EFFECTS OF AUTUMN APPLICATION OF OIL ON SPARTINA ALTERNIFLORA IN A TEXAS SALT MARSH,

Texas A and M Univ. at Galveston. Dept. of Marine Biology.
J. W. Webb, S. K. Alexander, and J. K. Winters.
Environmental Pollution (Series A), Vol. 38, No. 4, p 321-337, 1985. 1 Fig, 5 Tab, 35 Ref. State of Texas grant 18837.

Descriptors: *Water pollution effects, *Oil pollution, *Spartina, *Salt marches, *Texas, Marshes, Sediments, Aquatic plants, Plant growth, Biodegradation, Biomass.

Arabian crude oil, Libyan crude oil, No. 6 fuel oil and No. 2 fuel oil were applied, in November 1981, to 1 sq m salt marsh plots in Galveston Bay, Texas. Oil treatments were: no oil, 1 liter on sediment, 1.5 liters on sediment and lower 30 cm of Spartina alterniflora and 2 liters on sediment and entire S. alterniflora surfaces. All oils caused death of above-ground parts of plants within 3 weeks when applied to entire plant surfaces. Partial coverage was harmful only with No. 2 fuel oil, while sediment application had no effect. By 5 months, new growth had occurred from roots and rhizomes in Arabian crude oil, Libyan crude oil and No. 6 fuel oil plots and live biomass was near that of controls. By 1 year recovery was complete. For No. 2 fuel oil plots, which sustained the greatest mortality, growth was significantly below control levels at 5 months and 1 year, but recovery was complete within 2 years. Slow recovery in No. 2 fuel oil plots appeared to be due to the initial mortality of below-ground, as well as above-ground, plant parts. Toxicity of residual oil in the sediment did not appear to be a factor in slow recovery since seedling establishment had occurred within 5 months and little residue of No. 2 fuel oil was present in the sediments after 1 year. Also, this residue did not contain alkyl-substituted naphthalenes, toxic components present in the original oil. Considerable residues of all oils except No. 2 fuel oil were present in the sediment after 1 year. Pristane/nC17 and phytane/nC18 ratios indicated that removal of some oil components had occurred through biodegradation. (Author's abstract)
W86-01465

IMPACT OF LAND-APPLIED INCINERATOR ASH RESIDUE ON A FRESHWATER WETLAND PLANT COMMUNITY,

Massachusetts Univ., Waltham. Suburban Experiment Station.

J. S. Mika, K. A. Frost, W. A. Feder, and C. J. Puccia.
Environmental Pollution (Series A), Vol. 38, No. 4, p 339-360. 1985. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Ash, *Land disposal, *Wetlands, *Vegetation, Species abundance, Species diversity, Environmental effects, Phytotoxicity, Groundwater pollution, Landfills.

In 1977, 60-70 tons of incinerator ash residue were deposited adjacent to a freshwater wetland. These residues are known to contain elevated concentrations of soluble cations and toxic elements. The impact on the wetland plant community was monitored over a 6-year period. Changes in species abundance and diversity were assessed both over time and distance from the residue deposition. A methodology from the marine benthic pollution literature as used to identify possible indicator species from the group of moderately adapted plants. Distance from the residue did not account for the overall increase in community richness, but appeared to be a factor in the increased relative abundance of moderately adapted species near the residue site, as a result of decreased relative abundance of dominant species. Acute phytotoxic effects were undetected, with the possible exception of the decline of Asclepia syriaca (milkweed). Post-experiment soil analyses indicated an increase of Ca, Mn, P, Zn and Cd in wetlands soils near the residue site and an even greater increase in P, K, Ca, Mg, B, Zn, Cu, Mn, Al, Cd, and Pb in the soil directly beneath the residue. If residue landfills are not properly designed or maintained, the cumulative impact of daily residue deposition could eventually disrupt sensitive ecosystems and pollute adjacent soils and groundwater. (Author's abstract)
W86-01466

WATERBORNE EPIDEMIC OF ACUTE INFECTIOUS NON-BACTERIAL GASTROENTERITIS IN ALBERTA, CANADA,

903 Abbotsford Drive N.E., Calgary, Alberta T2A 5Y3.
A. E. O'Neil, D. Richen, and P. Lundrie.
Canadian Journal of Public Health, Vol. 76, p 199-203, June, 1985. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Epidemiology, *Public health, *Drinking water, *Gastroenteritis, *Alberta, Water treatment, Monitoring, Wastewater pollution, Water pollution effects, Water quality control.

In February 1983, an epidemic of gastroenteritis affecting approximately 3000 persons occurred in a city of 6500 in Alberta. The onset of 78% of the cases was within a four day period. Vomiting was a sympton in 52% of the cases and diarrhea in 60%. Duration of illness was 24 to 48 hours. Median incubation period was 38 hours. Stool cultures form affected persons were negative for bacterial pathogens. Search for a viral agent has so far been unrevealing. Illness was associated with consumption of water from the municipal system. The execution and monitoring of water treatment were faulty. The source of water in that system is a river whose pollution was augmented just before the epidemic by a discharge of raw sewage from a lift station of the municipal sewage collection system. A chain of causation in a gastrointestinal epidemic is illustrated, against which legislation for protection exists in the Clean Water Act. Those carrying out the treatment of the water and the protection of the river and even those charged under the Act with monitoring and enforcing these functions had a weak appreciation of their significance to Public Health. (Author's abstract)
W86-01486

LIMITATIONS OF PHOSPHORUS WATER QUALITY CRITERIA,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5G.
W86-01492

EFFECT OF SUSPENDED SOLIDS ON THE GROWTH OF APICAL TIPS OF GAMETOPHYTE PLANTS OF LEMANEA AND ON CARPOSPORE GERMINATION AND SUBSEQUENT COLONISATION,

University Coll., Cardiff (Wales). Dept. of Plant Science.
H. H. Thirb, and K. Benson-Evans.
Archiv fur Hydrobiologia, Vol. 103, No. 4, p 40-417, June, 1985. 3 Tab, 18 Ref.

Descriptors: *Suspended solids, *Plant growth, Light penetration, Water pollution effects, Plant reproduction.

Lemanea was exposed to a range of concentrations of suspended solids and settled material covering the substrate. Coal dust was used as a source of suspended solids. In addition to the laboratory experiments, a field experiment involving the transplant of mature plants of Lemanea from a site with low suspended solids and little pollution to a site downstream where the suspended solids were high. Reduction in light intensity from turbid conditions of suspended solids (5,000 mg/l) reduced primary production in both the chantransia-stage and adult plants. The deposition of a thick layer of silt prevented fixation and colonization of the substrate by carpospores. (Baker-IVI)
W86-01498

EFFECTS OF A CRUDE OIL SPILL ON WATER QUALITY AND MACROBENTHOS OF A SOUTHEAST TEXAS STREAM,

Lamar Univ., Beaumont, TX. Dept. of Biology.
R. C. Harrel.
Hydrobiologia, Vol. 124, No. 3, p 223-228, May, 1985. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Oil spills, *Water pollution effects, *Stream pollution, *Benthos, *Texas, Water quality, Oil pollution, Dissolved oxygen, Carbon dioxide, Invertebrates, Species diversity, Oligochaetes, Midges, Streamflow, Water temperature.

On December 6, 1981 a crude oil spill of 160 barrels (25,440 liters) occurred in a small southeast Texas stream. On December 8 a boom was placed across the mouth of the stream, and organized cleanup began December 12. During the cleanup, some oil was manually pushed down into the steam sediments. Water quality changes, other than the presence of oil, were not evident until six months later when water temperature increased and stream flow ceased. A thick film of oil and plant detritus covered the surface of the stream. This resulted in decreased dissolved oxygen and increased carbon dioxide concentrations. Responses of the benthic macroinvertebrate community included an increase in density of oligochaetes, decrease in numbers and taxa of chironomids, with eventual complete elimination, and low community diversity. Decrease in oil concentration resulted in reversal of these responses. Eleven months after the spill, stream flow had resumed and water temperature decrease, but oxygen concentrations remained low. No clean water taxa were collected and complete recovery had not occurred 26 months after the spill when the study was terminated. All taxa were tolerant or facultative to organic pollution. (Moore-IVI)
W86-01506

MONITORING AND EVALUATION OF WATER POLLUTION IN TUMEN RIVER BY MEANS OF ALGAE (IN CHINESE),

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
Z. Zhand, Z. Mo, K. Rong, and H. Haoming.
Acta Hydrobiologica Sinica, Vol. 8, No. 1, November, 1983. 2 Fig, 7 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Algae, *Monitoring, *Tumen River, Scenedesmus, Bioassay, Industrial wastewater, Bioindicators, Periphyton, Photosynthesis.

Studies on attached algae communities, collected from artificial substrates, were made in upper and middle reaches of Tumen River in 1977-1979. Bioassay using Scenedesmus for some effluents was carried out in laboratory. Based on results obtained, an evaluation of water pollution in the River was made. The upper reach, represented by station Chongshan, is evaluated as an unpolluted area. The middle reach, from the drainage of iron-ore mining effluents downwards to station Xiangrenping, is a heavily to moderately polluted area. From station Caidui, where the River receives the pulp mill effluent, to city Tumen, the river water is most heavily polluted. The stretch of River between station Hedung and the pollution source of a brown-coal chemical industry in the lower reach is considered as slightly to moderately polluted. Bioassay test also show that pulp mill effluent is one of the main pollution sources of River Tumen. The acute ILm of Scenedesmus to the main sewer effluent of the pulp mill is about 45% (v/v). The most toxic is the sulfite waste liquor. The harmful effect on algae growth by iron-ore mining effluent is caused by the large amount of suspended solids contained in this effluent, which reduces photosynthetic activity of algae. This effluent must be considered as another main pollution source of the river. Discussing and comparing the results of periphyton studies in Tumen River, the authors propose some algological indices for monitoring and evaluating pollution conditions in this river. Among them the total count of attached algae is the most suitable and is expressed as a comparable relative value. Some indicator algae species are presented. The application of diversity indexes is discussed. (Author's abstract)
W86-01512

SPY POND DIAGNOSTIC-FEASIBILITY STUDY: RECOMMENDATIONS FOR RESTORING A LAKE IMPACTED BY URBAN STORMWATER RUNOFF,

Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
For primary bibliographic entry see Field 2H.
W86-01550

SIX PONDS DIOXIN SURVEY,

Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
J. J. Jonasch.
Northeastern Environmental Science, Vol. 3, No. 2, p 80-89, 1984. 3 Fig, 9 Tab, 8 Ref.

Descriptors: *Dioxins, *Massachusetts, *Lake Winthrop, *Boons Pond, *North Pond, *Nonesuch Pond, *Middlesex County, *Flint Pond, *Worcester County, *Stockbridge Bowl, *Lake Mahkeenac, *Berkshire County, *Chlorinated hydrocarbons, *Fish tissues, Animal tissues, Bullhead, Herbicides, Water pollution effects, Fate of pollutants.

The objective of this study was to determine through a screening survey whether 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) was present in six Massachusetts water bodies that have histories of treatments with herbicides (Silvex, Kuron, or 2,4,5-T) that contain 2,3,7,8-TCDD as a contaminant formed during the manufacturing process. The water bodies studied were Lake Winthrop, Boons Pond, North Pond, and Nonesuch Pond (Middlesex County), Flint Pond (Worcester County), and Stockbridge Bowl (Lake Mahkeenac) (Berkshire County). Five of the six sediment samples analyzed did not meet the analytic criteria for positive identification of the dioxin. Detection limits ranged from 3.0 ppt to 5.5 ppt. Lake Winthrop did meet the criteria for positive identification and the sediment had a 2,3,7,8-TCDD concentration of 5.9 ppt. The survey confirmed the presence of 2,3,7,8-TCDD in one pond with a sediment sample containing 5.9 ppt 2,3,7,8-TCDD and a fish sample (bullhead - Ictalurus sp.) containing 71 ppt of 2,3,7,8-TCDD. Age analysis suggests that all fish have had at least 2.5 years of exposure in their respective lakes with a study-wide average of 4.9 years. Lake Winthrop appears to have been treated very little over the years compared to the other lakes studied. The fish flesh concentration exceeds the U.S. Food and Drug Administration guideline of 50 ppt in fish flesh for human consumption. The five archived bullheads from Lake Winthrop were retested and nets were set in the lake to capture more specimens. Yellow perch and pickerel specimens had no detectable levels of 2,3,7,8-TCDD.

Only one of the bullheads had a detectable level of 2,3,7,8-TCDD; in two tests the concentration was determined to be 19 and 25 ppt. The high detection limits in the other samples present a problem since 2,3,7,8-TCDD could possibly be present below these limits. (Collier-IVI)
W86-01551

ENVIRONMENTAL IMPACT ASSESSMENT OF THE PCB PROBLEM: A REVIEW,

Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 5B.
W86-01553

HUDSON RIVER PCB RELATIONSHIPS BETWEEN RESIDENT FISH, WATER AND SEDIMENT,

New York State Dept. of Environmental Conservation, Albany.
R. Sloan, M. Brown, and R. Brandt.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 137-151. 18 Fig, 7 Tab, 37 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Fish, *Sediment, *Fate of pollutants, Monitoring, Chlorinated hydrocarbons, Water pollution effects, Pumpkinseed, Fish tissues, Estuarine environment.

In 1977, long term monitoring of PCB levels in several environmental strata in the Hudson River was initiated. Among the variety of fish species that have been monitored, fall-caught yearling pumpkinseed (Lepomis gibbonsus) were selected as a standardized tool for monitoring trends in the PCB contamination of the river's biota. This phase of monitoring was implemented in 1979, two years after cessation of the major PCB discharges at Ft. Edward and Hudson Falls. The high degree of correlation between waterborne and yearling pumpkinseed PCB concentrations demonstrated through time for a region of the upper Hudson that yearling pumpkinseed are a sensitive indicator of PCB environmental contamination. A decline in PCB concentrations in both water and fish was evident throughout the river through 1980. An 80-year flood during spring 1983 apparently did not increase the availability of PCB to the biota in the upper river. In the lower river, the bioavailability of PCB appeared to increase in the Newburgh area as indicated by an increase in the mean PCB concentration in the yearling pumpkinseed. The mean PCB concentration in pumpkinseed collected at Albany and Stillwater did not change significantly. These observations are consistent with a working hypothesis of how the hydrology and transport regimes of the upper and lower river mediate the environmental exposure of the biota to PCB. Comparisons among other adult spring sampled species and older age classes of the pumpkinseed through 1983 show that although increases were not uniform neither was there evidence of continued decline. Coupled with relatively high sediment concentrations, it appears that this system has reached a quasi-stable state with respect to PCB levels in the biota. (Author's abstract)
W86-01554

PCBS: DIETARY DOSE AND BURDENS IN STRIPED BASS FROM THE HUDSON RIVER,

New York Univ. Medical Center, Tuxedo Park. Lab. of Environmental Studies.
J. M. O'Connor.
Northeastern Environmental Science, Vol. 3, No 3/4, p 152-158. 4 Tab, 30 Ref. NIEHS grant ES00260.

Descriptors: *Polychlorinated biphenyls, *Bass, *Fish tissues, *Hudson River, *New York, *Water pollution effects, Fish diets, Chlorinated hydrocarbons, Gammarus, Amphipods.

Data supporting the hypothesis that polychlorinated biphenyl (PCB) body burdens in fish are related to the daily dietary dose, as modified by the metabolic processes of assimilation, tissue retention and elimination have been based exclusively on laboratory studies. As a field verification of this hypothesis samples of striped bass, and their stomach contents, were analyzed for PCBs in order to determine relationships between PCB concentration in the food and PCB burdens in the fish. Samples of striped bass were collected from the New York Harbor region (the Hudson River at Weehawken, NJ (WHK) and between piers at Canal Street in Manhattan, NY (CST)) during the winter of 1983. The majority of food organisms observed in striped bass stomachs were benthic and epibenthic crustacea, primarily Gammaridean amphipods. Total body burden of PCB in young striped bass was calculated as the concentration of PCB in the flesh times the dry-weight of the specimen with the dry-weight concentration in the flesh assumed to be the same as the dry-weight concentration in most of the tissues and organs. Due to the greater concentration of PCB in striped bass from CST, PCB burdens (mean = 67.6 micro-g total PCB) were greater than in the bass from WHK (mean = 25.7 micro-g). Stomach contents from striped bass taken at WHK contained a mean of 2.3 micro-g/g total PCB, while the PCB concentrations of stomach contents from fish taken at CST were 6.15 micro-g/g. At the CST station, PCB concentrations in the food were greater than in the flesh of the fish. At the WHK station the PCB concentrations in the food and in the fish were similar. The ratio of mean PCB concentrations in stomach contents to that of the flesh was similar at the two stations (0.70 at WHK and 0.71 at CST). The results provide paired dose/burden data useful in refining mathematical models for predicting the accumulation of PCB and other xenobiotics in fish, based upon empirical data rather than rough estimates of exposure parameters. (Collier-IVI)
W86-01555

ORIGIN OF HIGH CADMIUM CONCENTRATIONS IN HUDSON RIVER BLUE CRAB (CALLINECTES SAPIDUS RATHBUN),

New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
R. Sloan, and R. Karcher.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 221-231. 4 Fig, 4 Tab, 37 Ref.

Descriptors: *Cadmium, *Animal tissues, *Crab, *New York, *Hudson River, *Flushing Bay, *Long Island Sound, Heavy metals, Metals, Water pollution effects, Source of pollutants, Mercury, Public health.

In 1979, due to high cadmium concentrations in blue crab, Callinectes sapidus, the New York State Health Department warned against consuming the hepatopancreas and to restrict leg meat consumption to one meal per week, based on a limited Hudson River summer sampling. A lack of data from other localities led to collections in 1981 from 11 locations in New York marine waters, including 6 Hudson river, 1 Staten Island and 4 Long Island sites. Muscle and hepatopancreas tissues were analyzed for cadmium utilizing atomic absorption spectrophotometric techniques. Although female sample sizes were small in areas of high contamination, they tended to have greater cadmium concentrations than males by factors of 1.5 to 2. Regardless of sex, the six Hudson River locations produced average concentrations of 0.24 ppm (N = 55) and 7.86 ppm (N = 60) for the leg muscle and hepatopancreas, respectively, compared to average values for similar tissues from other areas (excluding Flushing Bay) of 0.09 ppm (N = 25) and 0.72 ppm (N = 25). Cadmium concentrations were two to five times higher in thoracic muscle than leg muscle (N = 8). Flushing Bay crabs had higher hepatopancreas levels (-x = 3.84 ppm; N = 8) than other Long Island crabs indicating a potential cadmium source. Overall, the bulk of cadmium contamination appears to originate in the Hudson River. Limited numbers of mercury analyses reflected relatively low concentrations with respect to the USFDA action level of 1 ppm. Lobsters (Homarus americanus) from western Long Island Sound were suprisingly high in cadmium, and the few analyzed (N = 10) indicate a need for additional study of this species. (Author's abstract)
W86-01565

SURVIVAL STRATEGIES OF INVERTEBRATES IN DISTURBED AQUATIC HABITATS,

Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-01581

RESPONSE OF INVERTEBRATES IN TEMPORARY VERNAL WETLANDS TO ALTOSID SR-10 AS USED IN MOSQUITO ABATEMENT PROGRAMS,

Minnesota Dept. of Natural Resources, St. Paul.
R. W. Lawrenz.
Journal of the Minnesota Academy of Science, Vol. 50, No. 3, p 31-34, 1984/85. 2 Fig, 5 Ref.

Descriptors: *Mosquitos, *Invertebrates, *Wetlands, *Insecticides, *Ecological effects, Water pollution effects, Pesticides, Toxicity, Hormones.

Three temporary vernal wetlands on the Bayport Wildlife Management Area in eastern Washington County, Minnesota, were divided by sandbag barrier into treatment and control areas. Designated areas were treated with Altosid SR-10 briquets at standard mosquito control rates. Invertebrate populations were monitored weekly using net sweeps, column samples, and ocular estimates. The development of Eubranchipus bundyi, Lyncerus sp, and Daphnia sp., the three major components of the invertebrate fauna, was delayed by as much as one week in site 47. Similar development lags were noted for E. bundyi populations in the treated portions of sites 6 and 32. Delay of maturation was expressed in greater longevity and higher male to female sex ratios for treated populations of E. bundyi. Daphnia sp. population growth was also retarded by treatment, with a concurrent lag in ephippium (resting egg) formation. Delay in the development or sexual maturity of vernal faunas could impact those faunas and the wildlife that are dependent on them as seasonal dietary protein resources. (Author's abstract)
W86-01582

IDENTIFYING POLLUTION RELATED CHANGES IN CHIRONOMID COMMUNITIES AS A FUNCTION OF TAXONOMIC RANK,

Oak Ridge National Lab., TN. Environmental Sciences Div.
J. C. Waterhouse, and M. P. Farrell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 406-413, March, 1985. 2 Fig, 3 Tab, 21 Ref. EPA grant R805193-02-2 and DOE contract DE-AC05-840R21400.

Descriptors: *Water pollution effects, *Midges, *Taxonomy, Heavy metals, Metals, Zinc, Copper, Chromium, Invertebrates, Presence/absence data, Ecological effects.

Specific- and generic-level analyses of chironomid presence/absence data were compared along a heavy-metal gradient. Eighteen binary similarity coefficients were calculated for five sampling stations from a small Ohio stream that receives an effluent containing zinc, copper, and chromium from a metal-plating industry. In general, the specific- and generic-level values were highly correlated and showed similar patterns across the 10 station comparisons. The basis for this correlation was then investigated by an assessment of both the amount (average number of species per genus) and the pattern (species to genus ratio trend) of information loss along the pollution gradient. Trends in the species to genus ratio along the gradient are viewed as indicative of the similarity of congenerics in their response to the gradient. The lack of a significant trend in the species to genus ratio in our data indicates that the agreement between specific- and generic-level analyses was due to the ability of a robust species distribution pattern to withstand a limited amount of random information loss, rather than any inherent similarity among congenerics reflected in their species to genus ratio trends. Analyses based on only a few species (e.g. abundant or indicator species) cannot afford as much information loss and must rely more heavily on similarity of congeneric species. (Author's abstract)

W86-01583

DISCRIMINATION OF THE STOCK OF FISH (EELS, ANGUILLA ROSTRATA) BASED ON THE PRESENCE OF THE SYNTHETIC CHEMICAL MIREX (DISCRIMINATION D'UN STOCK DE POISSON, L'ANGUILLE (ANGUILLA ROSTRATA), BASEE SUR LA PRESENCE D'UN PRODUIT CHIMIQUE DE SYNTHESE, LE MIREX),

Department of Fisheries and Oceans, Quebec. Fisheries Research Branch.
J. D. Dutil, B. Legare, and C. Desjardins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 3, p 455-458, March, 1985. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Bioindicators, *Fisheries, *Eels, *Saint Lawrence River, *Ontario, *Quebec, *Lake Ontario, *Mirex, Pesticides, Chlorinated hydrocarbons, Path of pollutants, Water pollution effects, Fish, Water quality.

Mirex concentrations were measured in eels (Anguilla rostrata) from eastern Canada to determine the contribution of Lake Ontario eels to the Saint Lawrence commercial fishery. Mirex could be detected in all eels (50 specimens) collected in Lake Ontario (0.18 + or - 0.11 micro-g/g). Most sedentary eels collected from the Saint Lawrence commercial fishery and both the migratory and sedentary eels collected from the Saint Lawrence tributaries and the Maritimes had no mirex. Of the migrating eels collected in the Saint Lawrence 74% contained mirex (0.17 + or - 0.19 micro-g/g). These results show that stocks can be discriminated on the basis of the presence of synthetic chemical products such as pesticides and other contaminants that are distributed heterogeneously in the environment. Based on a presence-absence criterion, this method for stock discrimination has the distinct advantage that it is more accurate and less time consuming than similar methods based on the presence of natural chemical products. (Author's abstract)
W86-01584

WINTER RESPIRATION OF LAKES AT SAQVAQJUAC, N.W.T.,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 2H.
W86-01587

RESULTS OF OHIO RIVER MACROINVERTEBRATE SAMPLING FOR 1975-1981,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. E. Fisher, and L. E. McCoy.
Proceedings of the West Virginia Academy of Sciences, Vol. 55, No. 2/3/4, p 42-55, 1983. 9 Fig, 7 Ref.

Descriptors: *Ohio River, *Macroinvertebrates, *Species diversity, *Rivers, Water pollution effects, Species composition.

The results of macroinvertebrate sampling from nine stations along the Ohio River are presented. Comparisons of Brillouin diversity, numbers of individuals, and taxa present for each site indicated significant improvements in the biological communities for two sites, Weirton and Hannibal. Only one site, Keyger Creek, was significantly poorer over time. Most other stations appeared to have made some improvement or remained unchanged, with the notable exceptions, however, of Willow Island and Belleville. These stations appeared to have been adversely impacted by some factor or combination of factors. The Belleville site had shown continued improvement from 1975 through 1980. However, the 1981 sample revealed a significant drop in diversity. (Author's abstract)
W86-01591

ASSOCIATIONS OF CANCER MORTALITY RATES AND EXOGENOUS ENVIRONMENTAL FACTORS IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Anatomy.
P. Baciu, E. C. Keller, and J. D. Tucker.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 82-91, 1983. 4 Tab, 6 Ref.

Descriptors: *Cancer, *West Virginia, *Water pollution effects, *Public health, Epidemiology, Alkalinity, Acidity, Zinc, Dissolved oxygen, Phosphate, Manganese, Water quality.

Correlation analyses were completed on West Virginia county data for cancer mortality rates and on county geological, water quality, and coal production variables. The individual cancer mortality variables most frequently observed to be in association with environmental variables were: mouth, pancreas, and rectal cancers in males, and nasal, lip, and stomach cancers in females. The environmental variables most frequently associated with these cancer were: (1) levels of alkalinity, water flow, acidity, zinc, dissolved oxygen, phosphate, and manganese found in the natural waters of the various counties; (2) levels of particulates, hydrocarbons, and nitrous oxides in the air; (3) the percentage of the county underlain by brine, medium bituminous coals, and three types of limestones; and (4) to a minor degree, the number of sand quarries in the county. An 'acid mine drainage' environmental factor as defined by factor analysis was highly associated with two cancer mortality groupings viz., 'male digestive' and 'female upper digestive' cancers. Two other water factors 'alkalinity' and 'zinc' were also strongly associated with the 'male digestive' cancer factor. The environmental factors are likely to be, at least in part, surrogates for other populational or occupational aspects of the demography such as urban-industrialized and rural-coal-producing areas. (Author's abstract)
W86-01593

CORBICULA FLUMINEA (MOLLUSCA: PELECYPODA) AS A BIOLOGICAL INDICATOR OF HEAVY METALS IN THE KANAWHA RIVER, WV,

Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
For primary bibliographic entry see Field 7A.
W86-01596

LOW PH TOLERANCE UNDER CONTINUOUS-FLOW BIOASSAY CONDITIONS OF HELLGRAMMITE LARVAE, CORYDALUS CORNUTUS L. (MEGALOPTERA: CORYDALIDAE),

Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
D. C. Tarter, L. O. Hartsock, S. I. McBride, and M. F. Sheridan.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 131-135, 1983. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Acidity, *Hydrogen ion concentration, *Toxicity, *Helgrammites, *Corydalidae, *Macroinvertebrates, *Bioassays, Water pollution effects, Acid mine drainage, Aquatic insects, Larvae.

Bituminous coal mining produces an acid drainage effluent that is generally recognized as the most widespread pollution problem in the Ohio River Basin. Hellgrammite larvae, Corydalus cornutus L., were experimentally tested under continuous-flow bioassay conditions to determine their tolerance to low pH. The straight-line graphical interpolation method was employed to determine the pH value at which 50 percent of the hellgrammites survived after 96 hours. The 96 hr median tolerance limit pH value was 1.76. Based on the hellgrammite larval continous-flow bioassay experiments and other laboratory and field studies of aquatic insects, the order Megaloptera can be considered the group of aquatic insects most tolerant to low pH conditions. The toxic mode of action of acid mine drainage on benthic macroinvertebrates has received some attention in the literature. Several mechanisms may be involved in the toxic mode of action of acid mine water on aquatic insect larvae. Apparently, larval megalopterans are able to survive in higher concentrations of acid mine drainage than most aquatic insects because of some well-adapted physiological response to these extreme environmental conditions. (Collier-IVI)
W86-01597

EFFECT OF TEMPERATURE ON THE GROWTH OF PLANKTONIC LARVAE OF TELLINA TENUIS DA COSTA,

Dunstaffnage Marine Research Lab., Oban (Scotland).
P. R. O. Barnet.
Journal of Experimental Marine Biology and Ecology, Vol. 89, No. 1, p 1-10, June, 1985. 4 Fig, 36 Ref.

Descriptors: *Kames Bay, *Firth of Clyde, *Scotland, *Tellina, *Bivalves, *Water temperature, *Growth rates, Water pollution effects, Growth stages, Mollusks.

Tellina tenuis da Costa has wide distribution on the intertidal sandy shores of Europe and is the commonest intertidal lamellibranch on most clean sandy shores in the Firth of Clyde, Scotland, where large annual variations in spatfalls are known to occur. The effects of temperature on Tellina populations in Kames Bay were examined, continuing earlier research, for comparison with the influences of heated effluents from the Hunterston electricity generating stations at Ayrshire. The growth in length of planktonic veliger larvae was examined experimentally at 7, 10, 15, and 20 C. There were very pronounced differences between the lengths at different temperatures. The experiments commenced four days after fertilization with straight-hinge larvae of mean length 104 micro-m. Three days later t-tests showed that there were highly significant differences between the mean lengths of larvae grown at 7, 10, 15, and 20 degrees C (104, 107, 111, 115 micro-m, respectively). There were large differences between the lengths at the end of the experiment, 32 days after fertilization; 20 C larvae reached a mean of 216 micro-m compared with 196 micro-m at 15 C, 142 micro-m at 10 C, and only 117 micro-m at 7 C. The greatest increase in growth rate was between 10 and 15 C; this is the range within which July seawater temperatures, when large numbers of larvae are expected to be in the plankton, vary between warm and cool years. Sea-water temperatures in the Firth of Clyde probably never reach a level permitting optimum growth; higher July sea-water temperatures in some years may encourage more rapid larval growth than in cooler years. This would shorten the pelagic larval phase, probably decreasing the vulnerability to predation in the plankton and permitting better survival to the settlement phase and may partly account for the large annual variability in spatfalls of T. tenuis in Kames Bay. (Collier-IVI)
W86-01603

BENTHIC ORGANISMS AS INDICATORS OF WATER QUALITY IN LAKE PATZCUARO, MEXICO,

Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
For primary bibliographic entry see Field 5A.
W86-01608

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - I; REVIEW OF PREVIOUS RESEARCH,

Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research. Vol. 19, No. 8, p 947-954, 1985. 9 Tab, 22 Ref.

Descriptors: *Pulp wastes, *Wastewater pollution, *Microorganisms, *Reviews, Pulp and paper industry, Water pollution effects, Biological wastewater treatment, Sugars, Fatty acids, Alcohols.

The term 'sewage fungus' denotes the variable community of microorganisms which form voluminous, cottonwool-like growths on river beds having suitable physical characteristics. A brief review is given of the published literature on sewage fungus growth from pulp and paper mill discharges up to 1978. Previously unpublished work undertaken over the period 1965-1975 is described. By 1978, it seemed clear that sewage growth from pulp and paper industry effluents was caused by the presence of low molecular weight organics, a mixture of sugars, volatile fatty acids and alcohols in the case of pulping wastewaters and starch-derived sugars in paper/board mill wastewaters. Intermittent discharge was a proven technique for controlling sewage fungus growth from pulp mill effluents. While biological treatment of papermill discharges could achieve high BOD removal, the inherent variability in the performance of biological plants precluded the complete elimination of sewage fungus growth potential when the dilution available was only of the order of 10- to 20-fold. (Moore-IVI)
W86-01635

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - II; CHEMICAL ANALYSIS OF MILL EFFLUENTS,

Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 955-959, 1985. 4 Tab, 3 Ref.

Descriptors: *Pulp wastes, *Effluents, *Chemical composition, *Wastewater pollution, Dissolved solids, Organic matter, Carbohydrates, Glucose, Gelatin, Melamine, Sugars, Nutrients.

A sampling and analytical program was carried out at three U.K. paper and board mills, the objective of which was to characterize the dissolved organic matter in final effluents and component wastewater streams. The analyses conducted were dissolved organic carbon (DOC), carbohydrate, glucose, gelatin, melamine, hydrolyzed sugars and molecular weight distribution. For 2 mills using virgin wood pulp and waste-paper, carbohydrates (principally glucans) are the major dissolved organic component (70-80% DOC). The concentrations of low molecular weight oligosaccharides and glucose at both mills could be very significant in terms of sewage fungus growth in the receiving river, depending on the dilution available. At a third mill with on-site chemical pulping of rags, carbohydrate was less dominant in the mixed effluent, which contained a high proportion (70%) of thus far unidentified organics. While the likely nutrients for sewage fungus growth at the third mill are thus less definite, the identified organics (carbohydrate plus gelatin) are more degraded than the organics at other mills. This factor combined with the low effluent dilution available may compensate for the lower nutrient concentrations. (Moore-IVI)
W86-01636

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - IV; GROWTH IN EXPERIMENTAL CHANNELS DOSED WITH EFFLUENTS AND PURE COMPOUNDS,

Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 969-974, 1985. 2 Tab, 6 Ref.

Descriptors: *Wastewater pollution, *Pulp and paper industry, *Microorganisms, Water pollution effects, Pulp wastes, Carbohydrates, Effluents, Nutrients, Glucose, Starch, Gelatin, Resins, Organic compounds.

This is the fourth and final paper in a series of articles describing research undertaken at PIRA during 1978-1980 on the causes and prevention of sewage fungus growth in rivers receiving paper and board mill effluents. This paper describes simulated stream studies in which sewage fungus growths from mixed mill effluents, component effluent streams and mill raw materials were quantified at two paper-mill sites. At the first mill, sewage fungus growth from treated effluent was only light and somewhat less than might have been expected from the measured level of glucose. Cationic starch was a better nutrient than unmodified starch and possible reasons for this are put forward. Individual waste streams at the second mill supported heavy growths of sewage fungus comparable to that from the mixed mill effluent after clarification. As sole sources of organic carbon, fresh or degraded gelatin and melamine formaldehyde resin gave very little sewage fungus growth, but glycerol supported some growth. As the effluent from this mill was considerably more complex than others previously examined, it was concluded that sewage fungus nutrients were provided by degraded organics (largely unidentified) extracted from rags and broke. (Author's abstract)
W86-01638

EVALUATION OF MATHEMATICAL MODELS FOR THE EFFECTS OF PH AND TEMPERATURE ON AMMONIA TOXICITY TO AQUATIC ORGANISMS,

College of Saint Scholastica, Duluth, MN. Dept. of Chemistry.
R. J. Erickson.
Water Research, Vol. 19, No. 8, p 1047-1058, 1985. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Mathematical models, *Hydrogen ion concentration, *Temperature, *Ammonia, *Toxicity, Aquatic animals, Gills, Fish.

Available data on the pH and temperature dependence of ammonia toxicity to aquatic organisms were examined and their agreement with various models was evaluated. A model which considers alteration of the relative concentration of un-ionized ammonia at the gill surface failed to adequately describe either pH or temperature dependence. A model that assumes that un-ionized ammonia and ammonium ion are jointly toxic was strongly supported by the data on pH dependence, but could not explain observed temperature dependence. Temperature dependence can be described empirically by a simple log-linear model. The effects of pH and temperature were generally found to be qualitatively and quantitatively similar among fish species. (Author's abstract)
W86-01648

ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN SEDIMENT AND FISH FROM WETLANDS IN THE NORTH CENTRAL UNITED STATES,

Columbia National Fisheries Research Lab., Yankton, SD. Field Research Station.
D. B. Martin, and W. A. Hartman.
Journal of the Association of Official Analytical Chemists, Vol. 68, No. 4, p 712-717, July/August, 1985. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Pesticides, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Wetlands, *Sediment contamination, *Fish, Pesticide residues, DDD, DDT, Dieldrin, BHC, Trans-nonachlor, DDE.

Sediments samples collected in 1980-1982 from riverine and pothole wetlands at 17 locations in the north central United States were analyzed for organochlorine pesticides, certain of their metabolites, and polychlorinated biphenyls (PCBs). Concentrations were above minimum detection levels (5 ng/g of organochlorines and 20 ng/g of PCBs) in less than 4% of the samples taken. Fish samples taken at 9 of these 17 locations, and analyzed for the same compounds, showed a higher frequency of detectable contaminants. The most common compound found in fish was DDE, which was found in 51% of the samples at levels up to 512 ng/g. Alpha-BHC was present at concentrations of 5 to 27 ng/g in 36% of the fish samples, and DDD was found at levels of 5 to 60 ng/g in 14%. Four other compounds, DDT dieldrin, PCB, and trans-nonachlor, were detected in fish at relatively low concentrations in less than 10% of the samples. This survey, thus, indicated little contamination by organochlorine pesticides or PCBs in the wetland habitats of this region. (Author's abstract)
W86-01651

ALUMINUM MOBILIZATION IN AN ACIDIC HEADWATER STREAM: TEMPORAL VARIATION AND MINERAL DISSOLUTION DISEQUILIBRIA,

Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
R. P. Hooper, and C. A. Shoemaker.
Science, Vol. 229, No. 4712, p 463-465, August, 1985. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Aluminum, *Water pollution effects, *Acid rain, *Acidity, *Streams, *Hubbard Brook Experimental Forest, *New Hampshire, Geochemistry, Metals, Hydrogen ion concentration, Seasonal variation, Snowmelt.

As part of an integrated field and modeling study an extensive sampling effort was undertaken on an instrumented watershed at the Hubbard Brook Experimental Forest (New Hampshire) to examine the chemical response of a stream to snowmelt and storm events during the spring of 1984. Intensive sampling was performed along an elevational gradient in the headwater stream to observe the chemical response of the stream to acidic inputs. Aluminum concentrations during this period were not in equilibrium with a readily formed mineral phase, as has been assumed, and the increase in aluminum concentration due to episodic depressions in pH lessened during the snowmelt. The temporal variation in the aluminum response to pH depressions indicates a more complicated aluminum mobilization mechanism than a mineral dissolution equilibrium. This temporal variation may be caused by the depletion of a slowly forming, labile pool of aluminum in the soil. The high aluminum concentrations may be influenced by a kinetic constraint in the precipitation of an aluminum mineral. Since the sampling focused on high flow events, the higher aluminum concentrations at the higher pH's found downstream could have been due to transport of aluminum that did not have time to precipitate out of solution. The observed disequilibrium between aluminum concentrations in stream water and a readily formed $Al(OH)3$ mineral phase reduce confidence in predictions of short-term temporal changes in stream chemistry made by investigators using models based on an equilibrium. The temporal pattern of the snowmelt is important in the mobilization of aluminum. The highest aluminum concentrations were observed in the midwinter thaw, not during the main spring melt. Because sensitive life stages of fish species are present only at certain times of the year, such patterns are important in the assessment of the biological impacts of acid precipitation. (Collier-IVI)
W86-01678

BEHAVIORAL MODIFICATION OF ESTUARINE FISH EXPOSED TO SULFUR DIOXIDE,

Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, D. T. Burton, W. C. Graves, and S. L. Margrey.
Journal of Toxicology and Environmental Health, Vol. 13, No 4-6, p 969-978, 1984. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Animal behavior, *Sulfur dioxide, *Fish behavior, *Water pollution effects, *Sulfites, Bass, Menhaden, Water temperature, Avoidance response, Model studies.

This study was designed to determine the avoidance responses of juvenile striped bass (Morone saxatilis) and Atlantic menhaden (Brevoortia tyrannus) exposed to sulfur dioxide (sulfite) at acclimation temperatures of 15, 20, 25, and 30 C. Predictive models were developed and compared for each species at each acclimation temperature. Striped bass avoided 2.2, 2.3, 3.0, and 3.5 mg sulfite/l at 15, 20, 25, and 30 C, respectively. Atlantic menhaden avoided 3.2, 3.6, 2.9, and 3.0 mg sulfite/l at acclimation temperatures of 15, 20, 25, and 30 C, respectively. Acclimation tempera-

ture was an important factor influencing the avoidance response of each species exposed to sulfur dioxide. Striped bass avoided lower concentrations of sulfite than Atlantic menhaden at 15 and 20 C. Both species avoided approximately the same concentration of sulfite at 25 C. Atlantic menhaden avoided lower concentrations of sulfur dioxide than striped bass at 30 C. (Author's abstract)
W86-01679

EFFECT OF SEWAGE SLUDGE ON MICROBIAL ACTIVITY IN AN OLD, ABANDONED MINESOIL,

Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W86-01702

BIOGEOCHEMISTRY OF LEAD IN MCDONALDS BRANCH WATERSHED, NEW JERSEY PINE BARRENS,

Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-01703

LEAD DISTRIBUTION AND FLUXES IN A HIGH-ELEVATION FOREST IN NORTHERN VERMONT,

Pennsylvania Univ., Philadelphia.
For primary bibliographic entry see Field 5B.
W86-01706

EFFECTS OF PO RIVER INDUCED EUTROPHICATION ON THE DISTRIBUTION AND COMMUNITY STRUCTURE OF CILIATED PROTOZOAN AND MICROMETAZOAN POPULATIONS IN THE NORTHERN ADRIATIC SEA,

Institut Rudjer Boskovic, Rovinj (Yugoslavia). Centar za Istrazivanje Mora.
N. Revelante, M. Gilmartin, and N. Smodlaka.
Journal of Plankton Research, Vol. 7, No. 4, p 461-471, 1985. 2 Fig, 4 Tab, 22 NSF grant F7FO22Y and Smithsonian Institution grant JF-10-SMI.

Descriptors: *Protozoa, *Invertebrates, *Eutrophication, *Po River, *Adriatic Sea, Water pollution effects, Zooplankton, Mixing, Stratification, Seasonal variation, Abundance, Distribution.

The ciliated protozoans and micrometazoans in the northern Adriatic were repeatedly sampled and analyzed during summer and winter periods, with emphasis on quantifying the changes in abundance, and community structure, associated with a trophic gradient created by the discharge of the Po River. The community was characterized by major groups, organism abundance and volume, and size class frequency. The microzooplankton biomass increased 2- to 3-fold toward the western side of the Adriatic off the Po delta, during both 'mixed' and 'stratified' seasons, with increases in both the ciliated protozoans and micrometazoan components. At eutrophic sites and under 'stratified' conditions a marked increase in the relative abundance of ciliated protozoans was observed, with a relative increase in tintinnid contribution to the total ciliated protozoan biomass. Although marked changes in the ciliated protozoan biomass occurred, little change in their size class structure occurred except as influenced by inflowing waters from the central Adriatic. (Author's abstract)
W86-01757

ABUNDANCE OF WEST INDIAN MANATEES (TRICHECHUS MANATUS) AROUND SELECTED FLORIDA POWER PLANTS FOLLOWING WINTER COLD FRONTS, 1982-1983,

Eckerd Coll., St. Petersburg, FL. Dept. of Biology.
J. E. Reynolds, and J. R. Wilcox.
Bulletin of Marine Science, Vol. 36, No. 3, p 413-422, 1985. 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Manatees, *Powerplants, *Water temperature, *Florida, Air temperature, Behavior, Thermal pollution, Abundance.

Seven 1-day aerial surveys were flown during winter, 1982-1983, to assess manatee abundance. The surveys focussed on five Florida Power and Light Company plants: Cape Canaveral (PCC), Riviera (PRV), Port Everglades (PPE), Lauderdale (PFL), and Ft. Myers (PFM). Of the 1,191 manatees sighted during the surveys, 930 were present in the immediate vicinity of the plants. Ten percent of the total animals sighted were calves, with the highest percentage of calves (13.6%) being present at PFM. Maximum counts of manatees for each plant were as follows: PCC, 15; PRV, 98; PPE, 56; PFL, 16; PFM, 85. With the exception of PRV's maximum count, of the 1982-1983 maxima represent the lowest maximum counts for the respective plants in 6 years of surveys. The low counts most likely reflect the mild winter temperatures. With the exception of PFM, there is no indication that any regional manatee populations have declined significantly. Seventeen regressions compared the following variables: intake water temperature at power plants, mean daily air temperature, and number of manatees observed at each plant. Significant correlations were found only for three regressions of water temperature and number of manatees, for one regression of air temperature and number of manatees, and for one regression of all variables. The remaining regressions indicated correlations that were not significant, supporting the contention that winter cold was not of sufficient intensity or duration in 1982-1983 to cause large numbers of manatees to aggregate. (Author's abstract)
W86-01758

INVESTIGATION OF A EUTROPHIC TIDAL BASIN: PART 2 - NUTRIENTS AND ENVIRONMENTAL ASPECTS,

Southern Water Authority, Otterbourne (England). Resources Planning Lab.
H. A. C. Montgomery, P. G. Soulsby, I. C. Hart, and S. L. Wright.
Marine Environmental Research, Vol. 15, p 285-302, 1985. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Eutrophication, *Tidal basins, *Nutrients, Wastewater pollution, Water pollution sources, Sediments, Phosphorus, Nitrogen, Cycling nutrients, Algal growth.

The eutrophication of Langstone Harbour, a large tidal basin, has been studied by statistically designed nutrient surveys. Rates of input of nutrients from the sea, from effluent discharges and from other sources, have been estimated. Sediment/water interactions have been shown to be important in the phosphate budget of the basin, but they are less important in the nitrogen budget. Deductions were made about the relative importance of the various inputs and processes affecting concentrations of nutrients in the water column. It is concluded that ecologically or aesthetically detrimental growths of macroalgae are unlikely to occur in Langstone Harbour in the foreseeable future and that the removal of nutrient inputs, formerly thought to be necessary, will not, in fact, be required. The principles of the experimental design and of interpreting the data are of general applicability to tidal waters where the ratio of natural to man-made inputs needs to be known, where eutrophication is, or is expected to become, a problem, or where the progressive accumulation of nutrients by recycling is suspected. (Author's abstract)
W86-01789

COMBINED EFFECTS OF SALINITY AND CADMIUM CHLORIDE UPON EMBRYOS AND LARVAE OF THE JAPANESE OYSTER, CRASSOSTREA GIGAS,

Institut Francais de Recherche pour l'Exploitation de la Mer, Arcachon.
R. Robert, and E. His.
Marine Environmental Research, Vol. 15, p 303-312, 1985. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Salinity, *Cadmium chloride, *Oysters, *Embryos, *Larvae, Water pollution effects, Heavy metals, Cadmium compounds, Water pollution, Immature growth stages.

Following the observation of high concentrations of cadmium in Gironde estuarine waters, the response of embryos and larvae of the Japanese oyster, Crassostrea gigas to this heavy metal at various salinity regimes was studied for 10 days in the laboratory. The experimental design was a 4 x 4 factorial experiment using concentrations of cadmium of 0.10, 20 and 50 micro-g/liter and salinities of 20, 25, 30 and 35%. Statistical analysis indicated that the salinity changes have important effects on the embryonic development, survival and growth of C. gigas larvae. No deleterious effect of the toxin at all cadmium concentrations and no interaction between cadmium and salinity were found. (Author's abstract)
W86-01790

TRACE METALS IN BIVALVE MOLLUSCS FROM THAILAND,

Environmental Protection Agency, Kowloon (Hong Kong).
D. J. H. Phillips, and K. Muttarasin.
Marine Environmental Research, Vol. 15, p 215-234, 1985. 1 Fig, 8 Tab, 35 Ref.

Descriptors: *Trace metals, *Mollusks, *Thailand, Cadmium, Chromium, Copper, Iron, Lead, Nickel, Mercury, Zinc, Clams, Cockles, Mussels, Oysters, Shellfish, Public health.

Capture fisheries and aquaculture provide a large quantity of bivalve molluscs for human consumption in Thailand each year. The existing information on trace elements in these bivalves is fragmentary and contradictory. This paper reports data for eight metals (cadmium, chromium, copper, iron, lead, nickel, mercury and zinc) in the four major species marketed. These are the clam Paphia undulata, the cockle Anadara granosa, the green mussel Perna viridis and the rock oyster Crassostrea commercialis. The bivalves analyzed were taken at markets or in the field to cover as many of the major sources as possible. The results indicate no major threat to public health from trace elements in these species from Thailand and lend confidence to the expansion of aquaculture operations. In particular, the levels of lead found in the samples analyzed are considerably lower than those previously reported by other authors. (Author's abstract)
W86-01791

EFFECTS OF OIL AND A DISPERSANT ON INTERTIDAL ORGANISMS IN FIELD EXPERIMENTS WITH A MESOCOSM, THE BREMERHAVEN CAISSON,

Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
H. Farke, K. Wonneberger, W. Gunkel, and G. Dahlmann.
Marine Environmental Research, Vol. 15, p 97-114, 1985. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Oil pollution, *Dispersants, *Intertidal areas, *Benthos, Water pollution effects, Bacteria, Sediments, Hydrocarbons, Benthic fauna, Benthic flora, Mesocosms.

Three medium-scale field experiments on the effects of oil, a dispersant and an oil/dispersant mixture were carried out in an intertidal mud flat ecosystem of the Wadden Sea (German Bight). For six successive tides each contaminant was added to the water enclosed in a mesocosm during submersion of the flat. The fate of the oil in the sediment and effects on phytobenthos, bacteria and macrozoobenthos were studied. Penetration of the oil into the sediment was mainly observed at the surface layer. Higher oil concentrations and lower boiling polycyclic hydrocarbons were persent when oil was chemically dispersed. Sublethal effects were found in some macrofauna species (reduced feeding activity) and in phytobenthic organisms (increased activity); oil degrading bacteria increased. No major effects were observed when the dispersant alone was added. (Author's abstract)
W86-01792

COPPER AND SILVER ACCUMULATION IN TRANSPLANTED AND RESIDENT CLAMS (MACOMA BALTHICA) IN SOUTH SAN FRANCISCO BAY,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W86-01793

TOLERANCE OF BATHYPOREIA PILOSA LINDSTROM (AMPHIPODA: HAUSTORIIDAE) TO ORGANIC AND INORGANIC SALTS OF MERCURY,

Centre de Recherches Marines, Jounieh (Lebanon).
N. H. Khayrallah.
Marine Environmental Research, Vol. 15, p 137-151, 1985. 6 Tab, 52 Ref.

Descriptors: *Mercury compounds, *Amphipods, *Toxicity, Salinity, Temperature, Age, Heavy metals, Organic compounds, Bioaccumulation, Mercuric chloride, Ethyl mercuric chloride.

Toxicity tests of mercuric chloride and ethyl mercuric chloride were run on Bathyporeia pilosa. One-hundred-and-eight factorial combinations were analyzed for each mercurial compound (three salinities, three temperatures, two age groups and six mercury concentrations). These were complemented by an investigation on the uptake and concentration potential of these two compounds by B. pilosa. Toxicity of the inorganic and organic mercury was seen to be directly related to both concentration and temperature and inversely related to salinity and age. Sublethal effects were studied and related to the four parameters investigated. Accumulation of the organic mercury compound was almost twice as rapid as that of the inorganic form, although death occurred where animals contained very similar levels of mercury. (Author's abstract)
W86-01794

INFLUENCE OF CYCLIC EXPOSURE ON THE ACCUMULATION OF HEAVY METALS BY MYTILUS EDULIS PLANULATUS (LAMARCK),

Tasmania Univ., Hobart (Australia). Dept. of Zoology.
N. G. Elliott, R. Swain, and D. A. Ritz.
Marine Environmental Research, Vol. 15, p 17-30, 1985. 8 Fig, 6 Ref.

Descriptors: *Bioaccumulation, *Heavy metals, *Mussels, Cadmium, Copper, Lead, Zinc, Cyclic exposure.

Accumulation of cadmium, copper, lead and zinc in the tissues of Mytilus edulis planulatus was examined under cyclic conditions of exposure in order to establish whether the rate of accumulation of the metal is proportional to the time exposed to the elevated concentrations. When exposed to a single metal, the accumulation of lead and zinc was directly proportional to the exposure time, but that of copper was not. Under simultaneous exposure to all four metals both lead and cadmium were accumulated in direct proportion to the exposure time, while copper and zinc were not. Accumulation of the three metals cadmium, copper and zinc was influenced by the presence of other metals. (Author's abstract)
W86-01796

EFFECTS OF DREDGING AND DUMPING ON BENTHOS OF SAINT JOHN HARBOUR, CANADA,

Department of Fisheries and Oceans, St. Andrews (New Brunswick).
D. J. Wildish, and M. L. H. Thomas.
Marine Environmental Research, Vol. 15, p 45-57, 1985. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Dredging, *Dumping, *Ecological effects, *Saint John Harbor, *New Brunswick, *Benthos, Water pollution effects, Species composition, Polychaetes.

Of four impoverished communities of benthic macro-infauna in Saint John Harbor, three were attributable to anthropogenic causes: disposal of solid wood wastes, dredging, and dumping activity. Circumstantial evidence indicates that the fourth community resulted from strong tidal currents present in the inner harbor interacting with the sediment causing periodic erosion and deposition, resulting in an impoverished macro-infauna. The dredged area was rapidly recolonized; first by invasive species such as Capitella capitata and Nereis sp. and then by species present in adjacent sediments. The area adversely affected by dumping was of limited extent: of the order of 1 sq km, as indicated by the presence of exotic species in dump soil and the distribution of organic carbon. (Author's abstract)
W86-01798

CHLORINATED HYDROCARBONS AND HATCHING SUCCESS IN BALTIC HERRING SPRING SPAWNERS,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
P. D. Hansen, H. von Westernhagen, and H. Rosenthal.
Marine Environmental Research, Vol. 15, p 59-76, 1985. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Chlorinated hydrocarbons, *Herring, *Fish, *Water pollution effects, *Spawning, *Hatching, Toxicity, Polychlorinated biphenyls, DDD, DDE, Pesticides, Growth stages.

Eggs from 69 females of spring spawning herring from the German Baltic coast (Travemunde, April 1979) were incubated in clean sea water (20 0/00 S, temperature 8 C) under standard conditions. Sixty-one trials could be used for the evaluation of hatching success. Viable hatch was taken as a measure to evaluate the effects of chlorinated hydrocarbons accumulated in gonads, liver and muscle of parental fish. PCB levels in running ripe females ranged on a wet weight basis between 19 and 241 ng/g (gonad), 20 and 377 ng/g (liver) and 11 and 1820 ng/g (muscle). Concentrations of other chlorinated hydrocarbons (DDD, DDE, gamma-HCH, etc.) were in the same range as reported by other authors for Baltic herring. Viable hatch was significantly affected at ovary DDE concentrations higher than 18 ng/g (wet wt) and PCB concentrations of more than 120 ng/g (wet wt). (Author's abstract)
W86-01799

STUDY OF THE TOXICITY OF SOME SILICONE COMPOUNDS IN RELATION TO MARINE BIOLOGICAL CHAINS,

Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
M. Aubert, J. Aubert, H. Augier, and C. Guillemaut.
Chemosphere, Vol. 14, No. 1, p 127-138, 1985. 10 Fig.

Descriptors: *Toxicity, *Silicone compounds, *Marine environment, *Food chains, Organosilicone compounds, Fish, Crustaceans, Mollusks, Bioaccumulation, Phytoplankton, Water pollution effects.

The trophic chain method developed in the laboratory is intended to reconstruct simplified but characteristic ecosystems and thus to provide a predictive method of studying the effects of chemical pollution on the various links in marine trophodynamic chains. The trophodynamic chain method was used in a study of the toxicity of organosilicone compounds and their emulsifier to marine biological chains. The trophodynamic chains studied include a fish benthic chain, a crustacean benthic chain, a mollusk chain and a pelagic chain. The accumulation factors are generally very low (from 0.036 to 2.08). The transfer factor is highest within the pelagic and neritic chains, where the first stage comprises phytoplankton. The silicone compound behaves, at least for a while, as a persistent pollutant, but the transfer and accumulation phenomena are extremely reduced and consequently it does not seem likely that harmful effects will be passed on to the consumer at the end of the chain. (Moore-IVI)
W86-01853

FATE AND TOXICITY OF HIGH DENSITY MISSILE FUELS RJ-5 AND JP-9 IN AQUATIC TEST SYSTEMS,

Georgia State Univ., Atlanta. Dept. of Biology.
J. C. Spain, and C. C. Somerville.
Chemosphere, Vol. 14, No. 2, p 239-248, 1985. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Fate of pollutants, *Fuels, *Water pollution effects, Biodegradation, Path of pollutants, Microorganisms, Shrimp, Sorption, Volatilization, Toxicity, Sediments.

The fate of the fuel components in lab test systems containing water and sediment collected from natural aquatic habitats was measured. Because the high density components seemed to be persistent, the toxicity of the fuels to microorganisms and Mysidopsis bahia were also examined. The difference in density between RJ-5 and JP-9 seems to determine the differences in their fate in aquatic systems. Volatilization of the components from JP-9 is much faster than from RJ-5 because JP-9 floats on the surface of the water. The difference is particularly notable with endo-endo-dihydrodi(norbornadiene) which is present in both fuels; it volatilized from JP-9 mixtues within a few days yet remained for much longer periods in RJ-5. Sorption to the sediment greatly reduced the volatilization of both fuels. The norbornadiene dimers have a higher affinity for sediment than the cyclopentadiene dimers but both types of compounds resisted weathering in the presence of sediment. The structural features of the high density synthetic molecules make them very resistant to microbial attack. Biological transformations of the norbornadiene dimers by the insertion of an oxygen atom were not detected. The fuels were not toxic to microorganisms at low to moderate concentrations but RJ-5 was toxic to mysid shrimp. The recalcitrance of RJ-5 to microbial degradation, affinity for sediment, density, and toxicity to aquatic macrobiota, suggest that a large-scale spill of the fuel could present major environmental problems. JP-9 appears to be much less of a potential problem in the aquatic environment than RJ-5 because of its higher vapor pressure and lower density. (Baker-IVI)
W86-01854

PREDICTING THE EFFECT OF TOXIC SUBSTANCES ON PELAGIC ECOSYSTEMS,

Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Fisheries Research Branch.
U. Borgman.
Science of the Total Environment, Vol. 44, p 111-121, 1985. 4 Tab, 20 Ref.

Descriptors: *Ecosystems, *Toxicity, *Prediction, Biomass size spectrum, Lake Ontario, Zooplankton, Phytoplankton, Fish, Body size, Water pollution effects, Growth, Nutrient load.

Recent advances in the description of pelagic ecosystems using the biomass size spectrum can be adapted to predict the effect of toxic substances on whole ecosystems. The method is demonstrated using Lake Ontario as an example. First, the shape of the biomass size spectrum is predicted. Using a previously published estimate of particle-size conversion efficiency (-log(biomass conversion efficiency)/log(predator-prey size ratio)), and an estimated exponent of the allometric relationship between body size and turnover rate of 0.24, the biomass over logarithmically equal size classes in Lake Ontario is estimated to be proportional to body size raised to the exponent-0.02. The biomass within various size classes is then estimated from data on zooplankton and phytoplankton biomass. Total biomass, from algae to fish, is estimated to be 7-16 g/sq m dry weight. The change in biomass and production over various size classes after addition of a toxic substance can then be predicted if the total nutrient load remains relatively constant and if the effect of the substance on biomass conversion efficiency is known. A toxicity sufficient to decrease growth and conversion efficiency by 50% is predicted to reduce production of large fish by 91%, but phytoplankton production by only 12% in the lake. Fish biomass is predicted to drop substantially, phytoplankton biomass should rise,

and zooplankton biomass should remain relatively unaffected. (Author's abstract)
W86-01865

DETOXIFICATION OF COPPER IN THE CELLS OF THE DIGESTIVE GLAND OF MUSSEL: THE ROLE OF LYSOSOMES AND THIONEINS,

Genoa Univ. (Italy). Ist. di Fisiologia Generale.
A. Viarengo, M. N. Moore, M. Pertica, G. Mancinelli, and G. Zanicchi.
Science of the Total Environment, Vol. 44, p 135-145, 1985. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Mussels, *Copper, *Toxicity, Lysosomes, Thioneins, Digestive gland, Heavy metals, Detoxification, Water pollution effects.

The data reported shows that copper is naturally present in the lysosomes and residual bodies of mussel digestive gland, the concentration of the metal being greatly increased for mussels exposed to Cu(2+) (0.04 ppm) for 3 days and then detoxified for 6 days. A procedure has been devised to solubilize the copper that is present in an insoluble form in lysosomes and residual bodies. This procedure disrupts lysosomes with sonication and solubilizes Cu-protein complexes in a hypotonic solution containing 1% 2-mercapto-ethanol and a mixture of antiproteolytic agents. The solubilized copper, representing more than 80% of the total metal present in the organelles, has been found mainly bound to a protein showing characteristics similar to those of metallothioneins: it has a high metal content, a molecular weight of about 12000 as evaluated by gel filtration, a relatively low UV absorbance at 280 nm and a high -SH content, as evaluated by the Shikata orcein cytochemical technique. The lysosomal extracts from the digestive gland of controls contain low basal levels of this copper-rich thionein-like protein which increases 5-6 times when the mussels are exposed to copper (0.04 ppm) for 3 days and then detoxified for 6 days. (Author's abstract)
W86-01866

ACID DEPOSITION AND DRINKING WATER,

Wisconsin Univ.-Madison. Center for Limnology.
M. E. McDonald.
Environmental Science and Technology, Vol. 19, No. 9, p 772-776, 1985. 1 Fig, 1 Tab, 45 Ref.

Descriptors: *Acid rain, *Public health, *Drinking water, Aluminum, Copper, Cadmium, Corrosion, Asbestos, Lead, Groundwater, Surface water, Acid deposition, Water pollution effects.

Acid deposition could affect human health indirectly through two principal routes: bioaccumulation of chemicals in human food and contamination of drinking water. Acid deposition has been shown detrimental to aquatic ecosystems because of increased mobilization of trace metals. Acid deposition may enhance the scavenging of atmospheric contaminants, mobilize natural or synthetic contaminants in catchment areas, and promote corrosion of drinking water distribution systems. Numerous problems are associated with assessing human health risks from drinking contaminated water, such as subchronic effects, latency, antagonism, synergism, and general etiology. One of the most basic deals with the amount of water a person consumes daily. Contaminants of particular concern to human health include mercury, aluminum, copper, cadmium, lead, and asbestos. The source of drinking water is an important factor in determining its potential for being detrimentally affected by acid deposition. The major sources are groundwater and surface water. Other sources include cisterns and water suppliers. Research is needed to provide better estimates of affected populations and of the existing levels of the various contaminants in drinking water to which the affected populations are exposed. (Baker-IVI)
W86-01867

VARIABILITY OF ALUMINUM CONCENTRATIONS IN ORGANS AND WHOLE BODIES OF SMALLMOUTH BASS (MICROPTERUS DOLOMIEUI),

Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5A.
W86-01872

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5B.
W86-01873

BIOCONCENTRATION FACTORS OF SOME HALOGENATED ORGANICS FOR RAINBOW TROUT: LIMITATIONS IN THEIR USE FOR PREDICTION OF ENVIRONMENTAL RESIDUES,

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and A. J. Niimi.
Environmental Science and Technology, Vol. 19, No. 9, p 842-849, 1985. 1 Fig, 7 Tab, 49 Ref.

Descriptors: *Biological magnification, *Trout, *Chlorinated hydrocarbons, *Brominated hydrocarbons, *Fish, Water pollution effects, Partition coefficients, Bioaccumulation, Lake Ontario, Animal tissues.

The bioconcentration factors, BCF's, for 34 chlorinated and brominated chemicals in rainbow trout have been determined by the steady-state approach by using chemical water concentrations in the nanogram per liter range. In addition, for 13 chemicals with a known half-life in trout, BCF's were also estimated by using the kinetic approach. The two methods gave comparable results for compounds with short half-lives in the fish but significantly different results for longer half-life chemicals. The BCF's have been shown to correlate well with octanol/water partition coefficients, Kow, for many of the study compounds. But the BCF's of high molecular weight compounds and compounds metabolized by the fish did not correlate with Kow. The laboratory-derived BCF's were compared to field-derived BCF's for Lake Ontario rainbow trout. This comparison showed that predictions based on laboratory BCF's were useful for chemicals with short half-lives in fish but were much too low for long half-life chemicals, where contaminated food is the major chemical source. (Author's abstract)
W86-01874

GROWTH RESPONSE OF YELLOW-POPLAR (LIRIODENDRON TULIPIFERA L.) SEEDLINGS TO OZONE, SULFUR DIOXIDE, AND SIMULATED ACIDIC PRECIPITATION, ALONE AND IN COMBINATION,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology.
A. H. Chappelka, B. I. Chevone, and T. E. Burk.
Environmental and Experimental Botany, Vol. 25, No. 3, p 233-244, 1985. 2 Fig, 4 Tab, 39 Ref.

Descriptors: *Poplar trees, *Acid rain, *Water pollution effects, *Ozone, *Sulfur dioxide, Plant growth, Air pollution, Trees.

Nine-week-old, half-sib, yellow-poplar were exposed to O_3 and/or SO_2 (controls, 0.10 ppm O_3, 0.08 ppm SO_2 or 0.10 ppm O_3 + 0.08 ppm SO_2, 4 hr/d/wk) in combination with simulated rain (pH 3.0, 4.3 or 5.6 1 hr/d, 2d/wk at 0.75 cm/hr) for 6 wk, with rain applied either just before or after fumigation. Across all rain treatments, O_3 + SO_2 resulted in a significant decrease in height growth and dry matter production and an increase in leaf area ratio (LAR) compared with controls. The combined effect of O_3 and SO_2 was additive in nature, except for root dry weight and leaf weight ratio (LWR) in which a greater than additive response was observed. The alteration in LAR was due to dry matter remaining in the leaves as indicated by an increase in LWR. Rain treatments altered leaf dry weight which appeared as a quadratic function across all pollutant treatments. A significant gaseous pollutant x rain pH interaction occurred for root dry weight, leaf area increase, mean relative growth rate (RGR), mean unit leaf rate (ULR) and chlorophyll content. Ozone exposure resulted in a linear decrease in root dry weight, leaf area increase, RGR and ULR, as the acidity of rain increased (decreased pH), whereas fumigation with SO_2 resulted in an increase in these growth variables as rain pH decreased. Chlorophyll content increased in both O_3 and SO_2 treatments as the acidity of rain increased. Fumigation of wet leaves caused a significant reduction in dry matter production, shoot elongation, leaf area, RGR and ULR as compared with dry leaves across all treatments. The results of this study demonstrate that the effects of multiple pollutant stresses are more deleterius than any single pollutant exposure for these half-sib seedling trees. These findings are discussed relative to possible implications on the effects of gaseous pollutants in combination with acidic precipitation on yellow-poplar growth and productivity. (Author's abstract)
W86-01876

CONTAMINANT LEVELS IN COLONIAL WATERBIRDS FROM GREEN BAY AND LAKE MICHIGAN, 1975-80,

G. H. Heinz, T. C. Erdman, S. D. Haseltine, and C. Stafford.
Environmental Monitoring and Assessment, Vol. 3, No. 3, p 223-236, September, 1985. 3 Tab, 29 Ref.

Descriptors: *Water birds, *Pesticide residues, *Halogenated hydrocarbons, *Green Bay, *Lake Michigan, Mercury, Polychlorinated biphenyls, Polybrominated biphenyls, Polychlorinated styrenes, DDE, Dieldrin, Diets, Gulls, Herons, Egrets.

Residues of organochlorine pesticides, polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), polychlorinated styrenes (PCSs), and mercury were measured in the eggs of 10 species of colonial waterbirds nesting in areas around Green Bay or Lake Michigan from 1975 to 1980. Residues also were measured in the carcasses and brains of black-crowned night-herons (Nycticorax nycticorax). The highest residues were of PCBs, DDE, mercury, and dieldrin; for some species, levels of these chemicals possibly were high enough to have caused reproductive effects. Other organochlorine pesticides were found at low levels. Only trace amounts of PCBs and PBBs were found. Eggs of herring gulls (Larus argentatus) collected in 1977 from an island in Lake Michigan contained an average of 100 ppm PCBs and 33 ppm DDE; this was the most-contaminated species. Cattle egrets (Bubulcus ibis), the only bird that is not a fish eater, contained only small quantities of DDE and mercury. (Author's abstract)
W86-01885

INSECTICIDE RESISTANCE IN MOSQUITOFISH OF THE LOWER RIO GRANDE VALLEY OF TEXAS - AN ECOLOGICAL HAZARD,

Columbia National Fisheries Research Lab., Victoria, TX. Field Research Station.
J. K. Andreasen.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 573-577, September, 1985. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Insecticide resistance, *Mosquitofish, *Rio Grande Valley, *Texas, Pesticide toxicity, Genetics, Toxaphene, DDE, Pyrethriod insecticides, Bioaccumulation, Insecticides, Water pollution effects.

Large-scale agricultural development in the Lower Rio Grande Valley makes this an ideal location for examining genetic resistance in fish populations. Acute toxicity tests using mosquitofish showed that a population from the Lower Rio Grande Valley of Texas had developed resistance to toxaphene and cross resistance to DDE but not to pyrethroid insecticides. At toxaphene exposure concentrations up to 4,000 micro-g/l (4 ppm) about 30% of the fish from the Lower Rio Grande Valley survived and the 96 hr LC50 was estimated to be 790 micro-g/l. Control mosquitofish that had no known pesticide exposure did not survive at toxaphene concentrations greater than 32 micro-g/

l, and the 96 hr LC50 was 6.5 micro-g/l. Tests with progeny from resistant parents showed that the F1 generation was also resistant. Resistant mosquitofish bioaccumulate large body residues of organochlorine pesticides that apparently cause no problems for mosquitofish. Consumption of resistant fish may be hazardous to fish or avian predators and may be one factor contributing to an overall population decline of some species in southern Texas. The ability to develop cross resistance may preadapt a population to certain pesticides and thereby create a potentially hazardous situation when new chemicals are introduced. (Moore-IVI)
W86-01889

CONTAMINANT RESIDUES IN FISH AND SEDIMENTS FROM LAKES IN THE ATCHAFALAYA RIVER BASIN (LOUISIANA),

Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5B.
W86-01890

EFFECT OF TOLUENE ON FATHEAD MINNOW (PIMEPHALES PROMELAS RAFINESQUE) DEVELOPMENT,

Washington Univ., Seattle. Dept. of Pathology.
E. W. Devlin, J. D. Brammer, and R. L. Puyear.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 595-603, September, 1985. 4 Fig, 1 Tab, 42 Ref. Air Force grant AFOSR-78-3709 and NIH grant 5T32ESO7032.

Descriptors: *Toluene, *Fathead minnows, *Embryos, *Toxicity, Hydrocarbons, Aromatic compounds, Water pollution effects, Immature growth stages.

A category of highly refined petroleum products which represent a potential source of contamination is jet fuel. Toluene is a major aromatic in the water-soluble fraction of the jet fuel JP-4. The effect of toluene on teleost development was examined under controlled conditions. Young fathead minnow embryos 1-2 hr old were continuously exposed to 30-45 mg/l toluene for 14 to 124 hr. Live embryos as well as serial sections of paraffin-embedded embryos were examined to determine effects of the toxicant. Abnormalities noted under these conditions included distorted embryonic axis, abnormal heart and circulatory system development, hydration and swelling of the pericardial coelom, hemorrhaging, and overall stunted appearance, microphthalmia, and a unique migration of the ventrally located yolk syncytial layer and its associated nuclei. Toluene concentration necessary to elicit morphological responses were high, and may be approached in the environment only under extreme conditions such as a major spill in a confined area. (Moore-IVI)
W86-01892

INHIBITION OF GROWTH OF FRESHWATER MICROALGAE BY LONG-CHAINED ALIPHATIC AMINES EMPLOYED IN SOLVENT EXTRACTION PROCESSES,

Goeteborg Univ. (Sweden). Dept. of Botany.
H. Blanck.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 609-620, September, 1985. 4 Fig, 7 Tab, 48 Ref.

Descriptors: *Aliphatic amines, *Algal growth, *Phytotoxicity, *Solvent extraction, Bioassay, Diatoms, Cyanophyta, Chlorophyta, Amines, Water pollution effects, Industrial wastewater.

The influence on algal growth by six longchained aliphatic amines, used in industrial solvent extraction processes, was investigated by a conventional algal assay and, in addition, a simple assay where algae were grown in liquid medium in 250 micro-l cultures on microtitration plates. Loss of solvent extractants from processes to ambient water represent a potential environment problem. The primary, secondary, tertiary and quaternary amines (with one exception) had EC50-values based on growth rate (ECr) or algal biomass (ECb) at 0.01-0.3 mg/l (20-800 nM). This makes long-chained aliphatic amines about a thousand times more toxic than short-chained amines on a molar basis. The difference in toxicity was interpreted as being due to different modes of action between the two groups of amines. The diatom Asterionella formosa and the blue-green algae Anabaena flos-aquae were more sensitive to the amines than the green-algae Selenastrum capricornutum, Monoraphidium pusillum or Chlorella emersonii. The maximum ECma/ECmin ratio recorded was 19.5, for the primary amine. Anabaena flos-aquae was more sensitive by a factor 2-4 when grown under nitrogen fixation conditions than when supplied with combined nitrogen. Compared to other aquatic organisms, the algae show a particular sensitivity to amines. The microtitration test system was less sensitive than the flask test system. The low sensitivity of the microtitration test system is not an inherent property, but due to the use of an insensitive technique (visual inspection) for detection of algal biomass. The ECr50 and ECb50-values in the flask test system were both heavily time-dependent. (Author's abstract)
W86-01893

LYSOSOMAL ENZYME RELEASE IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS RAFINESQUE) EXPOSED TO CADMIUM,

Michigan State Univ., East Lansing. Pesticide Research Center.
D. J. Versteeg, and J. P. Giesy.
Archives of Environmental Contamination and Toxicology, Vol. 14, No. 5, p 631-640, September, 1985. 9 Tab, 50 Ref.

Descriptors: *Sunfish, *Cadmium, *Enzymes, Toxicity, Water pollution effects, Stress, Starvation, Biological magnification, Bioaccumulation.

Lysosomal membrane lability and enzyme activities were measured in gill and liver tissues of the bluegill sunfish (Lepomis macrochirus). Exposure to sublethal cadmium concentrations for 10 or 21 days resulted in significant increases in the lability of liver lysosomal membranes, as measured by release of N-acetyl-Beta-D-glucosaminidase (NAG) and acid phosphatase (ACP). Acid phosphatase and NAG activites in liver were decreased by 10 day exposure to cadmium. However, after 21 days of exposure, liver NAG activity was elevated. Cadmium exposure did not affect the lysosomal lability index or the total enzyme activity of lysosomes isolated from gill tissue. In vitro exposure of isolated liver lysosomes to cadmium demonstrated that the increase in membrane lability was not a direct effect of cadmium on the lysosome. Stress induced by crowding the fish had no effect on liver lysosomal membrane lability. Starved bluegill sunfish had significantly destabilized lysosomes, as measured by both NAG and ACP. However, starvation did not affect the total activity of either enzyme. Neither size nor sex had any affect on lysosomal membrane lability, which indicates that field experiments will not be confounded by these factors. The problem of metal bioconcentration in fish has created the need for diagnostic tests which can be utilized to understand the biological effects of these contaminants on fish. The lysosomal membrane lability assay currently holds promise for use as a health monitoring tool. (Author's abstract)
W86-01894

ACTIVATION OF POLYCYCLIC AROMATIC HYDROCARBONS BY HEPATIC S-9 FROM A MARINE FISH,

North Carolina Univ. at Chapel Hill. Inst. of Marine Sciences.
D. M. Milling, and M. B. Maddock.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 301-307, September, 1985. 2 Fig, 13 Ref. EPA Grant R811134.

Descriptors: *Polycyclic aromatic hydrocarbons, *Activation, *Fish, Hydrocarbons, Aromatic compounds, Aquatic life, Genotoxicity, Water pollution effects, Organic compounds.

The possibilities for monitoring aquatic systems for genotoxic hazards, including polycyclic aromatic hydrocarbons (PAH's) with cytogenetic assays of feral fish are being examined. Possible differences in metabolism by fish and mammalian systems or by different fish systems can influence the genetic effects of metabolism dependent genotoxic chemicals, such as the PAH's. A preliminary indication of the ability of toadfish S-9 to activate a series of weakly carcinogenic and mutagenic PAH's in the Salmonella assay was undertaken. The first experiment was designed to provide information on the mutagenicities in plate assays of single concentrations of four PHA's to Salmonella strains TA1527, TA1538, TA98,and TA100 with increasing concentrations of S-9 from untreated and 3-methylchlanthrene-pretreated toadfish. Comparison of the results of this study with toadfish S-9 and available data for mammalia S-9 does not suggest substantial differences in the ability to activate the PAH's tested. (Baker-IVI)
W86-01896

ACUTE TOXICITY OF FOUR PHENOXY HERBICIDES TO AQUATIC ORGANISMS,

Dow Chemical U.S.A., Midland, MI. Mammalian and Environmental Toxicology.
H. C. Alexander, F. M. Gersich, and M. A. Mayes.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 314-321, September, 1985. 4 Tab, 12 Ref.

Descriptors: *Herbicides, *Toxicity, *Phenoxy compounds, *Water pollution effects, Organic compounds, Aquatic life, Daphnia, Fish, Mortality.

The herbicides tested include 2,4-D, 2,4-D dimethylamine salt, 2,4-D isooctyl ester, and MXPA isooctyl ester. The 2,4-D isooctyl ester and MCPA isooctyl ester were not toxic to aquatic organisms (daphnia and fish) at their water solubility levels, 0.006 mg/l and 0.003 mg/l, respectively. Fish mortality observed in this study were attributed to low pH values, well within the range reported as being lethal to fish. Differences in acute toxicity values reported for 2,4-D on both invertebrates and fishes could be due to water quality. The daphnid acute toxicity value from this study for 2,4-D dimethylamine salt is significantly higher than earlier studies. Conversely, the acute fish toxicity of 2,4-D dimethylamine salt reported in this study and others was similar. The 2,4-D isooctyl ester has a low water solubility and exhibited no acute toxicity to aquatic organisms at nominal concentrations up to 1,000 times its water solubility. The acute toxicity data from these studies may be used to predict toxicity to aquatic life as a result of an accidental spill to the environment. (Baker-IVI)
W86-01898

METALS AND PCB CONCENTRATIONS IN MUSSELS FROM LONG ISLAND SOUND,

National Marine Fisheries Service, Milford, CT. Milford Lab.
R. A. Greig, and G. Sennefelder.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 331-334, September, 1985. 2 Tab.

Descriptors: *Polychlorinated biphenyls, *Metals, *Mussels, *Long Island Sound, Cadmium, Copper, Heavy metals, Water pollution.

Mussels were collected from the mouths of various rivers and inshore areas along the Connecticut shoreline and analyzed for cadmium, copper, and polychlorinated biphenyls (PCBs). Levels of PCBs in mussels from all ten stations sampled were low, ranging from a mean of 0.049 to 0.115 ppm wet weight. Mussel samples from six stations ranged in PCB levels from 0.049 to 0 068 ppm, whereas mussels from the remaining four stations ranged from 0.084 to 0 115 ppm. From a public health standpoint, both concentrations are quite low compared to the 5 ppm limit set by the FDA for PCBs in fish and shellfish. Copper levels were also low in all mussel samples, with means ranging from 1.0 to 2.3 ppm. Mussels from only two stations had the lower levels of 1.0 and 1.1 Cu, whereas mussels from the other stations had levels in the range of 1.7 to 2.3 ppm. The levels of cadmium in mussels were low, with the exception of those taken from Bridgeport where the mussels had a mean level of 5.1 ppm. Mussels from the other stations had mean

levels of cadmium ranging from 0.41 to 1.3 ppm. (Baker-IVI)
W86-01900

EFFECT OF SELENITE ON THE UPTAKE OF METHYLMERCURY IN COD (GADUS MORHUA),

Fiskeridirektoratet, Bergen (Norway). Inst. of Nutrition.
O. Ringdal, and K. Julshamn.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 335-344, September, 1985. 4 Tab, 18 Ref.

Descriptors: *Selenium, *Methylmercury, *Cod, *Fish, *Metals, *Mercury compounds, Toxicity, Water pollution effects, Heavy metals.

The possible interaction of methylmercury and selenium in different tissues of cod and in feeding diets supplemented with nontoxic levels of the elements was examined. There were no significant differences in the mercury uptake in the muscle between the groups with methylmercury exposure. The mercury concentration in muscle increased steadily in all three groups during the whole experimental period. The selenium supplement did not seem to influence the mercury uptake, quantitatively or with regard to the uptake rate in the muscle. Among the three tissues analyzed, the muscle accumulated the highest concentrations of mercury during the 32 days of exposure without selenium supplementation. The mercury concentration in the liver in one group increased to approximately 0.62 mg/kg after 8 days, and this level was constant through the rest of the experimental period. The total uptake of mercury in the brain increased with the selenium supplementation. While these experiments can offer no information on the mechanism of a methylmercury-selenium interaction in cod, the results indicate such an effect through the altered uptake of these elements in the liver and the brain. (Baker-IVI)
W86-01901

ABSORPTION OF CU++ BY LONG-TERM CULTURES OF DUNALIELLA SALINA, D. TERTIOLECTA, AND D. VIRIDIS,

Montclair State Coll., Upper Montclair, NJ. Dept. of Biology.
B. Lustigman, J. Korky, A. Zahady, and J. M. McCormick.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 3, p 362-367, September, 1985. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Copper, *Absorption, *Salinity, *Algae, *Metals, Aquatic plants, Fate of pollutants, Path of pollutants, Plasmalemma permeability.

The effect of salinity on the absorption of copper by algae was studied by means of atomic absorption analysis. Long term cultures of Dunaliella were used to determine if alterations in plasmalemma permeability occur as a result of adaptation to different osmotic conditions. Since copper appears to affect the mechanisms involved in osmotic resistance, Dunaliella does not exclude copper from the cell. As the extracellular concentration of Cu(++) increases, the intracellular accumulation rises proportionately, so that the intracellular Cu(++) is greater at 50 ppm than in the controls. The resistance of Dunaliella to heavy metals does not appear to be due to exclusion from the cells. Salinity has a significant effect on the amount of copper accumulated by the algal cells. The presence of TRIS in the medium acts to chelate Cu(++) and maintain its concentration to a steady level throughout the experiment. Copper binds to the cell surface and therefore causes alteration of the transport systems. In hypotonic medium the cells remained swollen, while in hypertonic they failed to shrink. Greater permeability in hyposaline medium than in hypersaline, is indicated by the increased absorption of copper into the 2%S cultures than the 6%S. The increased lethality in hypotonic medium may be due to increased water in flux or to greater permeability of copper into the critical regions of the cell. The inverse relationship of salinity and copper permeability may apply to other heavy metal ions as well, which may help to explain the resistance of Dunaliella to heavy metal toxicity. (Baker-IVI)
W86-01904

5D. Waste Treatment Processes

COLOR REMOVAL PROCESS FOR KRAFT PULP AND PAPER MILL EFFLUENTS,

Lakehead Univ., Thunder Bay (Ontario). School of Engineering.
R. G. Rosehart.
Water, Air, and Soil Pollution, Vol. 25, No. 3, p 275-284, July, 1985. 5 Fig, 5 Tab, 8 Ref.

Descriptors: Kraft mills, *Pulp Wastes, *Wastewater treatment, *Color removal, Sulfates, Chemical oxygen demand, Co-precipitation, Aluminum, Calcium, Chemical treatment.

An optimized co-precipitation process for color removal from Kraft pulp and paper mill effluents is described. A split addition process with 115 mg/L Al(+3) and 500 mg/L Ca(+2) appeared to be optimal with a removal percentage of 90.2. The addition of small amounts of a polyelectrolyte A did result in some nominal improvement over the standard process. An Al(+3)/Ca(+2) ratio of 0.23 appeared to give optimal results with the final pH in the 4 to 5 range. Dried sludge produced from the process had a reasonable energy value when combusted in a bomb calorimeter. The chemicals used in the suggested process are commonly available in most kraft mills. For pH control use is made of the acid effluent streams within the mill. Significant COD and hence BOD5 reductions take place during the process which may result in some operational savings during biological secondary treatment. Further development work is needed on a pilot plant scale to further optimize chemical addition rates and conditions and to optimize the mixing and temperature conditions of operation. (Baker-IVI)
W86-01355

NUMERICAL SIMULATION OF RECTANGULAR SETTLING TANKS,

Windsor Univ. (Ontario). Dept. of Civil Engineering.
S. M. Abdel-Gawad, and J. A. McCorquodale.
Journal of Hydraulic Research, Vol. 23, No. 2, p 85-100, 1985. 7 Fig, 1 Tab, 24 Ref, 1 Append.

Descriptors: *Settling tanks, *Wastewater treatment, Sedimentation, Model studies, Simulation, Hydrodynamics, Strip integral method, Sediment transport.

The strip integral method (SIM) is proposed as a simple, and computationally efficient approach to simulate the steady hydrodyamics and sediment transport in settling tanks operating in a neutral density environment. The method assumes a dominant flow direction; the partial differential equations are first reduced by partial integration to a system of ordinary differential equations in terms of a few preselected parameters which are functions of the independent variable, x. These equations are then integrated by methods like Runge-Kutta to give the velocity, the concentration profiles along the tank length and consequently the tank removal efficiency. The method requires the modeller to choose suitable shape functions and to perform the partial integrations. The shape functions given are valid only for tanks that have geometries similar to that demonstrated. Other tank geometries require different shape functions. Work is now in progress to provide more shape functions for different inlet conditions. The method can adequately simulate the major flow features in the tank, the mixing characteristics, the concentration distribution and the removal efficiency. The stability and convergence of the SIM is determined by the number and form of the shape functions; the Runge-Kutta solution is affected by changing the integration step and the order of the truncation error. (Baker-IVI)
W86-01390

EXPERIMENTAL MANIPULATION OF NUTRIENTS AND WATER IN A FRESHWATER MARSH: EFFECTS ON BIOMASS, DECOMPOSITION, AND NUTRIENT ACCUMULATION,

Manitoba Univ., Winnipeg. Dept. of Botany.
S. E. Bayley, J. Zoltek, A. J. Hermann, T. J. Dolan, and L. Tortora.
Limnology and Oceanography, Vol. 30, No. 3, p 500-512, May, 1985. 6 Fig, 6 Tab, 25 Ref.

Descriptors: *Nutrients, *Marshes, *Biomass, *Decomposition, *Wastewater disposal, Peat, Wetlands, Phosphorus, Environmental effects, Water level.

Experimental freshwater marsh plots (2,000 sq m) received 9.6, 3.7, and 1.5 cm/wk of treated sewage effluent and the control plot received 4.4 cm/wk potable water during a 2-year study. Surface water elevation above the peat substrate averaged 0.2 m in the second year. During the first year the marsh surface remained dry. Application of treated effluent increased net primary production only during the dry year. During the wet year there was no significant difference between the highest effluent plot and the control plot in aboveground biomass, or in phosphorus content in the aboveground live or dead vegetation and in the belowground vegetation. Based on the 2 years of the study, a natural increase in water level above the marsh surface had the same effect on the marsh production and nutrient accumulation as did application of 42 g P/sq m/yr in treated effluent. This was presumably due to the release of P from the peat substrate under flooded conditions. (Author's abstract)
W86-01414

RUSSIAN STUDY: CLO2, OXIDATION OF CYANIDES AND PHENOLS,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
A. N. Belevzev, and Yu. L. Maximenko.
Effluent and Water Treatment Journal, Vol. 25, No. 5, p 151-176, May, 1985. 9 Fig.

Descriptors: *Phenols, *Wastewater treatment, *Cyanides, *Chlorine dioxide, Oxidation, Quinones, Chlorination, Chemical reactions, Hydrocarbons.

The oxidation process rate of diatomic phenols, and quinones, depends on the interarrangements of hydroxyl groups and quinone grouping. The benzol ring of phenol or proper quinone is less subjected to breaking up under chlorine dioxide action if hydroxyl groups, or quinone grouping, are in para-position relative to each other and they are destroyed more readily when the group arrangement is reproduced either in the meta position or in ortho position. Methyl-derivatives of quinone do not undergo destruction. Phenols having methyl substituents in side chains are oxidized only to methyl-quinone. The chlorine dioxide effect on waste effluents containing some specific substances was examined. The biochemically treated refinery plant effluents that contained non-oxidized oily hydrocarbons and products with various degrees of oxidation were affected by chlorine dioxide. Experiments showed that the substances retained in the waste effluents detailed are oxidized only in the presence of a large excess quantity of ClO2, with maximum effect in strong alkaline media. Removing COD by 90-95% is achieved by using chlorine dioxide at a rate of 800-1000 mg/l. Phenols contained in biochemically treated refinery plant effluents in small concentrations (0.1 to 1 mg/l) are effectively oxidized by chlorine dioxide. Their complete oxidation is obtained at ClO2 rate of 5 mg/l over the period of 10-15 minutes. The results of comparative tests on phenol oxidation by calcium hydrochlorite in the same effluent indicated that to achieve the same effect the activated chlorine required was twenty times greater. Therefore chlorine dioxide utilization holds much promise for advanced treatment of wastewaters with phenols content in small concentrations. (Baker-IVI)
W86-01440

REVERSE OSMOSIS AND ULTRAFILTRATION SOLVE SEPARATION PROBLEMS,

Clemson Univ., SC.
C. H. Gooding.
Chemical Engineering, Vol. 92, No. 1, p 56-62, January, 1985. 87 Fig, 3 Ref.

Descriptors: *Reverse osmosis, *Ultrafiltration, Water treatment, Wastewater treatment, Water reuse, Membrane processes, Membranes, Filtration, Evaporation.

The basic principles of membrane separation are reviewed and approaches are suggested to design considerations and selection of membranes and equipment for specific jobs. A separation process is normally selected on the basis of experience and an economic evaluation of the alternatives. Analysis using osmosis and reverse osmosis assumes that the membrane is impermeable to the solute, at least in comparison to the rate of solvent permeation. Ultrafiltration obeys the same basic principle, and usually implies the separation of macromolecules from relatively low molecular weight solvents. One important factor to consider is the sensitivity of membrane permeability to factors other than temperature. Aside from concentration polarization, which represents a reduction in driving force, membrane permeability is subject to decline due to precipitation of supersaturated solute and to deposition of gels and fine particulate debris that may enter inadvertently with the feed. There are several design criteria to be kept in mind in selecting RO equipment. A high membrane-surface-to-volume ratio is good to minimize space requirements and capital cost. Adequate structural support is needed to allow the thin membrane to withstand the required pressure drop. Low pressure drop on the concentrate side of the membrane maintains the driving force for permeation. Turbulent flow on the concentrate side or some alternative means is needed to dissipate concentration polarization and minimize fouling. Ease of backflushing and/or ease of membrane replacement is needed in the event that fouling becomes a problem. Long membrane life and low replacement cost should also be considered. (Baker-IVI)
W86-01441

WASTEWATER TREATING AT LANZHOU,

Lanzhou Refinery (China).
L. X. Lie.
Hydrocarbon Processing, Vol. 64, No. 6, p 78-79, June, 1985. 3 Fig, 2 Tab.

Descriptors: *Wastewater treatment facilities, *Lanzhou, *China (Peoples Republic) *Refineries, Tertiary wastewater treatment, Chemical oxygen demand, Equalization, Flotation, Activated sludge treatment, Filtration, Activated carbon.

Lanzhou refinery is a modern, integrated petrochemical enterprise in Gans Province, the Peoples Republic of China. The principal purpose of refineries in China is to provide feedstocks for chemical units. A process wastewater treatment system with a hydraulic capacity of 1,200 t/h was constructed in 1980 to decontaminate the industrial wastewater, to protect the Yellow River. The overall refinery process water treatment scheme consists of the following sequential operations: equalization; oil/water/solids separation; chemical coagulation/dissolved air flotation; activated sludge treatment; sand filtration, and granular activated carbon adsorption. Ancillary operations include sludge thickening, incineration and activated carbon regeneration. The quality of process wastewaters varies widely. By using tertiary treatment, the effluent quality does achieve the required national emission standards and approaches surface water quality. Over 30% of the treated effluent is reused as nonprocess water. An unusual feature of the treatment plant is that it is the site of an attractive park for employees with a fountain fed by plant effluent. (Baker-IVI)
W86-01442

TREATMENT OF WASTEWATER BY APPLICATION TO FOREST LAND,

Georgia Univ., Brunswick. Marine Extension Service.
W. L. Nutter, and J. L. Red.
Tappi Journal, Vol. 68, No. 6, p 114-117, June, 1985. 3 Tab, 11 Ref.

Descriptors: *Land disposal, *Wastewater disposal, *Forest watersheds, Industrial wastes, Municipal wastewater, Leaching, Wastewater renovation.

Forest land across the United States is receiving a variety of industrial and municipal wastewaters. This is particularly true in the Southeast where the availability of forest land makes this method of wastewater disposal particularly attractive. With proper design and operation procedures, drinking water standards for groundwater can be met, tree growth improved, and soil properties also improved. Three general pathways for water assimilation by land treatment are identified as biological degradation and/or plant uptake, accumulation in the soil, and leaching of mobile and nondegradable compounds to subsurface waters. The Unicoi forest is described as an example of a system that maintains excellent surface soil hydraulic properties, permitting all wastewater to infiltrate. If the soil is not disturbed during harvesting, the permeability will not be affected and wastewater loading can be maintained. The nutrient status of the soil has improved with wastewater application. The increased nutrient availability also resulted in significant increases in vegetation growth. Renovation of wastewater constituents meets applicable standards for each of the three categories of assimilation pathways: biological degradation and/or plant uptake, accumulation in the soil, and leaching of mobile and nondegradable compounds. (Baker-IVI)
W86-01464

EFFECT OF REACTOR TURBULENCE ON THE BINDING-PROTEIN-MEDIATED ASPARTATE TRANSPORT SYSTEM IN THIN WASTEWATER BIOFILMS,

New Hampshire Univ., Durham. Dept. of Civil Engineering.
T. T. Eighmy, and P. L. Bishop.
Applied and Environmental Microbiology, Vol. 50, No. 1, p 120-124, July, 1985. 3 Fig, 1 Tab, 38 Ref.

Descriptors: *Biological wastewater treatment, *Reactor turbulence, *Biofilms, *Aspartate, Shear stress, Bacteria, Turbulence, Transport systems.

This research documents an effect of reactor turbulence on the ability of gram-negative wastewater biofilm bacteria to actively transport L-aspartate via a binding-protein-mediated transport system. Biofilms which were not preadapted to turbulence and which possessed two separate and distinct aspartate transport systems (systems 1 and 2) were subjected to a turbulent flow condition in a hydrodynamically defined closed-loop reactor system. A shear stress treatment of 3.1 N /sq m for 10 min at a turbulent Reynolds number (Re = 11,297) inactivated the low-affinity, high-capacity binding-protein-mediated transport system (system 2) and resolved the high-affinity, low-capacity membrane-bound proton symport system (system 1). The Kt and Vmax values for the resolved system were statistically similar to Kt and Vmax values for system 1 when system 2 was inactivated either by osmotic shock or arsenate, two treatments which are known to inactivate binding-protein-mediated transport systems. It is hypothesized that shear stress disrupts system 2 by deforming the outer membranes of the firmly adhered gram-negative bacteria. (Author's abstract)
W86-01482

MATHEMATICAL SIMULATION OF A BIOFILM PROCESS,

Auburn Univ., AL. Dept. of Civil Engineering.
L. Benefield, and F. Molz.
Biotechnology and Bioengineering, Vol. 27, No. 7, p 921-931, July, 1985. 12 Fig, 1 Tab, 32 Ref.

Descriptors: *Biological wastewater treatment, *Biofilms, *Mathematical models, Simulation, Fixed-film process, Diffusion, Oxygen, Organic compounds, Differential equations.

A mathematical model has been developed for a fixed-film biological process (film flow over a flat plate) that describes bulk liquid transport, diffusional transport of oxygen and organics across a stagnant film, diffusional transport of oxygen and organics into the biofilm, biochemical reactions by the individual cells within the biofilm, biofilm growth, and cell density changes within the biofilm due to cellular decay. The model consists of two partial differential equations and three ordinary differential equations. It was assumed for model development that a lack of either organics or oxygen, or both simultaneously could limit the rate of the metabolic reactions. The two sets of differential equations are themselves coupled by a mass balance around the diffusion layer. The response of the model is illustrated through a numerical solution to the system of five differential equations using specified parameter values. The model illustrates how loading, contact time, biofilm thickness, diffusion layer thickness, and oxygen concentration interact to effect organics removal in a fixed film process. Although the model is developed specifically for film flow over a flat plate, the general system response (in a qualitative sense) due to changes in contact time and diffusion layer thickness will be similar for any film flow biofilm process. (Moore-IVI)
W86-01484

TRAINING: THE BRIDGE BETWEEN TREATMENT AND TECHNOLOGY,

B. Quinn.
American City and County, Vol. 100, No. 2, p 52-54, February, 1985. 2 Fig.

Descriptors: *Wastewater treatment, *Financial aspects, *Training, Education, Management, Operations, Public information.

Training is essential for wastewater treatment and disposal plant operators in light of more stringent regulations being placed on these facilities. It is critical for all operating personnel to understand what the system is as a whole and what it is designed to accomplish. Job-specific training is also needed in light of the introduction of various advanced technologies in wastewater treatment. Frequently those who find themselves in positions of managers, have risen through the ranks and have not had the advantages incurred through management training programs. This is another area of training which needs to be implemented in many water treatment facilities. With training being such an obvious need, the reason why it is so often lacking comes down to available money. Far too often the public feels its responsibility for funding ends once the construction of a wastewater treatment plant is complete. The public needs to be educated about the importance of protecting its investment. (Baker-IVI)
W86-01489

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,

W. T. Lorenz.
American City and County, Vol. 100, No. 2, p 56-58, February, 1985. 1 Fig.

Descriptors: *Wastewater treatment, *Economic aspects, Membrane processes, Computers, Automation, Wastewater treatment facilities, Water reuse, Financing, Management.

Public officials are evaluating innovative and cost-effective technologies, as well as exploring alternative financing methods to meet the ever pressing demands for community wastewater treatment needs. Package wastewater treatment plants have been accepted for years as one solution to sewage treatment problems. Membrane technologies, as part of package treatment plants, are also in greater demand where higher quality effluent is desired, perhaps for recycling or reuse. There is a growing demand for instrumentation and sampling systems for monitoring the compositions and concentrations of substances found in influent resulting from industrial waste streams. Computer based services and software are fast becoming an important part of the water and wastewater treatment industry

For small treatment plants, the tend is toward onsite microcomputer operations that can reduce staff requirements by as much as 75%. Significant progress in water recycling is now underway, due to improved economics, tighter water supplies and tradeoffs between treating water supplies and recycling. Two major obstacles to this thought are the high costs and the potential health hazards posed by reclaimed water. Many public officials are now realizing the need for a business approach to financing and managing municipal wastewater treatment systems. As that market grows, public officials will have to keep informed of the benefits and it falls of the changing technology in order to make the best decision for the advancement of wastewater treatment projects in their communities. (Baker-IVI)
W86-01490

STUDIES ON THE POLLUTION CONTROL OF THE YA-ER LAKE (IN CHINESE),

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W86-01513

SEEKING TREATMENT; SEWAGE SOLUTIONS IN SAN DIEGO,

W. P. Deddeh.
Oceans, Vol. 18, No. 4, p 63-64, July-August, 1985.

Descriptors: *Tijuana, *Mexico, *San Diego, *California, *Wastewater treatment, Municipal wastewater, Filtration, Public health, Water reuse, Wastewater renovation.

The problems of sewage spills and ocean disposal methods have caused grave concern among environmentalists, legislators, and government officials about the ecological balance of marine life. San Diego, California has a unique problem caused by the neighboring Mexican city of Tijuana. Lack of adequate sewage collection, treatment and disposal facilities in Tijuana have had a serious impact on San Diego's beaches and on the Tijuana River. It is unlikely that the sewage situation in Mexico will improve. Currently, under an agreement between the US and Mexico, San Diego treats 15 million gallons/day (MGD) of Tijuana's raw sewage at the Point Loma plant. The remainder, two MGD, is pumped to an ocean discharge point about three miles south of the border. The Tijuana sewage pipe breaks have forced beach quarantines for 307 days in 1981, 219 days in 1982, and 294 days in 1983. Holding ponds have been established which offer a temporary remedy to the situation. One alternative to the construction of a larger pipeline to the Point Loma plant which seems to have the backing of environmentalists and a number of engineers is one which uses a static screening process and plastic media, roughing filters, developed for industrial wastewater treatment. The screen and filter approach also does away with the need to build costly ocean outfalls for ocean discharge and allows the treated waste water to be used for reclamation projects in agriculture or industry. (Baker-IVI)
W86-01540

CASE STUDY ANALYSIS FOR SEASONAL NITRIFICATION: ECONOMIC EFFICIENCY AND WATER QUALITY PRESERVATION,

Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
R. A. Ferrara, and M. A. Dimino.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 763-769, July, 1985. 5 Fig, 6 Tab, 6 Ref.

Descriptors: *Nitrification, *Economic aspects, *Wastewater treatment, *Water quality control, Seasonal variation, Water treatment facilities.

A case analysis demonstrated the elements of a cost effective wasteload allocation procedure for wastewater discharges. For many advanced wastewater treatment facilities, a single year-round effluent limitation is imposed. That limitation is normally based on maintenance of water quality standards during critical conditions of low waste assimilative capacity in the receiving water. Generally this critical condition occurs less than 1% of the time, and therefore these treatment facilities are required to be designed and operated to provide effluent quality far in excess of that necessary to preserve water quality most of the time. A practical approach for biological treatment systems is to assign seasonally varying effluent limitations. The approach is particularly appropriate for nitrification systems because of decreased rates of nitrification and lower ammonia toxicity in the receiving water during cooler times of the year. A statistically determined winter low flow criterion was proposed as the appropriate analog to the conventional 7 day 10 year low flow. In this case study, the annual operation and maintenance cost savings were substantial. It is recommended that regulatory agencies include these procedures routinely in specifying effluent limitations. Wastewater treatment facilities should be encouraged to reevaluate their methods of operation for innovative ways to minimize the costs of operation while still preserving stream water quality. Any reduction in other advanced treatment requirements that can be technically and economically justified while still preserving receiving water quality standards and uses should also be pursued. (Baker-IVI)
W86-01543

OPERATIONAL DYNAMICS AND CONTROL OF SECONDARY CLARIFIERS,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
T. M. Keinath.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 770-776, July, 1985. 13 Fig, 8 Ref.

Descriptors: *Secondary wastewater treatment, *Clarification, Wastewater treatment, Management, Maintenance, Operation.

Solids inventory control strategies have been described for several secondary clarifier overload situations including thickening overloads, and thickening and clarification overloads. A recycle rate control strategy was shown to be effective for thickening overloads and a certain class of thickening and clarification overloads. Effective solids inventory control for situations in which secondary clarifiers are grossly overloaded with respect to both thickening and clarification can be achieved only by applying a step-feed control strategy. Although the graphical approach was used in this research to illustrate various solids inventory control strategies proposed, many treatment plant operators may consider the approach too tedious. Consequently, the control algorithms described were incorporated in a software package designed to control the activated sludge system. This is available under a software package that also includes a data management and comprehensive total maintenance management program. When using the software, the operator inputs only the current influent and recycle flow rates and the MLSS value. The software analyzes the operational state of the system and specifies the type and extent of control action required, if any. This effectively relieves the tedium of the graphical procedure. (Baker-IVI)
W86-01544

PILOT TESTS OF CHLORINATION FACILITY FOR DISINFECTING SECONDARY EFFLUENT,

Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, R. Warriner, and N. S. N. Ni.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 777-784, July, 1985. 6 Fig, 4 Tab, 15 Ref.

Descriptors: *Secondary wastewater treatment, Wastewater treatment, Water treatment facilities, Chlorination, Model studies, Sulfur dioxide, Economic aspects, Coliform, Bacteria, Water quality control.

A comparison was made of effluent fecal coliform reductions achievable with chlorine application by jet and by conventional diffuser. An initial mixing reactor with an assembly equipped for investigating either jet mixer or diffuser mixer was constructed, and evaluated with secondary effluents. An improved iodometric method involving the back-titration of TRC with coulometrically generated iodine was used to determine the chlorine residuals. The efficiency of chlorination was evaluated based on fecal coliform MPN for various mixing modes and initial chlorine application dosages. Most of the chlorine reduction took place during the initial mixing period of about 30 seconds. Higher reductions occurred with the jets than with the diffuser. Lower chlorine residuals in an improved initial mixing system will reduce sulfur dioxide requirements when dechlorination is required. Although most of the coliform reduction took place during the initial mixing period, significant coliform reduction continued for up to 15 minutes after chlorine application. The initial mixing intensity seemed to affect only the initial kills but not later kills. Based on the data, a regression model was formulated, which incorporated the pertinent variables of inital chlorine dosage and chlorine contact time. Because of the data scatter, the model may best be considered an indication of the relative importance of the time and concentration variables. (Baker-IVI)
W86-01545

FIELD STUDIES OF THE OVERLAND FLOW PROCESS FOR THE TREATMENT OF RAW AND PRIMARY TREATED MUNICIPAL WASTEWATER,

California Univ., Davis. Dept. of Civil Engineering.
R. G. Smith, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 785-794, July, 1985. 12 Fig, 5 Tab, 22 Ref. EPA contract R807757, and California State Water Resources Control Board grant 7-196-41.

Descriptors: *Wastewater treatment, *Overland flow, *Davis, *California, Land disposal, Municipal wastewater, Temperature effects, Precipitation.

A field study was conducted at the city of Davis, California overland flow treatment site. The entire system comprised an area of 65 ha and was divided into 15 zones. Each zone consisted of one pair of opposite facing slopes fed by a central double-gate aluminum pipe, 25.4 cm in diameter. Each slope was 45 m long and 512 m across. All slopes were constructed with a down-slope grade of 2% and a cross slope grade of 0.2%. Studies were conducted with raw wastewater and primary effluent to determine the relationships between overland flow process performance and the parameters application rate and application period. The effects of precipitation and temperature on process performance were also monitored. Model studies based on slope length and application rate lead to predictions of smaller land requirements than current design guidelines have imposed. (Baker-IVI)
W86-01546

RESPONSE OF PHENOL-ACCLIMATED ACTIVATED SLUDGE PROCESS TO QUANTITATIVE SHOCK LOADING,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, and A. F. Gaudy.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 795-804, July, 1985. 9 Fig, 2 Tab, 32 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Phenols, Kinetics, Shock loads, Biological wastewater treatment.

Predictions of system response to quantitative shock loads, using kinetic model equations recommended for activated sludge treatment of toxic wastes, do not accurately depict changes in X and S in the reactor. A similar situation exists with predictive equations for nontoxic substrates. In both cases, certain discrepancies between predicted and observed response occur. These experimental findings support previous recommendations for design and operation of activated sludge systems for treatment of toxic wastes. Laboratory studies

must be performed to evaluate the biokinetic constants and a critical point analysis should be performed to determine the limits of the allowable operating range. It appears from this work that engineers should design for slow specific growth rates when treating toxic substrates. This appears to be even more critical for systems subject to quantitative shock loadings. It seems very important that, in addition to providing for slow specific growth rates, equalization basins to attenuate changes in the concentration of substrate in inflowing feed to a biological reactor and in flow be provided. While phenol can be considered a typical inhibitory substrate, work on other carbon sources would be a welcome addition to the data base. (Baker-IVI)
W86-01547

CHARACTERIZATION OF THE SIZE DISTRIBUTION OF CONTAMINANTS IN WASTEWATER: TREATMENT AND REUSE IMPLICATIONS,

Iowa State Univ., Ames. Dept. of Civil Engineering.
A. D. Levine, G. Tchobanoglous, and T. Asano.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 805-816, July, 1985. 16 Fig, 7 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Pollutants, Particle size, Size distribution, Organic matter, Water reuse, Wastewater facilities.

The types and sizes of the organic matter in wastewater and their relationship to treatment are discussed along with techniques for characterizing particle size distributions in wastewater, the impacts of treatment on particle size distribution, and the implications of particle size in evaluating and designing treatment and reuse facilities. The organic contaminants in municipal wastewater can be effectively classified as either greater than or less than 0.1 micro-m. The size of the organic particulate matter in settled municipal wastewater ranges from about 0.1 to 50 micro-m. The molecular size of organic contaminants smaller than 0.1 micro-m ranges from less than 10 to the 3rd to about 10 to the 7th power amu. The percentage of organic material larger than 0.1 micro-m in settled municipal wastewater ranges from 30 to 85%. The specific percentage will depend on the nature of the community, the length and flow regime in the sewers, whether influent pumping or grit removal is used, and on the design and operating characteristics of the primary sedimentation facilities. The predominant removal mechanisms of most processes for treatment of wastewater contaminants are related to particle size. Appropriate technology can be used to tailor the size distribution of contaminants to meet specific treatment objectives. The incorporation of size distribution analyses into the design process will result in the development of more innovative and cost-effective treatment facilities for wastewater treatment and reuse. The selection, design, and operation of wastewater treatment facilities can be improved by using a design procedure that incorporates the concept of particle size management. (Baker-IVI)
W86-01548

LIQUID SLUDGE STABILIZATION USING VERMISTABILIZATION,

Texas Univ. at Austin. Dept. of Civil Engineering.
R. C. Loehr, J. H. Martin, and E. F. Neuhauser.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 817-826, July, 1985. 7 Fig, 13 Tab, 18 Ref. NSF grant ISP-8016764.

Descriptors: *Sludge stabilization, *Earthworms, *Vermistabilization, Municipal waste, Sludge, Wastewater treatment, Liquid sludge, Activated sludge.

Basic studies to identify fundamental factors that affect the performance of the vermistabilization process and applied studies to determine design and management relationships were conducted. Earthworms are a key component of the liquid sludge vermistabilization (LSVS) process. Control reactors that did not contain worms failed in a much shorter period of time than did the reactors with the worms. The LSVS reactors that were not overloaded functioned successfully for 140 to 198 days and were stopped only because the project ended. Oxidized nitrogen (nitrates) in the drainage from the LSVS reactors indicates that aerobic conditions were being maintained. Liquid primary sludge and liquid wastes activated sludge can be stabilized by the LSVS process. LSVS reactors were not adversely affected by short term, large variations in loading rates. Liquid primary sludge was stabilized to about the same degree as liquid aerobically digested sludge in the LSVS process. Moisture balances indicated an overall moisture loss of 4 to 20%. Loading rates of about 21000 g/sq m/week volatile solids or less resulted in satisfactory operation of LSVS reactors stabilizing liquid primary and liquid waste activated sludge. Loading rates greater than 1200 g/sq m/week volatile solids can be used for LSVS reactors stabilizing liquid aerobically digested sludge. With LSVS reactors, the disposal of residual stabilized solids occurs at long intervals. The total solids content of the stabilized residual solids in the LSVS reactors was from 14 to 24%, a considerable increase from the 0.6 to 1.3% that was added. LSVS is a successful process for both dewatering and stabilization. The stabilized residual solids had approximately the same characteristics regardless of the type of liquid sludge added to the reactors. Size and cost estimates indicate that LSVS may be an economically feasible sludge management process. (Baker-IVI)
W86-01549

INFLUENCE OF TRANSIENT PHENOMENA ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS I: VARIATIONS IN HYDRAULIC LOADING AND SEWAGE STRENGTH,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. Hunter, T. Stephenson, J. N. Lester, and R. Perry.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 415-430, August, 1985. 6 Fig, 2 Tab, 56 Ref.

Descriptors: *Nitrilotriacetic acid, *Activated sludge process, *Biodegradation, Hydraulic load, Chemical oxygen demand, Temperature effects, Detergent builders.

The removal of nitrilotriacetic acid (NTA) following acclimatization in an activated sludge pilot plant has been studied during transient changes in operating conditions. These changes included increases in hydraulic loading and influent chemical oxygen demand (COD) and such phenomena in combination with transient temperature reductions. Short-term increases in hydraulic loading from 1 to 2 dry weather flow (dwf) had a very limited effect on NTA removal. Increasing the influent COD had a slight effect on NTA removal. Short term increases in hydraulic loading combined with transient reductions in temperature significantly reduced NTA removal. The effect of these combined changes on NTA removal was synergistic, rather than additive. Increases in influent COD combined with transient temperature reductions also caused a significant reduction of NTA removal. The effect of such combined changes on NTA removal was at most only additive. (Author's abstract)
W86-01609

INFLUENCE OF TRANSIENT PHENOMENA ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS II. VARIATIONS IN INFLUENT METAL AND NTA CONCENTRATIONS,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
T. Stephenson, R. Perry, and J. N. Lester.
Water, Air, and Soil Pollution, Vol. 25, No. 4, p 431-450, August, 1985. 9 Fig, 5 Tab, 56 Ref.

Descriptors: *Nitrilotriacetic acid, *Activated sludge process, *Biodegradation, *Metals, Wastewater treatment, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Detergent builders, Temperature effects.

The removal of Cd, Cr, Cu, Pb, Ni, and Zn in an activated sludge pilot plant acclimatized to nitrilotriacetic acid (NTA) has been compared with an identically operated plant receiving no NTA. During steady-state operation the removal of Pb and Ni was reduced in the presence of NTA but there was no detectable difference in mixed liquor metal concentrations. Transient changes in the influent metal concentration of an order of magnitude had only a slight influence on NTA removal; Ni had the greatest effect, Cd and Cu some effect and Pb a negligible effect. Short term variations in influent NTA concentrations had no effect on NTA removal. A transient increase in influent NTA concentrations caused a slight decrease in NTA removal. Transient increases in influent Ni concentrations combined with reductions in temperature to 10 and 7.5 C had a slight adverse effect on NTA removal. This effect did not appear to be additive or synergistic. Combinations of transient increases in influent NTA concentration and reductions in temperature caused a significant decrease in NTA removal. The effect was synergistic rather than additive. (Author's abstract)
W86-01610

NEW FIELD OF APPLICATION FOR THE ANAMET PROCESS FOR THE PURIFICATION OF INDUSTRIAL WASTEWATER (NEUE ANWENDUNGSGEBIETE DES ANAMET-VERFAHRENS FUR DIE REINIGUNG VON INDUSTRIE-ABWASSERN),

AC Biotechnics A.B., Arloev (Sweden).
B. Hallin.
Chemie-Ingenieur-Technik, Vol. 57, No. 5, p 458-460, May, 1985. 1 Fig, 2 Tab.

Descriptors: *Pulp and paper industry, *Wastewater treatment, *Anamet Process, Industrial wastewater, Pulp wastes, Anaerobic digestion.

The Anamet Process is a anaerobic-aerobic process that was originally developed for the treatment of sugar production wastewater. The newest and most promising application of the Anamet Process concerns the cellulose and paper industry. In general, these wastewaters are more difficult to treat that the wastewaters from the food processing industry. Pilot plant studies were carried out to determine the treatability of cellulose and paper industry wastewaters using the Anamet Process. The first large scale application of the Anamet Process for the treatment of paper mill wastewaters indicates that these wastewaters are treatable using anaerobic methods. (Moore-IVI)
W86-01613

INDUSTRIAL EFFLUENT, HOW TO MINIMISE THE FAILURE,

B. Sidebottom.
Water and Waste Treatment, Vol. 28, No. 6, p 50-52, June, 1985. 3 Fig.

Descriptors: *Wastewater treatment, *Industrial wastewater, Economic aspects, Food-processing industry, Pharmaceutical industry.

Industries where the need to handle liquid waste products is an important, but secondary unproductive and undesirable cost, are considered. These industries include food, pharmaceuticals and manufacturing plants where some chemical process is involved. The first requirement is for the manufacturer to identify and estimate the volume of the waste and the chemical and physical characteristics of its components. The most positive and productive step is to eliminate the creation of waste or pollution products. Consideration is given to the design of the effluent system, commissioning of the plant, and project management and coordination. (Baker-IVI)
W86-01634

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - I; REVIEW OF PREVIOUS RESEARCH,

Pira, Leatherhead (England). Paper and Board Div.

For primary bibliographic entry see Field 5C.
W86-01635

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - II; CHEMICAL ANALYSIS OF MILL EFFLUENTS,

Pira, Leatherhead (England). Paper and Board Div.
For primary bibliographic entry see Field 5C.
W86-01636

INVESTIGATION INTO THE OCCURRENCE OF SEWAGE FUNGUS IN RIVERS CONTAINING PAPERMILL EFFLUENTS - III; REMOVAL OF SEWAGE FUNGUS-NUTRIENTS,

Pira, Leatherhead (England). Paper and Board Div.
L. J. Webb.
Water Research, Vol. 19, No. 8, p 961-967, 1985. 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Paper wastes, *Wastewater treatment, *Pulp and paper industry, Biological filtration, Activated sludge process, Filtration, Hydrogen peroxide, Glucose.

Pilot scale trials were carried out at two papermills to assess various treatment systems for removal of BOD and effluents: biological filtration through plastic media, activated sludge, multi-media mechanical filtration and hydrogen peroxide addition. Despite some operating difficulties in both cases, activated sludge treatment and biological filtration are capable of substantial reductions in the concentrations of both BOD and sewage fungus nutrients. Mechanical filtration through graded media had no controlling effect on sewage fungus growth produced by clarified or activated sludge effluents; in the case of the primary clarified effluent, some increase in the concentration of glucose (a proven sewage fungus nutrient at this mill) was observed on filtration. On both a laboratory and pilot scale, treatment of clarified effluent with hydrogen peroxide plus ferrous sulfate reduced glucose levels substantially, but the effect on sewage fungus in experimental channels was less clear due to a low level of growth produced at this time by the control, untreated clarified effluent. (Moore-IVI)
W86-01637

CONTROL OF ACTIVATED SLUDGE FILAMENTOUS BULKING - VI; FORMULATION OF BASIC PRINCIPLES,

Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba.
Water Research, Vol. 19, No. 8, p 1017-1022, 1985. 6 Fig, 1 Tab, 48 Ref.

Descriptors: *Bulking sludge, *Activated sludge process, Wastewater treatment, Microorganisms, Bacteria, Biological wastewater treatment, Dissolved oxygen.

Extensive research has been conducted concerning filamentous bulking during the past 20 years in numerous countries. A detailed analysis of these findings enables basic principles to be formulated for controlling filamentous bulking. Filamentous microorganisms are present in any activated sludge. Bulking problems appear when the filaments overgrow the floc-formers. Overgrowing of filamentous microorganisms in activated sludge is affected by composition of treated waste water, actual concentration of dissolved oxygen in an aeration tank, actual concentration of soluble substrate under which microorganisms grow, and technological parameters of the process. The microorganism which accumulates most of the amount of substrate in the selector or in an inlet part of the aeration system will be dominant in this system provided the regeneration period for exhaustion of all the accumulated substrate is sufficient. In the aeration system without separate sludge regeneration, all microorganisms have their accumulation capacities fully restored only at low sludge loadings. Filamentous microorganisms in activated sludge are slow-growers. Floc-forming microorganisms in activated sludge are fast-growers. (Baker-IVI)
W86-01643

USING THE SEWERAGE SYSTEM MAIN CONDUITS FOR BIOLOGICAL TREATMENT; GREATER TEL-AVIV AS A CONCEPTUAL MODEL,

Technion - Israel Inst. of Tech., Haifa. Dept. of Environmental and Water Resources Engineering.
M. Green, G. Shelef, and A. Messing.
Water Research, Vol. 19, No. 8, p 1023-1028, 1985. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Biological wastewater treatment, *Sewer systems, Tel Aviv, Israel, Model studies, Plug-flow reactors, Aeration, Construction costs, Corrosion control, Loop system.

The long-sought idea of using main sewerage conduits as a step-fed plug-flow reactor, where biological sludge is introduced at the head of the main pipelines (hence loop system) and where aeration is provided at various points along the loop, was investigated in this paper in a bench-scale physical model using the Greater Tel-Aviv (Dan Region, Israel) sewerage with design population of 1.3 million and flow of 300,000 cu m/day, as a conceptual model. Due to the inherent advantages of a step-fed plug-flow reactor where high substrate concentrations are maintained along most of the length of the reactor, (except for the final section which provides effluent polishing), the viability of the biomass is 3-5.2-fold higher than the one usually encountered in a conventional activated sludge plant, thus substantially increasing its rate and efficiency of organic substrate removal. It has been shown that in the case of Greater Tel-Aviv, replacing the activated sludge conventional treatment plant with the loop system (with only secondary clarifiers to provide the return biological sludge), or alternatively resorting to the loop system instead of doubling an existing overloaded treatment plant, will produce final effluents well below the requirements of 25 mg/l BOD5 and will provide savings of more than 50% in construction costs. An additional advantage of corrosion control along the main conduits thus increasing their longevity is also discussed. (Author's abstract)
W86-01644

MODELING AND EFFICIENCY OF ULTRAVIOLET DISINFECTION SYSTEMS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls, and J. D. Johnson.
Water Research, Vol. 19, No. 8, p 1039-1046, 1985. 6 Fig, 3 Tab, 24 Ref. EPA grant R80470010, NSF grant CEE82-05274.

Descriptors: *Model studies, *Ultraviolet radiation, *Disinfection, *Wastewater treatment, Bacteria, Dispersion, Efficiency, Ultraviolet disinfection.

Disinfection of wastewater effluents with ultraviolet (u.v.) light has recently become a rapidly growing alternative to chlorination, but there have been difficulties in measuring u.v. dose. A model is presented which predicts bacterial survival in flow-through systems. The calculation takes into account the complex intensity patterns, non-ideal flow patterns, and non-linear curves of log survival vs u.v. dose. Based on the organismal dose-response, the number of survivors in each fraction of the residence time distribution is calculated separately and summed to calculate the average survival. The model uses as input data the average u.v. intensity within the system, the residence time distribution, and an experimentally determined dose-survival curve in a simplified system where dose can be directly measured. The predictions of the model corresponded well with measured survival in a u.v. pilot plant study. The model was used to show the effects of flow dispersion on average survival by varying residence time distribution. Measures of capacity and efficiency of u.v. systems were derived and illustrated experimentally in simple cylindrical batch units and in two multiple lamp units. Model calculations can be a useful tool for research and development of reactor design. (Moore-IVI)
W86-01647

NITROGEN TRANSFORMATIONS AND FATE OF OTHER PARAMETERS IN COLUMNAR DENITRIFICATION,

Windsor Univ. (Ontario). Dept. of Civil Engineering.
N. Biswas, and R. G. Warnock.
Water Research, Vol. 19, No. 8, p 1065-1071, 1985. 4 Fig, 6 Tab, 28 Ref.

Descriptors: *Columnar denitrification, *Wastewater treatment, *Denitrification, Nitrates, Organic carbon, Domestic wastes, Nitrogen, Alkalinity, Attached growth system.

Septic tanks followed by some type of subsurface disposal system have been a common method of wastewater disposal for small communities as well as individual homes for many years. Nitrogen present in wastewater in the form of ammonia is often oxidized to nitrate and causes serious groundwater contamination. A laboratory study was conducted using kitchen waste as the source of organic carbon for denitrification in an attached growth system. Kitchen waste is readily available on site and is inexpensive. Soil columns were used as denitrifying reactors in the laboratory where the feed solutions were composed of nitrified solution and kitchen waste. Five different carbon (expressed as methanol) to nitrogen ratios ranging from 2:2 to 6:1 were applied to twenty soil columns. A high degree of denitrification was obtained for C:N ratios of 4:1 or higher. Rate of application was not a significant factor. Most of the TKN present in the feed solutions escaped the denitrification reactors. The production of total alkalinity during denitrification was somewhat lower than the values reported in the literature Biological cells were washed out regularly from the soil column and results show that in many cases the column effluents contained higher solids concentrations than the influent. (Moore-IVI)
W86-01650

TURN KEY APPROACH TO CLEAN WATER IN ALABAMA,

Harmon Engineering and Testing, Auburn, AL.
G. R. Harmon.
Current Municipal Problems, Vol. 11, No. 4, p 498-503, Spring, 1985. 18 Ref.

Descriptors: *Water pollution control, *Wastewater treatment, *Alabama, *Auburn, Clean Water Act, Economic aspects, Privatization.

Recent policy statements of the Environmental Protection Agency have directed that municipal wastewater treatment plants will be in compliance with the Clean Water Act, regardless of the availability of Federal monies. Public/private partnerships are emerging nationwide as the answer to the financial dilemma facing many local governments. The entry of private business into the provision of municipal services is not a new concept. Municipalities are finding that private sector financing, or the privatization approach, allows them to provide cost efficient wastewater treatment without exhausting their budget funds and/or borrowing capability to provide the services. Private sector firms are showing a keen interest in funding, and subsequently owning and operating, wastewater treatment and other traditionally public facilities on a turn key basis. Privatization permits the local governments to meet discharge limits, and at the same time, control costs. The investor, too, finds privatization to be an attractive and profitable venture. A specific example of privatization, Auburn, Alabama, is cited as an example of a plan that is working. (Baker-IVI)
W86-01687

REDUCTIVE DECHLORINATION OF THE PESTICIDES 2,4-D, 2,4,5-T, AND PENTACHLOROPHENOL IN ANAEROBIC SLUDGES,

Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
M. D. Mikesell, and S. A. Boyd.
Journal of Environmental Quality, Vol. 14, No. 3,

p 337-340, 1985. 4 Fig, 1 Tab, 14 Ref. Dep. of Air Force contract F08635-83-C-0290.

Descriptors: *Dechlorination, *Reduction, *Degradation, *Pesticides, *Dichlorophenoxy acetic acid, *Trichlorophenoxy acetic acid, *Pentachlorophenol, *Trichlorophenol, *Chlorophenols, *Anaerobic treatment, Fate of pollutants, Herbicides, Chlorinated hydrocarbons, Halogenated hydrocarbons, Wastewater treatment.

The degradation of seven chlorinated aromatic compounds in anaerobic sewage sludge from three Michigan communities was examined. The compounds tested were 2,4-D (2,4-dichlorophenoxy acetic acid), 2,4,5-T (2,4,5-trichlorophenoxy acetic acid), PCP (penta-chlorophenol), 2,4,6-trichlorophenol, and 2-, 3-, and 4-chlorophenol. All of the compounds tested were degraded in one or more of the sludges during a 70-d incubation period. Overall, 4-chlorophenol was the most persistent compound tested followed by 3-chlorophenol. The most rapid degradative reactions were cleavage of the ether linkage of the phenoxy acetic acid herbicides, 2,4-D, and 2,4,5-T, and the removal of Cl atoms ortho to the phenolic OH group of the chlorophenols. The initial products of 2,4-D and 2,4,5-T degradation were 4-chlorophenol and 2,4,5-trichlorophenol. Reductive dechlorination of 2,4,5-trichlorophenol (produced from 2,4,5-T) gave 3,4-dichlorophenol and 4-chlorophenol which were the final products of 2,4,5-T degradation. Dechlorination of PCP gave 3,4,5-trichlorophenol as the initial transformation product, and further dechlorination gave 3,5-dichlorophenol as final product of PCP degradation. The Jackson sludge had the greatest capacity to degrade the compounds tested. With the exception of 3- and 4-chlorophenol, all other compounds tested were completely degraded in 7 to 14 d in the Jackson sludge. Mason and Adrian sludges were similar in their degradative pathways overall, but significantly less active than the Jackson sludge. (Author's abstract)
W86-01707

PERFORMANCE OF EXPANDED-BED METHANOGENIC REACTOR,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y.-T. Wang, M. T. Suidan, and B. E. Rittmann.
Journal of Environmental Engineering, Vol. 111, No. 4, p 460-471, August, 1985. 9 Fig, 3 Tab, 16 Ref. U.S. EPA contract EPA R-809750-01.

Descriptors: *Expanded-bed reactors, *Methanogenesis, *Wastewater treatment, *Anaerobic digestion, Biological treatment, Fluidized bed process, Water treatment.

The expanded-bed reactor can achieve high organic removal percentages at low temperatures, even when treating low strength waste at short liquid detention times. A completely mixed, expanded-bed, anaerobic granular activated carbon reactor was operated continuously on synthetic wastewaters in which acetate was the only organic carbon source. Acetic acid was used as the substrate because it is the major metabolic product during the fermentation of organic matter. During 859 days of continuous operation, steady-state performance was achieved for four influent acetate concentrations: 800, 1,600, 3,200, and 6,400 mg/L. Steady-state removal efficiencies of acetate, COD and DOC exceeded 98, 97, and 98%, respectively. By the end of the study period, 99.6% of the feed COD was converted to methane gas, suggesting that biological utilization was the major removal mechanism for acetate in the expanded bed reactor and that the net growth of methanogens was very low. Gas production from the reactor doubled virtually immediately after sudden doubling of the organic load while the aqueous phase concentration did not increase drastically. The completely mixed, expanded-bed GAC reactor may be used to achieve good effluent quality from low-strength and medium strength wastewaters. (Collier-IVI)
W86-01726

CONDITIONING OF ANAEROBICALLY DIGESTED SLUDGE,

Camp, Dresser and McKee, Inc., Raleigh, NC.
For primary bibliographic entry see Field 5E.
W86-01728

RUSSIAN USE OF FLOTATION FOR WASTEWATER TREATMENT,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
N. Myasnikov, L. V. Gandurina, and L. N. Butseva.
Effluent and Water Treatment Journal, Vol. 25, No. 6, p 202-206, June, 1985. 4 Fig, 4 Ref.

Descriptors: *Wastewater treatment, *Flotation, Sediments, Petroleum products, Oil, Fats, Surfactants, Water treatment, Physical properties, Chemical properties, Activated sludge.

Schemes and techniques being used in Russia for oils, fats, petroleum products and surfactants removal from wastewaters by flotation are reviewed. The following kinds of flotation are being used at present for treatment of sediments and activated sludges: compression (pressure), impeller, vacuum, biological, chemical, electric and ionic flotation, froth separation. For the sake of further development of methods and structures of flotation plants for wastewater purification and sediment treatment, attention should be paid to the following aspects: increase in operating efficiency of devices for dissolving air and gas in liquid; providing optimum conditions of flotation separation of gas and liquid medium; studying hydrodynamic conditions of frother cells; studying physical and chemical properties of water air medium; creating reagents for floation treatment of wastewater and compaction of sediments and activated sludges; studying flotation process accompanied by sorption, adsorption, and oxidation; designing combined installations; studying the pecularities of flotation treatment of wastewater and final treatment of biologically purified water with activated sludge compaction; designing devices for froth removal, its processing and reclaiming of valuable components; designing automatized flotation plants; and generalizing the operational results of flotation plants and their technical and economic evaluation. (Baker-IVI)
W86-01736

CURRENT STATUS OF DENVER'S POTABLE WATER REUSE PROJECT,

Denver Water Dept., CO.
For primary bibliographic entry see Field 3B.
W86-01742

RECLAIMING DESERT LANDS THROUGH WATER REUSE,

Goff Consulting and Engineering Corp., Chandler, AZ.
J. D. Goff, and P. L. Busch.
Journal of American Water Works Association, p. 84-87, July, 1985. 1 Fig, 4 Tab.

Descriptors: *Water reuse, *Land reclamation, Deserts, Urban areas, Municipal wastewater, Wastewater treatment facilities, Urban areas, Chandler, Arizona.

The city of Chandler, Arizona, has implemented a program for total reuse of its municipal wastewater effluent. The municipal water system is supplied from groundwater sources that are being pumped at a rate far in excess of the rate of recharge. To meet the total future water supply needs, reuse of municipal wastewater is essential. A new reclamation facility will serve as the cornerstone of the city's program, which has several unique aspects. The new wastewater treatment facility will be sited where there is no adjacent watercourse, thus necessitating complete reuse of its effluent. Financing, ownership, and operation of the facility are being done through privatization. The reuse system has been developed through a public-private partnership between the city and landowners whose property borders the facility. The facilities will include an effluent pipeline and an artificial lake system to be surrounded by a golf course, greenbelt area, and areas designated for residential and commericial development. (Moore-IVI)
W86-01746

BACTERIAL ADHESION AND FOULING OF REVERSE OSMOSIS MEMBRANES,

Orange County Water District, Fountain Valley, CA. Water Factory 21.
H. F. Ridgway, M. G. Rigby, and D. G. Argo.
Journal of the American Water Works Association, p 97-106, July, 1985. 16 Fig, 36 Ref.

Descriptors: *Wastewater renovation, *Reverse osmosis, *Membrane processes, *Bacteria, Biofouling, Mycobacterium, Escherichia, Acinetobacter, Cellulose acetate, Hydrophobic interaction.

Adhesion of selected bacteria to cellulose actetate (CA) reverse osmosis (RO) membranes used in wastewater reclamation processes was investigated to determine its role in membrane fouling and reduces process efficiency. Adhesion of a Mycobacterium sp. previously isolated from an early stage of RO membrane biofouling was relatively unaffected by large variations in the ionic strength or pH of the buffer system. However, trace quantities of a polyoxyethylene ether nonionic detergent almost completely inhibited attachment. The mycobacteria were found to adhere to the CA membrane surface (or to a CA-affinity column) approximately 25-fold more effectively than a wild-type strain of Escherichia coli. The ability of Mycobacterium and E. coli to adhere to the membrane was correlated with their relative surface hydrophobicities as determined by their affinities for n-hexadecane. A similar correlation was established between a hydrophilic wild-type strain of Acinetobacter phosphadevorus containing a single 17.8 mega-Dalton plasmid (PYG1) and a more hydrophobic isogenic derivative strain (P7P-) lacking the PYG1 plasmid. Unlike the P7WT parent strain, the P7P- derivative produced more fimbrialike appendages, which may account for its enhanced hydrophobic and adhesive properties. The results suggest that hydrophobic interactions between bacterial cell surface components and the CA membrane surface play an important role in the initial stages of bacterial adhesion and RO membrane biofilm formation. (Author's abstract)
W86-01748

EFFECTS OF SEWAGE EFFLUENT ON ENDOMYCORRHIZAL DEVELOPMENT IN ACER,

Michigan Univ., Ann Arbor. School of Natural Resources.
P. C. Otto, and J. R. Boyle.
Canadian Journal of Forest Research, Vol. 14, No. 2, p 246-249, April, 1984. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Wastewater irrigation, *Maple trees, *Endomycorrhizae, Phosphorus removal, Nitrogen removal, Wastewater renovation, Forests, Michigan.

Application of stabilized sewage effluent on forested sites has proved an effective means of removing phosphorus and nitrogen which could otherwise cause overabundant growth in lakes and streams. The effects of such applications on mycorrhizal association must be included in a complete evaluation of the effects of sewage effluent application to hardwood forest sites. Secondarily treated sewage effluent was sprayed into a 50-year-old beech-maple forest near Harbor Springs, Emmet County, Michigan. Effluent was applied at rates of 0, 3.8, and 7.6 cm per week onto thinned and unthinned plots during the growing seasons of 1978 and 1979. Each spray rate and density combination was replicated four times. Acer sp. roots were examined each growing season to evaluate development of endomycorrhizae. Numbers of mycorrhizae were significantly greater in the sprayed than in the unsprayed plots but did not vary significantly with month of thinning. Nutrient additions and increased water availability may have contributed to the mycorrhizal increases at this site. The endomycorrhizal increases observed on this study site further indicate the suitability of these hardwood sites for use in wastewater renovation. (Moore-IVI)
W86-01778

CALCULATION OF OXYGEN CONSUMPTION AND AMOUNT OF EXCESS ACTIVATED SLUDGE IN MULTISTAGE AERATION TANKS,

Kievskii Tekhnologicheskii Inst. Pischevoi Promyshlennosti (USSR).
S. P. Tsygankov.
Water Resources, Vol. 11, No. 4, p 386-390, July-August, 1984. 1 Fig, 1 Tab, 9 Ref. Translated from Vodnye Resursy, No. 4, p 139-143, July-August, 1984.

Descriptors: *Biological wastewater treatment, *Activated sludge process, *Oxygen consumption, *Aeration tanks, Sludge, Mathematical equations, Energy, Wastewater treatment.

Taking into account the energy consumption of the process of biological treatment, which increases with increasing pollution of wastewaters, it is quite important to select the most economical multistage systems. Economy is determined mainly by oxygen consumption and the amount of activated sludge formed, the utilization of which requires certain expenditures. Methods of calculation are developed which are suitable for optimization of sectional or multistage aeration tanks with respect to oxygen expenditures and formation of excess activated sludge. A schematic diagram is presented of the flows of the aeration tank-mixer and secondary sedimentation tank. The conventional assumptions are introduced that processes of an increase of biomass and utilization of the substrate do not occur in the sedimentation tank and there is no activated sludge biomass in the clarified liquid leaving the sedimentation tank. Despite the smaller consumption of the substrate in the second stage, the oxygen requirement is higher owing to oxidation of the incoming activated sludge biomass. The specific consumption of oxygen for treatment increases with decrease of the specific rate of increase of biomass. The latter depends on the flow rate of the biomass entering the aeration tank from the secondary sedimentation tank or from the preceding aeration tank. The specific oxygen consumption and productivity of the aeration tank with respect to biomass are inversely related. The equation obtained can be used for optimization calculations of the stoichiometry of single- and multistage aeration tanks. (Baker-IVI)
W86-01814

ROLE OF MACROPHYTES IN REMOVING ALIPHATIC AMINES FROM WATER,

Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
S. S. Timofeeva, and O. A. Men'shikova.
Water Resources, Vol. 11, No. 3, p 240-244, May-June, 1984. 4 Fig, 10 Ref. Translated from Vodnye Resursy, No. 3, p 109-113, May-June, 1984.

Descriptors: *Water treatment, *Macrophytes, *Methylamine, Aliphatic hydrocarbons, Organic matter, Aquatic plants, Waterweed, Biological wastewater treatment.

The elimination of methylamine from water by a number of macrophytes and possible mechanisms of this process were investigated, and the possible use of macrophytes in wastewater treatment is discussed. Of the various macrophytes investigated, waterweed had the the maximum rate of elimination of methylamine. While it was not possible to make unequivocal conclusions about the mechanism of the elimination process, both the following components most likely made a substantial contribution to the methylamine elimination process: the diffusion entry and accumulation and enzymatic conversion with the participation both of oxidizing enzymes and other enzymes participating in nitrogen metabolism of plants. Waterweed effectively eliminated methylamine, and methylanime was not detected after 2 days following treatment. The successive introduction of methylamine once a week showed that a waterweed biofilter can actively purify water during the entire time of this study, up to 2 months. When the phytomass of waterweed increases, it is necessary to remove it and keep it within the optimal conditions of 5 g/liter. Waterweed can remove aliphatic amines not only of technogenic origin but also those which are formed upon decomposition of phytoplankton and naturally makes a substantial contribution to self-purificaton of water bodies and to water quality. (Baker-IVI)
W86-01823

USE OF MACROPHYTES FOR TREATING AGRICULTURAL RUNOFF,

N. V. Morozov.
Water Resources, Vol. 11, No. 3, p 259-268, May-June, 1984. 3 Fig, 6 Tab, 39 Ref. Translated from Vodnye Resursy, No. 3, p 131-141, May-June, 1984.

Descriptors: *Macrophytes, *Wastewater treatment, *Agricultural runoff, Biological wastewater treatment, Runoff, Agricultural chemicals, Fertilizers, Farming, Aquatic plants.

Measures aimed at protecting waters from surface runoff from cultivated land can be divided into three groups. The first calls for improvement of farming practices. The second includes measures to prevent the inflow of polluted surface and drainage runoff by diverting it into lagoons, stabilization and oxidation ponds, buffer reservoirs, or other holding areas. The third group is aimed at the accumulation and decontamination of the diffuse surface runoff. Biological ponds with their photosynthetic aeration by microalgae and higher aquatic plants have potential application for decontaminating surface waters. The considerable filtering, accumulating, absorbing, and mineralizing ability of macrophytes makes them a powerful factor for biological self-purification of fresh and brackish waters. Duckweed showed maximum activity in extracting nitrate and nitrite nitrogen from the water. The ability of macrophytes to remove fertilizers from water improves in June and July, which is related to the period of active physiological activity of the plants. In these months the content of nitrite nitrogen in experiments with bulrush and cattail decreased by more than tenfold as early as five days after fertilizer application. Experiments with bulrush, narrowleaf cattail, and waterweed showed that waterweed extracts nitrates more than nitrites from wastewaters. The use of higher aquatic plants for treating highly eutrophic waters can be accomplished by introducing them in the littoral zones and mouths of small rivers, in shallows of reservoirs, or in canals, buffer storages, biological ponds or lagoons, specially created for this purpose. (Baker-IVI)
W86-01826

STOICHIOMETRY OF PROCESSES OF AEROBIC BIOCHEMICAL WASTEWATER TREATMENT,

Ministerstvo Sel'skogo Khozyaistva URSR, Kiev. Main Design Inst.
S. P. Tsygankov, O. P. Smirnov, A. N. Dergileva, and T. P. Slyusarenko.
Water Resources, Vol. 11, No. 3, p 268-272, May-June, 1984. 4 Fig, 3 Tab, 9 Ref. Translated from Vodnye Resursy, No. 3, p 142-146, May-June, 1984.

Descriptors: *Wastewater treatment, *Activated sludge process, *Evaluation, *Stochastic process, Aerobic digestion, Mathematical equations, Carbon dioxide, Oxygen, Carbon.

The relationship between the technological parameters of a treatment process and material and energy balance in apparatus consisting of a biochemical reactor (mixer) and biomass sedimentation tank was investigated. The balance of elements was studied during continuous culturing of activated sludge microorganisms on wastewaters of a swine-raising complex in the ANKUM-2 apparatus at a temperature of 20 degrees C. The working volume of the fermenter was 1 and 2 liters, the rotational speed of the stirrer was 500/min with complete oxygen saturation of the fluid. Culturing was carried out at various dilution rates: 0.16, 0.04, and 0.02/hr. The fermenter was connected with the sedimentation tank by a 1 liter vessel, for withdrawing the excess and recirculating biomass for which a peristaltic pump was used. Equations are derived which can be used for evaluating aerobic wastewater treatment systems. (Baker-IVI)
W86-01827

INFLUENCE OF NITRATES ON BIOLOGICAL PHOSPHORUS REMOVAL FROM WASTEWATER,

Compagnie Generale des Eaux, Paris (France). Anjou Recherche.
M. C. Hascoet, and M. Florentz.
Water S. A., Vol. 11, No. 1, p 1-8, January, 1985. 7 Fig, 4 Tab, 13 Ref.

Descriptors: *Nitrates, *Phosphorus removal, *Biological wastewater treatment, Aeration, Nuclear magnetic resonance, Aerobic conditions, Anaerobic conditions, Biomass.

A study was carried out to observe the behavior of orthophosphates under aerated or non-aerated conditions in the presence of nitrates during batch experiments, the effect of nitrate concentration (40 mg/l as N) in the influent of a laboratory unit prior to phosphate removal and the evolution of phosphorus assimilation after stopping nitrate addition. Phosphorus nuclear magnetic resonance was used to observed the changes in the different phosphorus compounds with time, without disturbing the living system. The substrate concentration expressed as COD must be taken into account as well as the concentration of nitrates being introduced in the anaerobic zone. Nitrates, even in high concentrations during the aerobic stage do not prevent good phosphorus uptake by microorganisms, although they can prevent the formation of an anaerobic phase required for the luxury uptake of phosphorus. The polyphosphates are not used during the non-aerated period because the ATP pool can be maintained by the glycolitic metabolism. The continuous addition of nitrates during the non-aerated phase modified either the microbial population or the enzymatic activities, because the release of phosphate is not immediate after stopping the nitrate addition to the feed, but takes seven days to occur. This time is necessary to acclimatize the biomass to the alternating anaerobic-aerobic phases. (Moore-IVI)
W86-01857

KINETICS AND MECHANISM OF OZONATION OF FREE CYANIDE SPECIES IN WATER,

Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
M. D. Gurol, and W. M. Bremen.
Environmental Science and Technology, Vol. 19, No. 9, p 804-809, 1985. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Chemical kinetics, *Ozonation, *Cyanides, Ozone, Hydrogen ion concentration, Cyanates, Wastewater treatment, Mass transfer.

The kinetics and the mechanism of the ozonation reaction of free cyanide species were investigated in aqueous solution in the pH range 2.5-12.0. According to the kinetic results obtained with a stopped-flow spectrophotometer, the reaction is first order with respect to ozone, and the rate increases with increasing pH. The rate shows a varying dependence on cyanide concentration for different pH values. The rate constant for the direct reaction of molecular ozone with cyanide ion was calculated to be 2600 +/- 700/M/s. Batch and bubble-column experiments indicated stoichiometric conversion of cyanide to cyanate and an ozone consumption of 1.2 +/- 0.2 mol/mol of oxidized cyanide. Ozonation of cyanide-bearing wastewaters at high pH is expected to be mass transfer limited under the operating conditions of most experimental or full-scale contactors. The kinetic regime for the process at neutral pH should depend upon the mass-transfer characteristics of the ozone contactors. (Moore-IVI)
W86-01870

LOW-TECH SCORES PAR FOR WATERING GOLF COURSE,

Greeley and Hansen Southwest, Phoenix, AZ.
W. A. Ambrose.
Consulting Engineer, Vol. 65, No. 3, p 38-39, September, 1985. 1 Fig.

Descriptors: *Wastewater treatment, *Golf courses, *Water reuse, Irrigation water, Design criteria, Water supply development.

Innovative application of basic water reclamation tenets provided the solution for irrigating the 27 hole championship golf course that is part of Gainey Ranch, a 640 acre, luxury, mixed use resort community under development. There is adequate groundwater on site for irrigation. For other purposes, a 1.7 mgd water reclamation plant was included as part of the initial design phase of the development. The objectionable characteristics of odor, noise, and unsightliness were overcome by specific design adaptations. Public acceptance has been achieved in direct relationship to the success of these design adaptations. Wastewater flows in a serpentine fashion through five 20 ft by 116 ft aeration tanks. Next, it flows to two 20 ft x 100 ft rectangular clarifiers where sludge and dilute scum are collected. The dilute scum flows by gravity and waste sludge is pumped back to the municipal sewer. Clarified water flows to two 9 x 38 ft rapid sand filters and then to two ultraviolet disinfection units before it is pumped to the reclaimed water reservoir. From there it subsequently is pumped for lake level maintenance and golf course irrigation. Environmental controls for the plant are briefly considered. (Baker-IVI)
W86-01881

SORPTION OF CARBON AND PHOSPHORUS FROM LIQUID POULTRY MANURE BY SOIL AGGREGATES OF DIFFERING SIZE,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
V. K. Bhatnagar, and M. H. Miller.
Canadian Journal of Soil Science, Vol. 65, p 467-473, August, 1985. 7 Tab, 12 Ref.

Descriptors: *Carbon, *Phosphorus, *Manure, *Soil aggregates, *Sorption, Particle size, Animal wastes, Wastewater disposal, Particulate matter.

A series of laboratory experiments was conducted to determine the mechanism(s) responsible for a previously reported observation that addition of liquid manure to soil increased the NaHCO3-extractable P (Ext-P) of large aggregates (>2 mm) more than that of smaller aggregates whereas addition of an inorganic P solution did not. Application of liquid poultry manure increased the total P, Ext-P and total C concentrations in large aggregates (> 2mm) much more (> 2.5x) than that in small aggregates (< 1 mm). Addition of inorganic P solution or of supernatant liquid from a centrifuged manure slurry increased the P content of the large aggregates only slightly (1.2x). A greater increase in Ext-P in large aggregates was observed even when the smaller aggregates were purposely layered on top of the larger ones prior to addition of the liquid manure. A similar but less pronounced effect of aggregate size on increase in P or C concentration was observed when different sized aggregates were left in contact with an effectively infinite source of liquid manure for 24 h. It is concluded that the larger aggregates absorbed more of the bulk manure slurry than smaller aggregates. A partial sealing of small aggregates by particulates is suggested as a possible mechanism. (Author's abstract)
W86-01908

5E. Ultimate Disposal Of Wastes

APPLICATION OF ARTIFICIAL CLAYS IN THE CONTROL OF TOXIC POLLUTANTS,

Chemfix International Ltd., London (England).
P. J. D. Jarrett, and E. W. Marwood.
Engineering Geology, Vol. 21, No. 3/4, p 267-272, June, 1985. 2 Fig, 3 Tab, 3 Ref.

Descriptors: *Hazardous materials, *Landfills, *Artificial clay, *Waste disposal, Water pollution prevention, Sodium silicate, Cement, Waste stabilization, Heavy metals, Sludge disposal.

The potential for acid leaching is one of the major causes for concern in the landfilling of heavy metal sludges. It is possible to create barriers against migration around the toxic particles themselves, rather than around a landfill as a whole. The CHEMFIX process starts with a concentrated solution of sodium silicate, which is mixed with the waste. This is in turn mixed with cement. In the final mixture, the cement reacts with the evenly distributed silicate to give a gel around the waste particles that creates the desired barriers to migration. The artificial clay-like solid resulting from the stabilization of toxic waste using the CHEMFIX process has many advantages. The CHEMFIX waste-form, because of its low permeability, high buffer capacity against acid leaching and its clay-like structure and properties, can be used to stabilize heavy metal sludges for landfilling. A simple model is developed and used to investigate the values of the various parameters involved in the product design. The immobilization periods expected for a CHEMFIX wasteform monolith are in excess of current design values for screens and liners. (Moore-IVI)
W86-01456

EFFECT OF LEACHING ON THE INTEGRITY OF A NATURAL CLAY,

McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
R. N. Yong, D. S. Elmonayeri, and T. S. Chong.
Engineering Geology, Vol. 21, No. 3/4, p 279-299, June, 1985. 22 Fig, 3 Tab, 17 Ref.

Descriptors: *Leaching, *Clay, *Strength, *Integrity, Liners, Waste ponds, Soil properties, Water pollution prevention, Chemical properties, Boundary conditions, Soil structure.

Clay minerals have long been used as ion-sieving filters, separators, or reinforcing elements to prevent contamination of the domestic groundwater from the transmission of polluted liquids through the bottom and side boundaries of waste holding ponds. Leaching effects on the strength of a natural clay substrate can lead to loss of integrity of pond containment situation, especially if the clay material constitutes the liner system for the containment pond. The integrity of the clay in the face of five different types of leachates is studied via the creep characteristics of the clay. The leachate types include sodium silicate, sodium chloride, sodium acetate, saturated calcium hydroxide solution plus 10 carbon dioxide air, distilled water and a reference natural untreated water sample. The resultant effects are evaluated in terms of soil fabric/structure reinforcement or degradation, and changes in the relationships established between soil particles and chemical pore fluid. The integrity of the clay is severely conditioned by factors producing the initial soil structural state, the chemistry of the leachate, local boundary conditions, and time. (Moore-IVI)
W86-01457

US SLUDGE MANAGEMENT GUIDELINES EXPLAINED,

E. D. Lomnitz.
Water and Water Treatment, Vol. 28, No. 4, p 37, 40, April, 1985.

Descriptors: *Sludge management, *Standards, Management, Planning Sludge disposal, Wastewater management.

An EPA sludge task force was established in 1982 which was responsible for assessing the magnitude and management approaches to municipal sludge reuse and disposal nationwide, evaluating strengths and weaknesses of past regulatory activities, and identifying data and informational needs in order to direct EPA research in the field. In developing regulations for reuse/disposal options, several key areas need to be considered including the identification of potential pollutants, the magnitude of hazard or risk, levels at which these pollutants cause these risks, the existence of management practices which could reduce the risks, and the relevant risks between the various reuse/disposal options. With the completon of technical support documents, drafting of the proposed regulations can commence. The proposed regulations will clearly delineate the requirements in terms of management practices and numeric standards. The regulations will also contain compliance monitoring requirements. (Baker-IVI)
W86-01461

USE OF AERIAL PHOTOGRAPHY AND IMAGE PROCESSING TO MEASURE DYE DISPERSION FROM A LONG SEA OUTFALL,

Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W86-01518

MANAGEMENT OF CONTAMINATED DREDGED MATERIAL FROM THE HUDSON RIVER,

Pirnie (Malcolm), Inc., White Plains, NY.
For primary bibliographic entry see Field 5G.
W86-01564

EFFECT OF SEWAGE SLUDGE ON MICROBIAL ACTIVITY IN AN OLD, ABANDONED MINESOIL,

Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
H. F. Stroo, and E. M. Jencks.
Journal of Environmental Quality, Vol. 14, No. 3, p 301-304, July-September, 1985. 3 Tab, 45 Ref. West Virginia University Mining and Mineral Res. Inst. project MI8050R.

Descriptors: *Sludge, *Water pollution effects, *Land reclamation, *Mining, *Minesoils, *Microbial activity, Enzymes, Amylase activity, Phosphatase activity, Respiration, Urease activity, Fescue, Waste disposal, Land treatment.

The effect of lime, fertilizer, and sewage sludge (50 and 100 kg/ha) upon microbial activity and growth of sparsely distributed tall fescue (Festuca arundinaceae Schreb.) on an old, acidic, infertile sandy loam (Typic Udispolents; loamy-skeletal, mixed, acid, mesic) minesoil was evaluated. Respiration rate and activities of amylase, urease, and phosphatase were used as indices of microbial activity. When compared with the control, lime significantly increased respiration rate, had no effect upon amylase and urease activities, and significantly reduced phosphatase activity. Fertilizer significantly increased respiration rate and amylase activity, but significantly decreased urease activity. Phosphatase activity was not affected by fertilizer applications. Lime plus fertilizer significantly increased respiration rate and amylase activity, had no affect upon phosphatase activity, while it drastically reduced urease activity. Sludge at both rates of application in conjuction with lime and fertilizer (S1LF, S2LF) are only compared with the lime-fertilizer treatment. Both S1LF and S2LF significantly increased respiration rate and urease activity; S2LF was significantly more effective more than S1LF. Amylase activity was significantly increased by both S1LF and S2LF, although there was no difference between the two treatments. The S1LF had no effect upon phosphatase activity, whereas activty, whereas S2LF caused a significant activity increase. All treatments produced significant increases in tall fescue yield. Fertilizer was significantly more effective than lime. The fertilizer and the lime-fertilizer treatments were about equally effective. Both S1LF and S2LF produced yields that were significantly greater than the lime-fertilizer treatment. The S2LF had a significantly greater effect upon yield than did S1LF. (Author's abstract)
W86-01702

CONDITIONING OF ANAEROBICALLY DIGESTED SLUDGE,

Camp, Dresser and McKee, Inc., Raleigh, NC.
A. I. Cole, and P. C. Singer.
Journal of Environmental Engineering, Vol. 111, No. 4, p 501-510, August, 1985. 10 Fig, 1 Tab, 6 Ref.

Descriptors: *Anaerobic digestion, *Sludge conditioning, *Polyelectrolytes, Electrolytes, Biological treatment, Digestion, Polymers, Wastewater treatment.

Synthetic organic polyelectrolytes can be used to condition sludges to enhance their dewaterability. When conditioning biological sludges, the charge on the polymer has a significant impact on the effectiveness of the polymer as a conditioner. The objectives of this investigation were to determine the most effective type of polymer product for conditioning anaerobically digested sludge prior to dewatering, and to investigate how the chemical characteristics of the polymer influence the way it interacts with the sludge particles. Capillary suction time and particle electrophoretic mobility measurements were employed to achieve this objective. The results indicate that cationic polymers with molecular weight in excess of 1,000,000 appear to be required for effective conditioning. However, effective sludge conditioning can be achieved with either high or low charge density cationic polymers and that dosing to achieve charge neutralization of the sludge particles is not a prerequisite for effective sludge conditioning. (Author's abstract)
W86-01728

DESIGN CONSIDERATIONS FOR A NOVEL LANDFILL LINER,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W86-01730

5F. Water Treatment and Quality Alteration

FLOCCULATION, PRECIPITATION, SEDIMENTATION AND FLOTATION FOR USE AS PRETREATMENT STAGES FOR BRACKISH WATER AND SEAWATER IN DESALINATION PLANTS,
Hager und Elsaesser G.m.b.H., Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W86-01370

REVERSE OSMOSIS AND ULTRAFILTRATION SOLVE SEPARATION PROBLEMS,
Clemson Univ., SC.
For primary bibliographic entry see Field 5D.
W86-01441

ROLE OF FORMATION AND REDUCTION OF THM AND CHLORITE CONCENTRATIONS IN THE DISINFECTION OF WATER WITH CL2 AND CLO2,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
Ch. Rav-Acha, E. Choshen, A. Serri, and B. Limoni.
Environmental Pollution (Series B), Vol. 10, p 47-60, 1985. 7 Fig, 3 Tab, 22 Ref.

Descriptors: *Disinfection, *Chlorine, *Chlorine dioxide, *Trihalomethanes, *Chlorite, Water treatment, Drinking water, Chlorination, Oxidation, Lake Kinneret, Israel.

Chlorine dioxide is one of the most promising alternatives to chlorine for the disinfection of drinking water. One of the major advantages of chlorine dioxide over chlorine is that it does not produce trihalomethanes (THM); however, chlorine dioxide is reduced mainly to undesirable chlorite. Mixtures of ClO2 and Cl2 may successfully reduce the formation of both THM and chlorite in the absence of bromide. The ClO2 may compete with chlorine for the organic precursors, thus reducing the formation of chlorinated by-products, while the chlorine can, in turn, oxidize the chlorite, which is the main reduction product of chlorine dioxide. When Lake Kinneret water in Israel was studied, however, it was found that such mixtures caused only a minor reduction in the formation of THM compared with chlorine alone. This is probably due to the presence of 2 mg/l bromide in the water of Lake Kinneret. The formation of THM and chlorite may be satisfactorily reduced (by about 60% and 90%, respectively), if chloride dioxide is allowed to react in water with the THM precursors before chlorine is introduced. (Moore-IVI)
W86-01453

WATERBORNE EPIDEMIC OF ACUTE INFECTIOUS NON-BACTERIAL GASTROENTERITIS IN ALBERTA, CANADA,
903 Abbotsford Drive N.E., Calgary, Alberta T2A 5Y3.
For primary bibliographic entry see Field 5C.
W86-01486

IMPROVEMENTS IN TREATMENT PERFORMANCE AT GRAFHAM WATER TREATMENT WORKS: ANGLIAN WATER,
C. Harward.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 225-230, June, 1985. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Water treatment facilities, *Grafham Water Treatment Works, *England, *Water treatment, Coagulation, Aeration, Soda ash, Filtration, Sludge.

The effect of modifying the coagulant aid dosing system and other operational changes which resulted in the achievement of the desired increased efficiency at the Grafham Water Treatment Works are reviewed. During the winter of 1983-84 a prolonged increase in demand for water at a time of low water temperatures (3-6 C) resulted in treatment difficulties when flows exceeded 182 Ml/d. Improved polymer dispersion and increased delay between coagulant and coagulant aid dosing resulted in marked improvement in floc blanket stability and settled water quality. This enabled substantial savings in treatment chemical costs to be made and increased the treatment capacity of the works during the period when water temperatures were low. Changes in filter washing practices combined with improved settled water quality reduced the number of daily filter washes, thereby further reducing costs. (Baker-IVI)
W86-01520

MODELING THE EFFECTS OF HYDROLYZED ALUMINUM AND SOLUTION CHEMISTRY ON FLOCCULATION KINETICS,
Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman, and D. R. Iyer.
Environmental Science and Technology, Vol. 19, No. 8, p 673-681, August, 1985. 7 Fig, 4 Tab, 29 Ref, 1 Append.

Descriptors: *Flocculation, *Computer models, *Aluminum compounds, Model studies, Coagulation, Solution chemistry, Surface properties, Ionization, Complexation, Particulate matter.

Computer programs are available that allow self-consistent calculations to be made simultaneously for solution and surface chemical equilibria. One of these programs, an augmented version of MINEQL, employs the Gouy-Chapman-Stern-Grahame model of the electrical double layer to account for the distribution of charge and potential at the solid solution interface. In this study the modified program has been used to predict the effects of solution and suspension variables on flocculation efficiency when aluminum salt coagulants are used. Electrophoretic mobility measurements and constant pH titrations with the surface complexing sulfate ion have been used to determine intrinsic surface ionization and complexation constants for the aluminum sites. Expressions that relate the model-predicted electrical double-layer characteristics of the aluminum-treated particles and the amount of aluminum hydroxide coating on the particles to the efficiency of flocculation are also employed. For the simple system tested, model predictions of relative flocculation efficiency are in reasonable agreement with batch flocculation results. (Author's abstract)
W86-01617

RATE CONSTANTS OF REACTIONS OF OZONE WITH ORGANIC AND INORGANIC COMPOUNDS IN WATER - III; INORGANIC COMPOUNDS AND RADICALS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2K.
W86-01641

ADSORPTION OF HUMIC ACIDS ONTO POWDERED ACTIVATED CARBON; THE INFLUENCE OF SODIUM TRIPHOSPHATE (ADSORPTION DES ACIDES HUMIQUES SUR CHARBON ACTIVE EN POUDRE INFLUENCE DU TRIPHOSPHATE DE SODIUM),
Limoges Univ. (France). Lab. de Genie Chimique, Traitement des Eaux.
P. Lafrance, and M. Mazet.
Water Research, Vol. 19, No. 8, p 1059-1064, 1985. 6 Fig, 20 Ref.

Descriptors: *Adsorption, *Humic acids, *Activated carbon, *Sodium triphosphate, Water treatment, Detergents, Fulvic acids, Electrokinetics, Hydrogen ion concentration, Phosphates.

The removal of natural humic and fulvic substances found in water supplies, through the use of activated carbon beds is under study. The effect of a main component of domestic detergents, sodium triphosphate (STP), on the adsorptive capacities of powdered activated carbon (PAC) for commercially supplied humic acids was determined at different pH values in distilled water. A first batch equilibrium study showed an effective enhancement of adsorption capacity for humic acids as a function of STP concentration in a non buffered media (pH of distilled water, close to 5.0). Visible absorption analysis of humic acids indicates an increase of 93% (500 mg/l PAC) and 133% (1000 mg/l PAC) in the carbon adsorption efficiency for a STP concentration from 0.2 to 1.0 mM. A second batch equilibrium study led to adsorption isotherms for humic acids in distilled water, as a function of STP concentration and initial pH value of the non-buffered multicomponent system. Freundlich isotherms showed an increase in the adsorption capacity of the PAC for humic acids, with a decrease in pH and an increase in STP concentration. The adsorption capacity for humic acids is reduced at high pH values in the presence of STP, in comparison with results obtained with distilled water. Electrokinetic measurements of PAC suspensions indicates that both humic acids and STP induce a negative variation of the zeta potential of carbon particles. In such a binary system, the zeta potential is a linear function of the pH; the negative surface charge of the carbon increasing with an elevation of pH. Some adsorption of triphosphate polyanion from solution could occur, contributing to the apparent negative surface charge of PAC particles. (Moore-IVI)
W86-01649

REMOVAL OF RADON FROM WATER SUPPLIES,
Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry, and J. E. Brandow.
Journal of Environmental Engineering, Vol. 111, No. 4, p 511-527, August, 1985. 13 Fig, 2 Tab, 36 Ref. U.S. EPA grant R808724.

Descriptors: *Radon, *Water treatment, *Water pollution, Activated carbon, Adsorbants, Geochemistry, Water supply, Groundwater.

Granular activated carbon (GAC) adsorption is extremely effective for the removal of radon from water supplies. A high removal efficiency is achieved through an adsorption/decay steady state that can result in near-background radon levels with currently available commercial GAC units. An adsorption/decay steady state analysis based upon secular equilibrium shows that the life of the GAC will be in terms of decades with respect to radon. A variety of GAC products were evaluated for radon removal and laboratory and field data are presented to document the steady state performance for water supplies ranging in concentration from 1,500-750,000 pCi/L. Because radon and its daughters build to steady state levels corresponding to the influent mass loading, the GAC bed becomes a source of low gamma radiation. An

empirical relationship is presented to estimate the maximum activity of the bed as a function of the influent radon concentration. This relation and other field measurements show that the low level activity of GAC bed does not present a problem for the vast majority of high radon wells. (Author's abstract)
W86-01729

PROTECTIVE COATINGS FOR WATER STORAGE TANKS AND WATER TREATMENT FACILITIES,

Mobil Chemical Co., Edison, NJ.
For primary bibliographic entry see Field 8G.
W86-01753

DIMETHYL TRISULPHIDE AND OBJECTIONABLE ODOURS IN POTABLE WATER,

Western Australian Inst. of Tech., South Bentley. School of Applied Chemistry.
J. E. Wajon, R. Alexander, and R. I. Kagi.
Chemosphere, Vol. 14, No. 1, p 85-89, 1985. 2 Fig, 16 Ref.

Descriptors: *Odor, *Potable water, *Dimethyl trisulfide, Perth, Western Australia, Sulfur compounds, Water conveyance.

Intermittently in the past five years, some residents of part of the metropolitan area north of Perth, Western Australia, experienced unpleasant odors in their water supply. These odors were described as swampy, sulfidic or like cooked vegetables. The odor episodes were often ephemeral and extremely localized in occurrence. The swampy odor was only present in water samples taken from the water supply mains or residences. Dimethyl trisulfide was found in samples of potable water in concentrations ranging from 5 to 250 ng/l. The presence of dimethyl trisulfide in concentrations greater than 10 ng/l was associated with the objectionable odor in water samples. The odor intensity and dimethyl trisulfide concentrations increased in distribution mains with increasing distance from a holding reservoir. The mechanism of formation of dimethyl trisulfide in the water supply is not yet known. (Moore-IVI)
W86-01851

TOXICITY AND MUTAGENICITY EVALUATION OF WATER COAGULATED WITH MORINGA OLEIFERA SEED PREPARATIONS USING FISH, PROTOZOAN, BACTERIAL, COLIPHAGE, ENZYME AND AMES SALMONELLA ASSAYS,

National Inst. for Water Research, Pretoria (South Africa).
W. Grabow, J. L. Slabbert, W. S. G. Morgan, and S. A. A. Jahn.
Water S. A., Vol. 11, No. 1, p 9-14, January, 1985. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Toxicity, *Mutagenicity, *Coagulants, *Moringa, *Water treatment, Fish, Protozoa, Bacteria, Enzyme inhibition, Fish behavior, Toxins, Glycosides.

Moringa oleifera seed preparations equivalent to the 200 mg/l of cotyledon powder generally used for the coagulation of drinking-water in some rural areas had toxic effects on fish (guppies) (Poecilia reticulata), protozoa (Tetrahymena pyriformis), bacteria (Escherichia coli) and inhibited the enzyme acetylcholinesterase. The preparations had no effect on coliphages or the enzymes lactic dehydrogenase or invertase, nor did they display mutagenic effects in Ames Salmonella mutagenicity assays. Concentrations as low as the equivalent of 5 mg/l cotyledon powder affected the oxygen uptake rate of T. pyriformis, 30 to 40 mg/l induced aberration in locomotor behavior patterns of guppies, while the 96-h LC50 for guppies was 196 mg/l. Salmonella mutagenicity assays yielded negative results for batch and serial extracts representing the equivalent of up to 1,000 mg/l cotyledon powder. Toxicity was limited to seed cotyledons; pericarps (shells) had no effect. The results suggest that toxic effects were due to the antimicrobial constituent 4(alpha-L-rhamnosyloxy) benzyl isothiocyanate, a glycosidic mustard oil. In view of complex associations of the toxin with organic matter, instability and the mechanism of action, it would, however, not appear to constitute a human health risk, at least not in the concentrations generally involved in the utilization of the seeds for nutritional, medicinal or water purification purposes. (Author's abstract)
W86-01858

EVALUATION OF THE ACTIVATED ALUMINA PROCESS FOR FLUORIDE REMOVAL FROM DRINKING-WATER AND SOME FACTORS INFLUENCING ITS PERFORMANCE,

National Inst. for Water Research, Pretoria (South Africa).
J. J. Schoeman, and G. R. Botha.
Water S. A., Vol. 11, No. 1, p 25-32, January, 1985. 5 Fig, 4 Tab, 23 Ref.

Descriptors: *Water treatment, *Fluoride removal, *Drinking water, *Activated alumina, Caustic soda, Alum, Hydrogen ion concentration, Design criteria, Costs.

The activated alumina defluoridation process was evaluated on an underground mine water containing approximately 8 mg/l of fluoride. The objectives of the study were to compare regeneration methods (caustic soda vs. aluminium sulfate (alum)), determine the importance of feedwater pH adjustment (pH 5 to 6) on process performance, establish design criteria for a 518 cu m/d plant, and to determine the economics of the process. Fluoride could be reduced from approximately 8 to less than 1 mg/l. Approximately one and a half times as much product water of a better quality could be produced with caustic soda than with alum as regenerant. Silicate and hydroxyl ions appeared to compete more strongly with fluoride ions for exchange sites when the pH of the feed was greater than 7. This resulted in a much reduced capacity for fluoride removal. The operating fluoride exchange capacity for design purposes was determined at 3.2 g/l alumina and the total defluoridation costs for a 518 cu m/d plant were calculated at R 0.33/cu m of treated water. (Author's abstract)
W86-01859

TRANSFER OF ACTIVE CHLORINE FROM CHLORAMINE TO NITROGENOUS ORGANIC COMPOUNDS. 2. MECHANISM,

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
R. A. Isaac, and J. C. Morris.
Environmental Science and Technology, Vol. 19, No. 9, p 810-814, 1985. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Chloramine, *Nitrogen compounds, *Chlorination, Organic compounds, Hydrolysis, Chemical reactions, Chemical kinetics.

In the kinetics of Cl(+) (i.e., active chlorine) transfer from NH2Cl (chloramine) to nitrogenous organic compounds, there are two plausible pathways: hydrolysis, and direct transfer. Transfer of active chlorine from NH2Cl to nitrogenous organic compounds occurs by direct transfer as well as by hydrolysis of NH2Cl which forms HOCl which then can react with the nitrogenous substrates. The nitrogenous compounds investigated fall into two categories: those that form zwitterions and anions and those that form primarily neutral and positive species. In this study, direct transfer was the dominant pathway and involved a second-order reaction - first order in NH2Cl and the nitrogenous substrate. At least two plausible mechanisms can explain the observed data, and a reasonable correlation exists between the absolute rate constants and the basicity of the nitrogenous receptor. Either hydrolysis of NH2Cl or direct transfer of Cl(+) can be the primary pathway depending on the concentrations of the reactants. (Moore-IVI)
W86-01871

HIGH-TECH SOLUTION TO CONTAMINATED DRINKING WATER,

Pirnie (Malcolm), Inc., White Plains, NY.
G. P. Westerhoff, and R. Miller.
Consulting Engineer, Vol. 65, No. 3, p 34-37, September, 1985. 2 Fig.

Descriptors: *Granular activated carbon, *Organic compounds, *Drinking water, *Water treatment, Water treatment facilities, Design criteria, Adsorption, Cincinnati, Ohio.

The nation's first large-scale facility using granular activated carbon is being built to remove a broad spectrum of organic contaminants from the city's drinking water in Cincinnati, Ohio. Cincinnati draws raw water for its California Water Treatment Plant from the Ohio River. The California Water Treatment plant is a typical alum coagulation/rapid sand filter type plant, with flow going from the filters to two large clear wells prior to distribution. A pilot study, conducted in 1977, had as its primary objective the determination of whether GAC was a feasible method for removing trace organics from water while treating it for use as drinking water. While the use of GAC is not new in the US, it has been largely limited to taste and odor control in potable water system filter beds, polishing in wastewater reclamation operations, and in certain industrial processes. Integrating the design of the 175 mgd facility into an existing treatment plant was a challenging task. Special design features and construction features are described. (Baker-IVI)
W86-01880

PRACTICAL, LOW-TECH PLANT ASSURES SUPPLY TO 2010,

Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, and A. H. Adams.
Consulting Engineer, Vol. 65, No. 3, p 40-43, September, 1985. 1 Table.

Descriptors: *Water treatment, *Water treatment facilities, *Drinking water, Design criteria, Filtration, Disinfection, Potomac River, Fairfax, Virginia.

The James J. Corbalis Water Treatment Plant, in operation in Fairfax, Virginia, is the first step in a program of capital imporvements that will provide adequate and economical water service for the area into the 21st century. This is the first facility in Virginia to use the Potomac River as a source of water supply. These facilities are a principal element of a water supply program now being developed by area water utilities to avert future shortages during periods of drought through coordinated management of available water resources. The plant is a conventional high rate treatment facility that includes the following processes: rapid mixing, flocculations, sedimentation, filtration, fluoridation, and disinfection; finished water storage and pumping; backwash water reclamation; and solids dewatering by plate and frame filter presses. (Baker-IVI)
W86-01882

HETEROTROPHIC BACTERIA IN WATER DISTRIBUTION SYSTEMS. I. SPATIAL AND TEMPORAL VARIATION,

Centre des Sciences de l'Environment, Metz (France).
A. Maul, A. H. El-Shaarawi, and J. C. Block.
Science of the Total Environment, Vol. 44, p 201-214, 1985. 6 Fig, 3 Tab, 17 Ref.

Descriptors: *Heterotrophic bacteria, *Water conveyance, *Spatial distribution, *Temporal distribution, Drinking water, Bacteria, Water distribution, Metz, France, Chlorine, Water mains, Retention time, Water temperature.

The drinking water distribution system of the city of Metz in France was sampled intensively during six monthly surveys which were designed to determine the spatial and temporal distribution of total heterotrophic bacteria in the network. A non-hierarchical nearest-centroid clustering method was used for dividing the water distribution system into zones corresponding to different levels of bacterial density. The general pattern of the spatial heterogeneity showed a high degree of reproducibility. Since the frequency distribution of total heterotrophic bacteria within the zones was compatible with

the negative binomial distribution, the water distribution system studied may be considered as being composed of several heterogeneous subsystems. The consistency of this structured spatial dispersion pattern of bacteria in light of some physical and chemical characteristics of the system is evident. In consideration of the principal features of flow in the system relevant to the layout of water mains, the location of zones of highest bacterial concentrations have been attributed to lower levels of chlorine residuals and prolonged retention time of the water in the network, especially in the storage units, before reaching the various distribution areas. Although the monthly variation in the bacterial concentration of the entire system showed a marked increase which was concomitant with warmest water temperatures, the zones were subject to noticeable discrepancies in the range of temporal variation. (Author's abstract)
W86-01914

HETEROTROPHIC BACTERIA IN WATER DISTRIBUTION SYSTEMS. II. SAMPLING DESIGN FOR MONITORING,

Centre des Sciences de l'Environment, Metz (France).
A. Maul, A. H. El-Shaarawi, and J. C. Block.
Science of the Total Environment, Vol. 44, p 215-224, 1985. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Water quality control, *Monitoring, *Bacteria, *Water conveyance, Drinking water, Water quality, Variability, Sampling.

Information on the spatial and temporal variability of bacteriological data from a water distribution system is used to develop a sampling design for use in future water quality monitoring. The water distribution system is considered to be composed of several zones where the variation of bacterial counts in each zone is modelled by the negative binomial distribution. Under the assumption that the objective of monitoring is to determine whether or not the mean bacterial density of the water exceeds a specific standard, a criterion is given which determines the optimal number of sampling stations allocated to each zone. These stations are determined by assuming that either the risk of sampling is prespecified or that the total number of stations to be sampled is predetermined. Sequential sampling offers another way of monitoring the level of bacterial density in a system. The procedure takes into account the concentration of bacteria in the samples after each collection. (Baker-IVI)
W86-01915

5G. Water Quality Control

APPROACH TO THE RESTORATION OF AQUATIC VEGETATION IN THE XIHU LAKE OF HANGZHOU, WITH REFERENCE TO THE WATER QUALITY PROBLEM (IN CHINESE),

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
C. Hongda.
Acta Hydrobiologica Sinica, Vol. 8, No. 2, p 237-244, May, 1984. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Lakes, *Xihu Lake, *Hangzhou, *China, *Water quality, *Aquatic vegetation, Phytoplankton, Fish, Lake management, Nutrients, Nitrogen, Phosphorus, Light penetration, Oysters, Mollusks.

The reasons for the deterioration of aquatic vegetation in Xihu Lake were analyzed and the possibility of, and approach to, restoration of the vegetation was investigated with reference to the water quality problem. There were three main causes for the deterioration: the overstocking of plant-eating fish such as Ctenopharyngoden idellus and Megalobrama amblycephala, the rapid growth of phytoplankton, and the deepening of the lake due to artificial removal of sand. Excessive numbers of plant-eating fish destroyed the vegetation by grazing on it. Due to pollution, the water contained large amounts of nitrogen and phosporous. These nutrients, in turn, were taken in by the phytoplankton, causing a rapid increase of these plants. The excessive phytoplankton deprived the underwater plants of their sun energy by blocking the amount of light penetrating the water. Finally, the deepening of the lake could cause a problem by lowering the light intensity at each and different depths. The situation could be remedied by lowering the water level of the lake, thus permitting more light thru; by limiting the number of plant-eating fish; and by planting new vegetation, using both natural and artificial means. After the vegetation was restored, it might prove to be effective in the removal of nitrogen and phosphorous, thus depriving the phytoplankton of their nutrient sources and curbing their growth. A decrease of these plants would allow higher light intensity to reach all levels of water. Study of using aquatic vegetation in purifying water in lakes had never carried out in this country. But yet, as a way of gaining experience, it was highly recommended that such a project should be started hand in hand with the restoration of the vegetation in Xihu Lake. In order to reduce the amount of nitrogen, phosphorous, and phytoplanktons, the stocking of plant-eating fish should be strictly controlled. If it were possible, the types of fish should be chosen in such a way that they mainly graze on the phytoplankton and organic debris. Furthermore, oysters and mollusks should be protected because they also helped to reduce the amount of organic debris and phytoplankton. (Eng-IVI)
W86-01324

ESTIMATING THE EXTENT OF REDUCTION NEEDED TO STATISTICALLY DEMONSTRATE REDUCED NON-POINT PHOSPHORUS LOADING TO LAKE ERIE,

Heidelberg Coll., Tiffin, OH. Water Quality Lab.
R. P. Richards.
Journal of Great Lakes Research, Vol. 11, NO. 2, p 110-116, 1985. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Great Lakes, *Lake Erie, *Eutrophication, *Phosphorus, Nonpoint pollution sources, Land management, Monitoring, Water pollution control, Statistical methods, Pollution load.

A method is presented for estimating the amount of change needed to establish a statistically significant reduction, based on the standard t-test, to nonpoint phosphorus loading in Lake Erie. Analysis of data from the Sandusky River, a north-central Ohio tributary of Lake Erie, indicates that the necessary change is about 35% of the current loads. Assuming that implementation rates will decrease with time, the time spans needed to achieve these changes will differ even more dramatically. Based on projections of implementation rates, a 20% change would require 8 years, but a 35% change would take at least 25 years. Even in cases where best management practices might produce sufficient load reductions for the change to be documented statistically without adjusting the load data for discharge, doing so will allow the change to be documented earlier in the implementation period, and to be more certainly attributed to the best management practices, rather than some other cause. Success in demonstrating a reduction in loads is assisted by a monitoring program which provides sufficient data to calculate loads accurately. Where such programs have been in place long enough to provide a historical database, high priority should be placed on continuing the intensive monitoring effort without change. Otherwise, the changes in sampling strategy will introduce unknown errors and biases into the comparison. This could prevent a real change in loads from being detected statistically, or produce a serious but statistically significant difference where no change in loads had occurred. (Baker-IVI)
W86-01343

LAKE ERIE NUTRIENT LOADS, 1970-1980,

Corps of Engineers, Buffalo, NY. Lake Erie Wastewater Management Study.
S. M. Yaksich, D. A. Melfi, D. B. Baker, and J. W. Kramer.
Journal of Great Lakes Research, Vol. 11, No. 2, p 117-131, 1985. 10 Fig, 3 Tab, 18 Ref.

Descriptors: *Lake Erie, *Nutrients, *Pollution load, Phosphorus, Eutrophication, Great Lakes, Mathematical models, Chlorides, Silica, Nitrogen, Water pollution control.

A nutrient sampling program was established by the Lake Erie Wastewater Management Study in the fall of 1974. This sampling program documented established tributary loading to the lake and the data were used to define nutrient loads to Lake Erie. Total phosphorus during this period had decreased as a result of phosphorus removal at wastewater treatment plants. The effect of these reductions can be seen in the lake concentrations and were predicted by a three basin phosphorus budget model developed in the early 1970s. Soluble orthophosphate loads, chloride loads, and silica loads have decreased over the period. Nitrogen species were highly variable and increased over the period. (Baker-IVI)
W86-01344

CHANCE-CONSTRAINED/STOCHASTIC LINEAR PROGRAMMING MODEL FOR ACID RAIN ABATEMENT - I. COMPLETE COLINEARITY AND NONCOLINEARITY,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-01381

COMPARISON OF TWO MODELS FOR PREDICTING RIVER WATER QUALITY,

Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-01438

MOBILE OXYGENATION IN THE THAMES ESTUARY,

Thames Water Authority, London (England).
I. M. Griffiths, and P. J. Lloyd.
Effluent and Water Treatment Journal, Vol. 25, No. 5, p 165-169, May, 1985. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality control, *Oxygenation, *Thames River, *England, Thames Bubbler, Dissolved oxygen, Urban runoff, Storm wastewater.

Discharges of storm sewage from the combined sewers in inner London during times of heavy rainfall present the greatest current threat to water quality of the tidal Thames. A prototype oxygenation barge was acquired in response to this threat which is capable of injecting ten ton of pure oxygen per day into the estuary. The Thames Bubbler has been operational for over three years during which time an extensive evaluation of the unit was undertaken. Minor mechanical problems which occurred in the post commissioning phase have been largely overcome and the plant has proved reliable. It has been possible to rapidly deploy the Thames Bubbler in response to deteriorating river conditions and it can easily be kept on station at the point of minimum dissolved oxygen. On at least one occasion the Thames bubbler has prevented a major fish mortality. There is a strong case for acquiring additional units to increase the capacity In providing a means of rapidly responding to changing situations, the Thames Bubbler adds a new dimension to water quality control. Some of the potential applications for use may be in advance of current traditional control methods. (Baker-IV)
W86-01439

WATER FLOW AND SWELLING PRESSURE IN NON-SATURATED BENTONITE-BASED CLAY BARRIERS,

Luleaa Univ. (Sweden).
For primary bibliographic entry see Field 2F.
W86-01455

APPLICATION OF ARTIFICIAL CLAYS IN THE CONTROL OF TOXIC POLLUTANTS,

Chemfix International Ltd., London (England).
For primary bibliographic entry see Field 5E.
W86-01456

PHYSICAL AND CHEMICAL BEHAVIOUR OF CLAY-BASED BARRIERS UNDER PERCOLATION WITH TEST LIQUIDS,

Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Grundbau und Bodenmechanik.
H. Simons, and E. Reuter.
Engineering Geology, Vol. 21, No. 3/4, p 301-310, June, 1985. 7 Fig, 1 Tab.

Descriptors: *Clay, *Liners, *Barriers, *Percolation, *Waste disposal, Physical properties, Chemical properties, Water pollution prevention, Bentonite, Cement, Leaching, Adsorption, Ion exchange, Electrostatic force.

Groundwater can be effectively protected from wastes by natural clay deposits where the waste is placed, or by horizontal barriers or vertical liners of clay, bentonite or cement mixtures. The permeability of clay liners for waste deposits was investigated using different aggressive test liquids (distilled water, two organic and five inorganic test liquids). The used test-liquids were analyzed before and after percolation of the liner materials. Leaching or adsorption effects can thus be recognized. After percolation the liner specimens were mineralogically investigated in order to obtain additional evidence on ion exchange processes by comparison with water analyses, and on the long-term durability of the liner materials. Differences in permeability can be attributed to ion exchange processes (desorption or adsorption porcesses) and alteration of the elecrostatic forces in the clay. (Moore-IVI)
W86-01458

MEASURING THE WATERBALANCE OF A THREE-LAYER COVER OF A DOMESTIC WASTE LANDFILL,

Karlsruhe Univ. (Germany, F.R.). Lehrstuhl fuer Angewandte Geologie.
H. Hotzl, H. Neff, H. Walter, and S. Wohnlich.
Engineering Geology, Vol. 21, No. 3/4, p 341-347, June, 1985. 5 Fig, 5 Ref.

Descriptors: *Water pollution control, *Landfills, *Covers, Barriers, Water movement, Lysimeters, Leachates, Permeability, Groundwater protection.

A covering system is described that is to be installed at a domestic waste landfill to reduce the generation of leachate. The landfill will be covered by such a system and simultaneously get an underground barrier for groundwater protection. The research program uses flexible large-scale lysimeters and soil moisture measurements for estimating the water balance within the covering system. The geological strata at the site consist of 40 m of Quaternary sand and gravel underlaid by a minimum 15 m clay layer. The water table is found at a depth of 16-18 m and groundwater is used for drinking water supply at three areas around the site. From the outer edge of the site the slopes show a gradient of 1:3 up to a height of 30 m. The center of the disposal is formed by a plateau. The plateau was designed as a fold-roof type - several segments of 100 m latitude and varying length. In the middle of each segment a water canal is situated, and slopes of 2.5% rise on each flank towards gas vents. The canals drain to the outside with a gradient of 1%. The covering system consists of three layers: sand filter layer, barrier layer, and vegetation support layer. Centered in the testing area are two large scale lysimeters each of a dimension of 9.5 to 16 m. Lysimeter I is designed to observe the watercycle of the covering system within a closed system. Lysimeter II is an open element within the covering system, gathering information on the vertical leachate below the barrier layer without taking horizontal water movements into account. Measurement of soil moisture changes within the covering system is another possibility to quantify the water movement. By using a neutron proble at several measuring points in the testing area, soil water contents at different depths are recorded weekly. (Baker-IVI)
W86-01459

USE OF A CEMENT-BENTONITE CUT-OFF WALL TO CONTAIN POSSIBLE POLLUTANTS FROM A LANDFILL CONTAINING HIGHLY POLLUTED DREDGING SPOILS,

Laboratorium voor Grondmechanica, Delft (Netherlands).
M. Loxham, and F. A. Westrate.
Engineering Geology, Vol. 21, No. 3/4, p 359-365, June, 1985. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Landfills, *Water pollution control, *Spoil banks, *Cutoff walls, Groundwater pollution, Water pollution sources, Heavy metals, Groundwater barriers, Bentonite, Cement.

The approach channels and canals of major ports must be regularly dredged to keep them at depth. The dredged spoil contains pollutants such as heavy metals, PCBs, and pesticides. When this dredging spoil is disposed of either by landspreading or by landfill, potential pollution problems come into play. The dredging spoil from the sea canal at Ghent in Belgium has been landfilled at a specially engineered site at Zelzate. The landfill was designed to an ultimate capacity of some 2.2 million cu m and occupies a total area of about 30 ha. The depot was excavated in fine sand down to a thick clay layer with a low permeability at approximately 25 m below the surface. With this particular dredging spoil, at the ultimate capacity of the landfill, there will be 5600 tons of toxic heavy metals in the fill. To prevent the spread of pollutants from the site to the surroundings a cement-bentonite screen has been constructed down to a thick clay layer 25 m under the surface. Calculations show that this barrier is adequate for the environmental objectives stipulated. The Zelzate site is one of the first and largest examples of the use of cement-bentonite cut-off walls in the field of pollution control. (Baker-IVI)
W86-01460

ACID RAIN: DOUSING COMMUNITY RESOURCES,

K. Anderberg.
American City and County, Vol. 100, No. 2, p 38, 42-44, 49, February, 1985. 2 Fig.

Descriptors: *Acid rain, *Powerplants, *Emissions, *Water pollution control, Sulfur dioxide, Planning, Management, Decision making, Political aspects, Water conveyance, Water treatment.

While almost everyone acknowledges that there is a problem with acid rain, the area of disagreement is centered around whether action is needed now or whether time can be allowed to pass while more data are gathered on the situation. Uncertainty remains the key word in discussions of acid rain. A recommendation regarding the reduction of sulfur dioxide emissions from coal fired electric power generating stations would have only a minimal effect on electric rates; it would still be highly politicized. For public officials, the problem transcends politics. They must be concerned with public welfare. Europe recognized and began dealing with the problem nearly two decades ago. In the US, forests in New England, Appalachia and California's Sierra Nevada Mountains are exhibiting signs of dead, dying and damaged trees believed to have been caused by acid precipitation. The areas usually affected are far removed from the actual source. Northeastern states have perhaps the greatest concern about acid precipitation's effect on water quality, since water distribution systems in this region often have been in place for decades. The challenge to water system operators focuses on the corrosive water's effect on the distribution system. Highly corrosive or acidic water effects a distribution system in three ways. First there is a health danger associated with higher than recommended levels of heavy metals. Second is the deterioration of pipes and joints that occurs, resulting in leaks, restricted flows and shortened lifespan of the system. The most effective method of protecting consumers from corrosive water and associated contaminants is through corrosion control at the treatment plant. Any emissions control program is likely to be deferred this year. The present administration also appears to prefer to wait for research to be completed before taking any action. (Baker-IVI)
W86-01488

LIMITATIONS OF PHOSPHORUS WATER QUALITY CRITERIA,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
A. N. Sharpley, S. J. Smith, and R. G. Menzel.
Journal of Soil and Water Conservation, Vol. 40, No. 3, p 283-284, May-June, 1985. 6 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Water quality standards, Runoff, Agricultural chemicals, Water quality control, Streams, Lakes, Rain.

The transport of phosphorus from agricultural land in runoff can result in a deterioration of water quality from accelerated eutrophication. Such problems led to the establishment of critical levels for soluble P at 10 micro-g/l and total P at 20 micro-g/l. Results of a water quality monitoring study in Oklahoma and Texas indicate that P concentrations in surface runoff and groundwater from relatively pristine agricultural land were found to be sufficient to stimulate accelerated eutrophication according to the critical-P-concentration guidelines. In addition, P concentrations in rainfall often exceed the critical levels. If runoff and rainfall do not flow directly into an impoundment, soluble P and total P concentration may increase or decrease as a result of release or uptake and erosion or deposition during transport. It may be unrealistic in most cases to attain or maintain P concentration in surface waters below the critical levels. Consequently, the use of these levels as the sole criteria in quantifying permissible tolerance levels of P in surface water as a result of differing management practices should be discouraged. (Baker-IVI)
W86-01492

WATER QUALITY EFFECTS OF PINE FLATWOODS SILVICULTURE,

Florida Univ., Gainesville. School of Forest Resources and Conservation.
For primary bibliographic entry see Field 4C.
W86-01494

STUDIES ON THE POLLUTION CONTROL OF THE YA-ER LAKE (IN CHINESE),

Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
Y. Zhang, Z. Chen, Y. Tan, M. Sun, and D. Zhuang.
Acta Hydrobiologica Sinica, Vol. 8, No. 1, p 113-124, November, 1983. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Water pollution control, *Ya-Er Lake, *China (Peoples Republic), Pesticides, Oxidation ponds, Biodegradation, Biological wastewater treatment, Aquaculture, Eutrophication, Water reuse, Parathion, Malathion, Dimethoate, BHC.

Ya-Er Lake is located in the west part of E-Cheng county, Hubei Province (Peoples Republic of China. In the past it covered about 6000 ha (now 2000 ha) and was one of the main fish production district in the province. Since 1962 the lake was polluted by wastewater of a chemical plant which manufactured parathion, malathion, dimethoate and BHC. The aquatic ecosystem was ruined. About forty percent of fish population were of abnormal form. After the ecological surveys carried out in 1972-1974, the pollution control of Ya-Er Lake was studied. The research works included: survey of the self-purification of pesticides of the lake, simulation experiment on the processes that would occur in the oxidation ponds, and the biological degradation of pesticides in aquatic environment, etc. The pollution control system of Ya-Er Lake consists of the following parts: 1. Oxidation ponds system. At one end of the lake, four oxidation ponds, connected in series, were constructed. The total area is about 187 ha and 3 m in depth. The retention time of wastewater is about 80 days when the amount of the effluent is 70,000 tons per day. The effluent from the pond system is then discharged into another pond for culturing fingerling fish. Therefore the nutritive elements contained in the effluent can be utilized by the fish and the eutrophication process is retarded in the receiving water body. 2. Sewer pipelines, 5.9 km long, between the chemical plant and oxidation

ponds. 3. Two outfall canals (12.8 km long) which run along either side of the oxidation ponds collect and drain the rainwater into the lake. They are also used as water sources for farming. The above facilities were nearly completed in 1976. The operating experience for four years showed that the system was quite successful in district pollution control. The oxidation pond system can effectively reduce the organic wastes. The average removal efficiences for COD, organic phosphate, p-nitrophenol, parathion, malathion, dimethaote and BHC are 77.3, 82.5, 99.3, 98.7, 98.4, 92.9 and 86.2 percent, respectively. The daily waste-water load was 80,000 tons. Biological survey showed that the biotic community in the Ya-Er Lake ecosystem has been recovering since 1977. The rate of abnormal type of fish decreased to 0.1% in 1979. The BHC residues in fish decreased from 15-30 mg/kg to 0.55 mg/kg (in skeletal muscle). The BHC residues of farm products in 1979 were 2.7-9.4 fold less than those before the construction of the oxidation ponds system. (Author's abstract)
W86-01513

COLLIFORD LAKE IN CORNWALL: FROM PROMOTION TO UTILIZATION,

For primary bibliographic entry see Field 6B.
W86-01519

HYDRAULIC CONDUCTIVITY OF TWO PROTOTYPE CLAY LINERS,

Geo-Con, Inc., Pittsburgh, PA.
S. R. Day, and D. E. Daniel.
Journal of Geotechnical Engineering, Vol. 111, No. 8, p 957-970, August, 1985. 13 Fig, 5 Tab, 2 Ref.

Descriptors: *Permeability coefficient, *Clay liners, *Liners, Landfills, Infiltration, Lagoons, Clays.

Two prototype liners were constructed at a site near Austin, Texas, using clays of low and high plasticity. The clays were compacted to 100% of standard Proctor density at a water content slightly wet of optimum using a sheepsfoot roller. The overall hydraulic conductivity (k) of each liner was determined by ponding water on the liners and measuring the rate of seepage. The field-measured k's of the liners were suprisingly high (0.000004 and 0.000009 cm/s). After water in the ponds was removed, laboratory permeability tests were performed on hand-carved samples obtained from the liners, on samples obtained with a thin-walled sampling tube, and on laboratory-compacted samples. Field permeability tests were also performed with ring infiltrometers. The tests showed that: (1) Essentially all of the laboratory tests, even on undisturbed samples, produced a measured k that was approximately 1,000 times less than the field-measured k; and (2) ring infiltration tests showed considerable scatter but the average k was close to the overall field-measured k. The findings raise important questions about whether laboratory permeability tests on compacted clay are relevant to clay liners and reinforce previous suggestions that compacted clay liners may contain numerous hydraulic defects such as fissures, slickensides, zones of poor bonding between clods of clay, and zones of relatively poor compaction. The desirability of field permeability tests is evident from the results reported. (Author's abstract)
W86-01531

CASE STUDY ANALYSIS FOR SEASONAL NITRIFICATION: ECONOMIC EFFICIENCY AND WATER QUALITY PRESERVATION,

Lafayette Coll., Easton, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-01543

MANAGEMENT OF CONTAMINATED DREDGED MATERIAL FROM THE HUDSON RIVER,

Pirnie (Malcolm), Inc., White Plains, NY.
J. S. Reed, J. C. Henningson, and L. Houston.
Northeastern Environmental Science, Vol. 3, No. 3/4, p 216-220. 2 Fig, 6 Ref.

Descriptors: *Environmental effects, *Dredging, *Hudson River, *New York Harbor, *Champlain Canal, Spoil disposal, Estuarine environment, Land disposal, Polychlorinated biphenyls, Waste disposal.

The Hudson River is an active commercial and recreational waterway requiring regular maintenance dredging. Disposal of the dredged material and methods of dredging and volume of material removed must be managed in a manner consistent with the level of sediment contamination. Four studies have been undertaken - two in the upper Hudson, and one each in the estuary and in New York Harbor - which evaluate dredge disposal practices appropriate to each region. The use of dredged material from the New York Harbor is being studied to meet the demand for sanitary landfill cover which is in increasingly short supply in the New York area. The study is being conducted for the New York District Corps of Engineers, as an option to ocean disposal. In the estuary, a 10-year maintenance dredging EIS and management plan were developed for the New York District Corps of Engineers. A total of 92 potential upland disposal sites were identified, a portion of which would be suitable for disposal of hazardous waste. In the upper Hudson consideration was also given to the maintenance dredging program conducted by the NYS Department of Transportation on the Champlain Canal. This evaluation will serve as the basis for an environmental impact on the 10 year maintenance program for the canal. In the Upper Hudson a remedial dredging program was developed for the New York State DEC to remove 'hot spots' containing the highest concentrations of PCB. (Author's abstract)
W86-01564

SIMPLE METHOD TO ESTIMATE LAKE PHOSPHORUS CONCENTRATIONS RESULTING FROM NATURAL, BACKGROUND, LOADINGS,

Pavia Univ. (Italy). Ist. di Entomologia Agraria.
For primary bibliographic entry see Field 2H.
W86-01640

ANALYSIS OF VARIANCES AS DETERMINED FROM REPLICATES VS. SUCCESSIVE SAMPLING,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and F. A. Rovers.
Ground Water Monitoring Review, Vol. 5, No. 3, p 61-64, Summer, 1985. 3 Fig, 9 Tab, 1 Ref.

Descriptors: *Monitoring, *Analysis of variance, *Sampling, Mathematical studies, Groundwater pollution.

Monitoring requirements as specified within the Resources Conservation and Recovery Act rely on increases over background level of the the concentrations of parameters to define when a unit is not in compliance. Evidence of groundwater contamination at a compliance point may be based on statistical comparisons of data from replicate analyses carried out on a single sample. A field test of the variances arising from between samples and within sample replicates indicated that the background concentration is fundamentally important in the statistical significance testing for the compliance point monitoring. Since the variance of the background concentration is best measured by sampling error, as well as analytical error, there is a strong argument that a program of background quality determination should involve successive sampling rather than the splitting of samples into aliquots. (Baker-IVI)
W86-01698

GROUTING AS A REMEDIAL TECHNIQUE FOR BURIED LOW-LEVEL RADIOACTIVE WASTES,

Oak Ridge National Lab., TN. Environmental Sciences Div.
B. P. Spalding, L. K. Hyder, and I. L. Munro.
Journal of Environmental Quality, Vol. 14, No. 3, p 389-396, 1985. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Grouting, *Radioactive wastes, *Waste disposal, Environmental protection, Soil stabilization, Soil properties, Sodium silicate, Polyacrilamide, Permeability coefficient.

Seven grout formulations were tested in the laboratory for their ability to penetrate and to reduce the hydraulic conductivities of soils used as backfills for shallow land burial trenches. Soil from two sites, in Oak Ridge, TN, and Maxey Flats, KY, were used and both are classified as Typic Dystrochrepts. Three soluble grout formulations (sodium silicate, polypropenamide (polyacrylamide), and 1,3-benzenediol (resorcinol)-formaldehyde) were able to both penetrate soil and sand columns and reduce hydraulic conductivities from initial values of ca. 10 to the -4th power m/s to < 10 to the -8th power m/s. Three particulate grouts (lime (calcium oxide)-fly ash, fly ash-cement-bentonite, and bentonite alone) could not penetrate columns; such as formulations would, therefore, be difficult to inject into closed burial trenches. Field demonstrations with both sodium silicate and polyacrylamide showed that grout could be distributed throughout a burial trench and that waste-backfill hydraulic conductivity could be reduced several orders of magnitude. Field grouting with polyacrylamide reduced the mean hydraulic conductivity of nine intratrench monitoring wells from 0.0001 to 10 to the -8th power m/s. Grouting of low-level radioactive solid waste in situ, therefore, should be an effective technique to correct situations where leaching of buried wastes has or will result in groundwater contamination. (Author's abstract)
W86-01712

USING CREAMS AND ECONOMIC MODELING TO EVALUATE CONSERVATION PRACTICES: AN APPLICATION,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 5B.
W86-01715

GROUNDWATER PROTECTION IN SAN FRANCISCO BAY AREA,

California Regional Water Quality Control Board, Oakland.
D. M. Eisenberg, A. W. Olivieri, M. R. Kurtovich, P. Johnson, and L. Pettegrew.
Journal of Environmental Engineering, Vol. 111, No. 4, p 431-440, August, 1985. 1 Fig, 4 Ref.

Descriptors: *Groundwater pollution, *San Francisco Bay, *California, *Environmental protection, Underground storage tanks, Source of pollutants, Water pollution, Legal aspects, Remedial action, Cleanup.

In the San Francisco Bay Region, the Regional Water Quality Control Board is now regulating approximately 140 sites where toxic chemicals have contaminated groundwater. Many of these were located through the Board's Underground Tank Leak Detection Program, which required subsurface investigations at the sites with underground solvent tanks. New ordinances and state laws are expected to result in the discovery of hundreds more contamination sites in the next few years. The Regional Board is developing a ranking methodology to assign priorities among cases and a set of guidelines for establishment of clean-up objectives on a site-by-site basis. Appropriate regulatory mechanisms have been selected to enforce the necessary investigation and clean-up activities. (Author's abstract)
W86-01724

DESIGN CONSIDERATIONS FOR A NOVEL LANDFILL LINER,

Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
A. C. Demetracopoulos, and L. Sehayek.
Journal of Environmental Engineering, Vol. 111, No. 4, p 528-539, August, 1985. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Landfill liners, *Design criteria, *Membranes, Environmental protection, Leachates, Linings, Diffusion coefficient.

A novel landfill leachate liner design consisting of a series of v-shaped contiguous elements constructed from an impervious membrane, a boxed soil layer saturated with clean water, and a gravel layer is proposed. Certain idealized boundary conditions are stipulated and an analytical solution is given for the diffusional mass transport of leachate through the saturated layer. This is used to assess the maxiumum value and time-of-occurrence of leachate concentration at the impervious membrane. It is shown that these two important quantities are sensitive to the diffusion coefficient and the thickness of the saturated layer. A method is formulated for the estimation of the diffusion coefficient, accounting for the type of contaminant, the effect of the porous medium, and the possibility of contaminant adsorption on the soil matrix. The overall procedure would be valuable in estimating the potential of destruction of the impervious membrane from the chemicals contained in the leachate. (Author's abstract)
W86-01730

HAZARDOUS WASTE CLEANUP: THE PRELIMINARIES,

Environmental Protection Agency, New York. Region II.
K. Amos.
Civil Engineering, Vol. 55, No. 8, p 40-43, August. 1985. 5 Fig.

Descriptors: *Water pollution control, *Cleanup operations, *Landfills, *Waste disposal, *Niagara River, Hazardous substances, Groundwater pollution, Monitoring.

An EPA suit filed in 1979 named four Hooker dump sites that were polluting the Niagara River. The parties involved agreed to negotiate remedial programs for each of the four sites in turn. S-Area, second on the list, may serve as a model for other negotiated settlements. It provides for a flexible plan, open to consideration of alternate technologies that may be developed in the future. It contains a phased approach to both defining and evaluating existing problems, then suggesting remedies. It requires monitoring for at least 35 years or until no danger remains. S-Area is an eight acre landfill built in 1947 on partially reclaimed land beside the river. Wastes were dumped into open trenches 18 ft deep even though groundwater was struck at 4 ft. The remedial plan set forth in the approved settlement agreement begins with a surveys-and-studies program similar to those outlined for Superfund sites. Flexibility, extensive use of computer models, and extensive monitoring programs for hydraulics, tracer and other chemicals will assure the remedial plan's effectiveness. An important technical remedy proposed for S-Area is the upward hydraulic gradient concept, innovative and as yet untried. (Baker-IVI)
W86-01738

HEALTH EFFECTS OF INDIRECT POTABLE WATER REUSE,

Los Angeles County Sanitation Districts, Whittier, CA.
M. H. Nellor, R. B. Baird, and J. R. Smyth.
Journal of American Water Works Association, p 88-96, July, 1985. 1 Fig, 6 Tab, 48 Ref.

Descriptors: *Water reuse, *Potable water, *Public health, Groundwater recharge, Toxicity, Percolation, Hydrogeology, Epidemiology, Chemical content.

Plans for expansion of water reuse through groundwater replenishment have been constrained by concerns regarding the potential impacts on health of indirect potable reuse, particularly the effects of exposure to trace organics, the presence of which may be exacerbated by groundwater replenishment activities. A five-year, multidisciplinary research project was undertaken to evaluate the effects on health of using treated wastewater for groundwater replenishment. The study focused on the Whittier Narrows Groundwater Replenishment Project in Los Angeles County, California, where replenishment with a mixture of imported river water, stormwater, and reclaimed wastewater has been practiced since 1962. The study included: characterization of the quality of the water; toxicological and chemical studies of the water; percolation studies to evaluate the efficacy of soil for attenuating inorganic and organic chemicals in reclaimed water; hydrogeology; epidemiological studies of populations ingesting reclaimed water. The proportion of reclaimed water currently used for replenishment had no measurable impact on either groundwater quality or human health. Recommendations for optimization of groundwater replenishment with reclaimed water are included. (Moore-IVI)
W86-01747

OPTIMIZATION MODELING OF WATER QUALITY IN AN UNCERTAIN ENVIRONMENT,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
D. H. Burn, and E. A. McBean.
Water Resources Research, Vol. 21, No. 7, p 934-940, July, 1985. 2 Fig, 2 Tab, 33 Ref, 1 Append.

Descriptors: *Optimization, *Water quality, *Model studies, Probability, Stochastic process, Dissolved oxygen, Wastewater treatment, Simulation, Costs.

A comprehensive approach to water quality modeling could incorporate the stochastic nature of water quality as a means of assuring compliance with probabilistic water quality standards. An optimization model with an ability to reflect uncertainties present in water quality problems is described. The technique employed is chance constrained programming wherein probabilistic constraints in a water quality optimization problem are replaced with their deterministic equivalents. To illustrate aspects of the proposed methodology, a case study is described which involves the determination of the optimal treatment level at two sources in order to satisfy two objectives of maximizing water quality (at a series of four locations) and minimizing treatment costs at the two sources. Water quality is assumed to be represented by the dissolved oxygen concentration in the river. The uncertainty inherent in the random elements of the problem is characterized using first-order uncertainty analysis for the case study. A lognormal distribution provided a satisfactory fit to the distribution of dissolved oxygen deficit. In choosing an appropriate distribution for this problem, consideration should be given to the loading condition and the probability level which is of interest. (Moore-IVI)
W86-01764

USE OF MACROPHYTES FOR TREATING AGRICULTURAL RUNOFF,

For primary bibliographic entry see Field 5D.
W86-01826

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

COMPUTER AIDED MAPPING PROJECT AIDS SEVERN TRENT,

N. McLeod.
Water Services, Vol. 89, No. 1072, p 161-163, June, 1985.

Descriptors: *Severn Trent Water System, *Mapping, *Computers, Automation, Planning, Water supply, Water distribution, Wastewater facilities, England.

The Lower Severn Division, on of the eight divisions of the Severn Trent Water Authority (England) supplies water to and treats sewage from 780,000 people. The Division is also responsible for maintaining some 658 km of rivers and estuaries. Lower Severn began investigating computer based mapping in May of 1982. A four person multidisciplinary team was set up, which included two independant consultants. Benchmark tests were established to demonstrate to the prospective user the strengths and weaknesses of the systems competing against each other. From the results of the benchmark tests a three workstation system was selected on an initial one-year rental contract. The mapping software is accurate to 1 mm on the ground and stores data on one of 32 reference files, each of which can have 63 levels. Lower Severn found it difficult to produce a financially sound case to purchase computer equipment for mapping purposes only. Thus it was necessary to exploit the full potential of the system's database capability to produce reports of all kinds. The real payoff will come when all the public utilities and the highway authorities all begin to communicate in specifying a system that will be of benefit to them all, and ultimately of benefit to the paying customers, the consumer. (Baker-IVI)
W86-01631

CALCULATING WITH MICROCOMPUTERS,

J. Houston.
Water Services, Vol. 89, No. 1072, p 164-166, June, 1985. 3 Fig, 6 Ref.

Descriptors: *Computers, *Water supply development, Hydrogeological analysis, Spatial analysis, Statistical analysis, Automation.

Microcomputer hardware is now well advanced, capable of carrying out most of the tasks required by professional water engineers. By comparison software has not kept pace and only now are program packages becoming available which use facilities to the full. A wide range of programs are available for the simpler tasks but there are still very few available for more complex data handling. The ease of access to microcomputers and their flexibility means that the software for these machines should not be the preserve of computer scientists. Programs should be and are being developed with the emphasis on ease of use but they are not a substitute for technical knowledge. Microcomputers must support the professional engineer, not replace him. (Baker-IVI)
W86-01632

MEASURING VALUES FOR ENVIRONMENTAL RESOURCES UNDER UNCERTAINTY,

New South Wales Univ., Kensington (Australia). School of Economics.
D. R. Gallagher, and V. K. Smith.
Journal of Environmental Economics and Management, Vol. 12, No. 1, p 132-143, June, 1985. 1 Fig, 17 Ref.

Descriptors: *Planning, *Policy making, *Uncertainty, Water pollution control, Environmental protection, Values, Decision making, Risk.

The relationship between conventional measures of the benefits from changes in environmental amenities under certainty and an individual's valuation of such changes under uncertain conditions is considered. The basic framework used in developing the conditions when the Hicksian compensating and equivalent measures of consumer surplus will bound an individual's value for a change in the likelihood of experiencing an improvement in an environmental amenity is introduced. The analysis is conducted within a contingent commodity framework with state-dependent preferences. This approach allows an individual's valuation of a change in access to an environmental amenity to be considered with and without the ability to efficiently allocate risk. This framework is used to evaluate the effects of the allocation of risk on the relationship between an individual's valuation of change in the access conditions and the conventional measures of consumer surplus for certain changes in the amenity resources. The paper concludes by considering the implications of the results for efforts to estimate the values associated with changes in the availability of uncertain environmental amenities. (Baker-IVI)
W86-01685

HYDROPOWER'S NEWEST GENERATION,

H. Smallowitz.
Civil Engineering, Vol. 55, No. 8, p 46-49, August, 1985. 3 Fig.

Descriptors: *Water resources development, *Hydroelectric power, *Canals, Small hydropower, Planning, Dam construction, Dams, Enviromental effects, Hydroelectric plants.

The Great Falls, Paterson, NJ project is based on a system of canals constructed in the late 1700s to spur small industry in the fledgling US, and develop independence from the economy of Great Britain. While the mills and factories the canals once powered have long since closed, the waterways are still capable of producing 4900 to 11000 Kw. The city of Paterson hopes to make use of this energy source in the future. In North slope, Alaska, the Susitna project is actually made up of two major developments on the Susitna River, some 180 mi North and East of Anchorage. The Eldred L. Field Project, in Lowell, Massachusetts is on a canal system that dates back to 1792. Efforts to make use of this system in modern times necessitated making certain that historical and environmental factors were considered. In Bumcombe County, North Carolina, near Ashville, developers are bringing out of retirement an abandoned hydroelectric plant. The Craggy Dam was originally constructed in 1904. A proposal to tap electricity from the flow of water to Jersey City, New Jersey's water taps is beset with regulatory problems. Plans call for two small hydroplants to be installed at the Boonton Reservoir, 25 mi west of the city. An innovative use of existing mud gates in the reservoir will also make it cost effective to generate 2 Mw more from the facility. (Baker-IVI)
W86-01739

COMPUTER KEEPS NEW ORLEANS' HEAD ABOVE WATER,

Daniel, Mann, Johnson and Mendenhall, New Orleans, LA.
M. A. Ports.
Civil Engineering, Vol, 55, No. 8, p 56-58, August, 1985. 1 Fig.

Descriptors: *Drainage control, *New Orleans, *Louisiana, *Computers, *Drainage systems, Data handling, Storm runoff, Canals, Simulation, Flood peak, Pumping rate.

Drainage problems have beset the city of New Orleans, Louisiana since its founding in 1718. By 1983 it was apparent that an adequate drainage system was necessary. The survey of the topography of the city revealed that the city is saucer shaped. A plan to lift storm water up and out of the city called for an extensive network of canals and pumping stations to Lake Pontchartrain and Lake Borgne. In order to simulate successfully the complex network of interconnected open and covered canals, conduits and pumping stations under both surcharged and free flowing conditions, any potential model must be capable of predicting for each area, for any storm, the time and elevation of peak flows, the maximum pumping rates required to handle peak flows, the above ground flood slopes and the time needed to pump away stormwater runoff. Designers worked to plan the most effective and cost effective improvements. The models for each area were formulated only after testing hundreds of trial simulations. Without the aid of an in-house minicomputer, such a vast array of data would not have been processed with more than 800 simulations completed in only 15 months. (Baker-IVI)
W86-01740

TWO PROJECTS BECOME ONE,

Bureau of Reclamation, Durango, CO.
W. M. Roche, and J. W. Davison.
Civil Engineering, Vol. 55, No. 8, p 64-65, August, 1985. 2 Fig.

Descriptors: *Water resources development, *Multipurpose projects, *Dolores Project, *McElmo Project, *Colorado, Sclinity control, Water management, Water supply development, Canals, Linings.

The Dolores and McElmo projects, both near Cortez, Colorado, were begun at different times. The Dolores Project, located in the Dolores and San Juan River Basins was set up to develop water from the Dolores River for municipal, industrial, and irrigation supplies; power; food control; and fish, wildlife and recreation. Just south of the Dolores Project at the McElmo Unit sites, studies were underway to determine the most cost-efficient alternative for reducing salt concentrations. Once preliminary investigations showed that creating a $34 million McElmo Unit that was separate from the Dolores Project would be inefficient, representatives from both projects met to discuss possible joint efforts. The combined project calls for enlarging and lining the Lower Hermana Lateral and Highline Ditch to handle the flows of Towaoc and Rocky Ford canals. Depending on soil conditions and right of way restrictions, either earth, concrete or plastic membrane lining will be used. Design for other portions of the project including canal enlargement and salinity control, will be completed in stages. (Baker-IVI)
W86-01741

PROBABILITY DISTRIBUTION MEMBERS OF A RANKED SAMPLE,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
L. D. Ratkovich.
Water Resources, Vol. 11, No. 3, p 179-185, May-June, 1984. 2 Fig, 3 Tab, 8 Ref. Translated from Vodnye Resursy, No. 3, p 15-22, May-June, 1984.

Descriptors: *Probability distribution, *Autocorrelation, *Time series analysis, Hydrology, Geophysics, Water management,.

When performing hydrologic and water management calculations, it is often necessary to estimate the probability of a particular member of a time series composed of geophysical quantities. The presence of autocorrelation of water-balance components in time series has been proven. Problems remain as to what probabilities the ordinates of a ranked sample of correlated quantities should be referred and what random errors can occur in the case. For a series length of more than 30 members the effect of autocorrelation on the estimates of empirical probabilities of a ranked sample is not evident. Even in this case, when the values of the autocorrelation coefficient are high, the effect of autocorrelation is comparable to the difference between the probabilities calculated by given equations. An equation is also provided for giving a sample estimate of probability with consideration of autocorrelation and is recommended for small samples. Further investigation should be geared toward a theoretical analysis of the distributions of the sample estimates of probabilities of correlated samples and, in particular, a refinement of the confidence limits. Of definite interest is an analysis of the effect of autocorrelation on errors in the estimates of the random variable itself on the basis of the calculated probability values. (Baker-IVI)
W86-01817

6B. Evaluation Process

LOWER MAE PING PROJECT, THAILAND,

Crippen International Ltd., Vancouver (British Columbia).
G. D. A. Akins, P. R. Blinch, and P. Premchun.
Water International, Vol. 10, No. 2, p 52-56, June, 1985. 2 Fig, 2 Ref.

Descriptors: *Lower Mae Ping Project, *Thailand, *Hydroelectric plants, Water resources development, Economic aspects, Design criteria, Water management, Pumped storage, Diversions, Flood control.

The Lower Mae Ping Project was designed to provide more hydropower generating capacity to the power system of Thailand, while increasing the volume of water available for irrigation in the dry season. This will be achieved through installation of a reversible pump/turbine at Bhumibol, an existing hydropower dam, construction of a low head hydropower scheme downstream of the dam, and diversion of flows towards these facilities from an adjacent river. Technical features of the project are outlined. Principal design constraints on the system include an affect on the EGAT power system, downstream water availability and the flood control function of Bhumibol dam. Environmental and social aspects are briefly noted along with benefits, costs, and scale of the project. Secondary benefits will include local irrigation, flood control, and inland fishery development. (Baker-IVI)
W86-01374

GROUNDWATER IN WATER RESOURCES PLANNING: CONJUNCTIVE USE,

Universidad Politecnica de Valencia (Spain).
For primary bibliographic entry see Field 4B.
W86-01375

NIGERIAN WATER RESOURCES AND THEIR MANAGEMENT,

Nigeria Univ., Nsukka. Dept. of Civil Engineering.
G. U. Ojiako.
Water International, Vol. 1, No. 2, p 64-72, June, 1985. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Nigeria, *Water resources development, *Developing countries, Water management, Decision making, Planning, Water supply, Surface waters, Rainfall, Groundwater, Institutional constraints.

The potentiality and management of the water resources of Nigeria are examined and early achievements of the authorities charged with the multi-purpose development of this resource are reviewed. The annual mean rainfall distribution ranges from about 157.5 inches at the coast to practically zero at the northern border and an average annual mean of 47.2 inches for the whole country. Surface sources include the River Niger, the third largest river in Africa. In addition there are also the River Benue, Cross River, Imo, Sokoto, Ogun, Anambra, and Kaduna Rivers together with several streams and channels, lakes and ponds which provide a nationwide web of drainage basins. The quantities of runoff from the drainage basins vary widely and depend upon a large number of factors the most important of which are the amount and intensity of rainfall, the climate and vegetation as well as geological, geographical and topographical features of the area. Major ground water reserves exist in numerous localities all over the country and have been conservatively estimated as 30 times the level of surface flows. The establishment of River Basin Authorities remains in Nigeria the greatest landmark made since independence in the development of the economy. The accelerating agricultural activities of the Authorities will return the country to its original position of an agricultural based economy capable of earning substantial foreign exchange and reducing overdependence on oil exports. The problems which face the Basin Authorities and tend to reduce their pace of development, such as financial constraints in fundings, and insufficiency of adequately trained technical and administrative manpower, can easily be overcome with the cooperation of developed countries and the goodwill of international organizations. At home, the tasks of the Authorities will be made easier with the cooperation of local financial houses, local industries, State Governments and organizations with interests in water development as well as institutions of higher learning. (Baker-IVI)
W86-01376

AGRICULTURAL BENEFITS FOR SENEGAL RIVER BASIN,

Army Engineer Battalion (79th), APO New York 09360. Company B.
For primary bibliographic entry see Field 3B.
W86-01432

BIG CHALLENGE OF SMALL WATER SYSTEMS,

Pirnie (Malcolm), Inc., White Plains, NY.

M. J. Shelstad, and J. Bennett.
American City and County, Vol. 100. No. 2, p 34-36, 38, February, 1985. 2 Fig.

Descriptors: *Water conveyance, *Management, Planning, Decision making, Water management, Water supply, Water treatment.

Small water systems must accomplished their mission with very limited resources. Because their small size cannot justify constant attention, both management and operation are part time efforts. Many small water systems are not economically viable. Often they may employ operators who are poorly paid and lacking strong motivation or without proper training and certification without knowledge enough to cope with the complex provisions of the Safe Drinking Water Act. Thus these systems are more likely to violate drinking water standards. Among possible solutions to these problems is consolidation which can occur in a variety of ways: small private utilities can merge into larger organizations or public agencies, usually at the county level, can take charge. Mergers and takeovers are not the only way to achieve the benefits of a regional system. Another mechanism is the cooperative agreement among water systems to share resources and services. Management services can be shared also, enabling such functions as purchasing, maintenance, bookkeeping and billing to be centralized. Avenues for technical assistance and financial assistance are briefly noted with some examples given. (Baker-IV)
W86-01487

COLLIFORD LAKE IN CORNWALL: FROM PROMOTION TO UTILIZATION,

D. Battersby, T. A. Johnston, and J. D. Evans.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 207-224, June, 1985. 9 Fig, 2 Tab.

Descriptors: *Clifford Lake, *England, *Reservoirs, *Water supply development, Water resources, Water supply, Water demand, Dam construction, Fish management.

Extensive investigations were made to determine the best route to take for meeting the water demand of the Cornwall River Authority area until the year 2001. The construction of Colliford Lake, the largest reservoir in Cornwall, fulfilled a key role in the water resource strategy thus developed. The total area to be supplied from Colliford Lake in conjunction with existing sources of supply amounts to some 3,322 sq km. Early investigations had ruled out the possibility of the use of groundwater, desalination, an estuarial barrage, or bunded storage for water resource development. Details are provided of the site selection process and dam construction. Reinforced concrete structures described include overflow works, draw-off valve tower, access gallery/overflow culvert, and the inspection gallery/cut-off. Construction of a subsidiary dam, Soimonstone Embankment, is also described. The river Fowey is well known for its salmon and sea trout fishing. To mitigate the loss of production due to the construction of the Colliford Dam, a fish trap and fence have been built across the river immediately downstream of Colliford Dam with an adjoining fish hatchery. Impounding began at the end of July 1983 and rainfall amounted to about 93% of the 15 year average during the first year. Drought occurred in the summer of 1984. During the early months, discharges to the St. Neot river were mainly limited to the compensation flow of 5.7 Ml/d. However, as the drought made itself felt, augmentation discharges were made. Prior to the augmentation release, temperature and dissolved oxygen monitoring had indicated that the lake was becoming thermally stratified and there was oxygen deficiency at the lower levels. The concentrations of iron, manganese, ammoniacal nitrogen and hydrogen sulfide had also increased in the deeper water although the algal productivity was low. Thus, in mid-August, the aeration compressor was used intermittently and it ran continuously during September and seemed to be effective in mixing, reoxygenating, and reducing the chemical concentrations in the water, although more experience will be needed to establish guidelines for economic use. (Baker-IVI)
W86-01519

HOW TO PUT MORE PUBLIC INTO PUBLIC WORKS,

Black and Veatch, Kansas City, MO.
T. E. Decker, and L. J. Saiger.
Journal of the Water Pollution Control Federation, Vol. 57, No. 7, p 756-762, July, 1985. 4 Fig.

Descriptors: *Public relations, *Education, Public participation, Public opinion, Attitudes, Utilities, Wastewater facilities, Water supply development.

A detailed list is presented of public involvement and education activities and methods that can be used to promote the acceptance of public works facilities, including wastewater and water supply facilities. A brief overview is given of a public participation program for their facilities plan demonstrated that a designed, comprehensive public campaign using standard activities can be successful in many instances. Case histories clearly show that it is occasionally necessary to use very specialized and intensive public relations techniques to educate and satisfy the public. These two case histories prove that public education, involvement, and relations activities are very important at all stages of a project; that words, diagrams, and photographs are not always sufficient to educate individuals about the impact that public works facilities may have on their lives; that the willingness of a municipality or utility to commit money and take the time and effort needed to appease public concerns is usually rewarded; and that, if treated fairly, individuals will generally be willing to compromise and respond positively. The keys to fair treatment are compassion, honesty, imagination, generosity, and perseverance. (Baker-IVI)
W86-01542

SOUTHERN OCEAN AND MARINE POLLUTION: PROBLEMS AND PROSPECTS,

George Washington Univ., Washington, DC. Dept. of Political Science.
C. C. Joyner.
Case Western Reserve Journal of International Law, Vol. 17, No. 2, p 165-194, Spring, 1985. 174 Ref.

Descriptors: *Planning, *Water pollution control, *Marine pollution, *International law, Legal aspects, Marine sediments, Oceans, Natural resources development, Antarctic region.

The nature of marine pollution is examined as it has come to affect global ocean space. An assessment is provided of the extent to which pollutant contamination is presently encroaching upon the Southern Ocean's ecosystem, as well as the possible threates which potential hydrocarbon development in or around Antarctica would likely pose for the circumpolar seas. Finally, an analysis is performed of the various international legal instruments which have been purposefully designed and implemented for curtailing marine pollution. In this connection, specific reference is made to the protection of the Antarctic maritime area. As a result of this analysis, hopefully the environmental degradation associated with marine pollution in the circumpolar region will be better understood and appreciated. More importantly, it is necessary to realize that new, viable, and effective international legal safeguards are imperative if the fragile ecosystem of the Southern Ocean is to be adequately protected and prudently managed. (Baker-IVI)
W86-01686

EVALUATING ALTERNATIVE INVESTMENT PROGRAMS FOR THE MEDITERRANEAN-DEAD SEA PROJECT,

Mediterranean-Dead Sea Co. Ltd., Jerusalem (Israel).
A. Gross, and J. Zahavi.
Water Resources Research, Vol. 21, No. 7, p 905-916, July, 1985. 7 Fig, 29 Ref, 1 Append.

Descriptors: *Israel, *Mediterranean-Dead Sea Project, *Evaluation, *Investment, Alternative planning, Optimization, Hydroelectric plants, Economic feasibility, Canals, Tunnels.

The sharp difference in elevation between the Mediterranean and the Dead Sea and the need to replace the water withdrawn from the Dead Sea by water from another source are the key to ambitious Mediterranean-Dead Sea (MDS) project. This project is intended to convey water from the Mediterranean to the Dead Sea via canals and tunnels utilizing the height difference of close to 400 m to generate hydroelectric energy. A methodology, geared toward the prefeasibility study, is devised for evaluating alternative investment programs in the MDS project, which is based on comparing the optimal configuration for each alternative route of the water carrier. The maximal energetic benefits are calculated using two interrelated optimization problems: a multiperiod optimization, involving dynamic programming, to find the optimal operating regime of the system over time, and a one-period optimization, imbedded in the multiperiod optimization, involving probabilistic methods, to find the loading point of the hydro unit that maximizes the value of the energy displaced. Cost-benefit analysis is used to find the optimal size of the hydroelectric components, including the hydro unit size and the water carrier diameter. The model has been applied to evaluate the economic feasibility of the MDS project and to rank the various alternatives by economic merit. The results of this study indicate that the MDS project is viable in all its alternatives with the Central project yielding the largest net benefits. Because the Central alignment introduces many other problems, mainly hydrological, it has been abandoned in favor of the next most economical plan, the Southern alignment. (Moore-IVI)
W86-01761

HYPERGAME ANALYSIS OF THE LAKE BIWA CONFLICT,

Tottori Univ. (Japan). Dept. of Civil Engineering.
N. Okada, K. W. Hipel, and Y. Oka.
Water Resources Research, Vol. 21, No. 7, p 917-926, July, 1985. 1 Fig, 6 Tab, 29 Ref.

Descriptors: *Lake Biwa, *Japan, *Hypergame analysis, *Water allocation, Model studies, Water management, Resource management, Conflict analysis, Decision making.

When there are misunderstandings among participants in a water resources conflict, hypergame analysis can be used to systematically model the conflict and predict the compromise resolutions. In order to demonstrate the efficacy of using hypergame analysis for studying water resources management problems, it is applied to the Lake Biwa conflict in Japan. This dispute constitutes a typical example of a water allocation conflict where downstream users would like more water from the upstream controllers of the major source of the water. Furthermore, each participant or player in the Lake Biwa dispute has misperceptions about the other players' preferences. Besides predicting the different resolutions which each of the players envisioned, hypergame analysis correctly forecasts the compromise resolution that occurred historically. (Author's abstract)
W86-01762

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,

For primary bibliographic entry see Field 5D.
W86-01490

QUESTION OF RATES,

Consumers/Pirnie Utility Services Co., Inc., Hamden, CT.
H. F. Hanson.
American City and County, Vol. 100, No. 6, p 38, 40, 42, June, 1985.

Descriptors: *Economic aspects, *Water rates, Metering, Planning, Management, Utilities, Financing.

Through the years, water utilities have supplied treated water to their customers at the lowest cost, consistent with quality and reliability requirements. This approach has sometimes caused water utilities to become victims of their own success when customers began taking for granted the dependable flow of water at what some consider artificially low prices. Customers and utilities alike are now confronted with the lasting results of this practice. The capital assets of utilities are long-lived, remaining in service for 50 years or more. The initial investments made in the 1930s have not generated sufficient depreciation in funds to finance the replacement or expansion required at today's high construction costs. Suburban expansion of older cities means that more customers must be provided with water over greater distances. New or expanded facilities often must be built to meet expected growth before the customers are in place to pay for service. Two chief problems face water utility managers: how to raise capital, and how to obtain higher rates to pay for the needed improvements. One alternative is the imposition of system development revenues, such as connection fees or cost-of-service charges. Demand rates for utility systems have also received consideration. An emerging technology that will enable utilities to monitor customers' consumption accurately on a frequent basis is automated meter reading. (Baker-IVI)
W86-01491

EFFLUENT REGULATION AND LONG-RUN OPTIMALITY,
University of Southern California, Los Angeles. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W86-01684

PAYING FOR REUSE WATER,
CH2M Hill, Inc., Portland, OR. Water and Wastewater Economics.
C. W. Corssmit.
Journal of American Water Works Association, p 78-83, July, 1985. 2 Fig, 1 Tab.

Descriptors: *Water reuse, *Pricing, Cost allocation, Cost-benefit analysis, Water demand, Financial feasibility.

To arrive at satisfactory financing plans and price schedules for reuse water, economic feasibility studies of the proposed projects, including consideration of the no-action alternative, should be undertaken before engaging in more traditional financial planning. This helps to determine the benefits and costs and a proper framework for cost allocations. A market analysis should also be performed to make sure there is a demand for reuse water and to determine what prices people would be willing to pay for it. Typically, revenues obtained from sales of reuse water will be less than for potable water and would possibly not be equal to the cost of serving reuse customers. Methods for redistributing the deficits to other water users are suggested. (Author's abstract)
W86-01745

CONSERVATION USING A RATE OF RETURN DECISION RULE: SOME EXAMPLES FROM CALIFORNIA MUNICIPAL WATER DEPARTMENTS,
California Univ., Santa Barbara. Dept. of Economics.
For primary bibliographic entry see Field 3D.
W86-01763

VOLUMETRIC PRICING OF AGRICULTURAL WATER SUPPLIES: A CASE STUDY,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
R. C. Griffin, and G. M. Perry.
Water Resources Research, Vol. 21, No. 7, p 944-950, July, 1985. 5 Tab, 17 Ref.

Descriptors: *Volumetric pricing, *Irrigation water, *Rice, *Texas, Consumptive use, Econometric models, Economic aspects, Model studies, Pricing.

Models of water consumption by rice producers are conceptualized and then estimated using cross-sectional time series data obtained from 16 Texas canal operators for the years 1977-1982. Two alternative econometric models demonstrate that both volumetric and flat rate water charges are strongly and inversely related to agricultural water consumption. Nonprice conservation incentives accompanying flat rates are hypothesized to explain the negative correlation of flat rate charges and water consumption. Application of the results suggests that water supply organizations in the sample population converting to volumetric pricing will generally reduce water consumption. (Author's abstract)
W86-01766

6D. Water Demand

NILE INSIDE THE SUDAN - INCREASING DEMANDS AND THEIR CONSEQUENCES,
King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.
A. M. A. Salih.
Water International, Vol. 10, No. 2, p 73-78, June, 1985. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Water resources development, *Water demand, *Nile River, *Sudan, Decision making, Management, Water quality control, Irrigation water, Water management, Environmental effects.

Water budgets of the Nile and its major tributaries have been reviewed and compared with changes in the rate of water abstraction for irrigation purposes in the period starting from Sudan's independence in 1956 to the medium range future. Considerable quantities of the Nile's average annual water budget were to be abstracted for irrigation schemes inside the Sudan in 1977. The effects of these vast abstractions are especially felt, during the low flow season, along many reaches of the Nile and its major tributaries. These abstractions reached 64% of the Blue Nile's average flow during the eight months of the low flow season in 1977. Due to a trend in water use, these effects are expected to worsen in the short and medium term future. Numerous harmful consequences result from these heavy water abstractions, including the neglected rights of the downstream population and the environmental hazards. Reservoir compensation ordinances have existed since 1937 and an Environmental Health Ordinance was issued in 1975. If these ordinances were strictly applied, many consequences would have been reduced or eliminated. Unfortunately these ordinances cannot be effectively implemented due to a lack of monitoring and operational capabilities. They must form an integral part of a comprehensive national water resources management plan. (Baker-IVI)
W86-01377

ETHIOPIAN INTERESTS IN THE DIVISION OF THE NILE RIVER WATERS,
Sanje Zivanovica 9, Belgrade, Yugoslavia.
D. Jovanovic.
Water International, Vol. 10, No. 2, p 82-85, June, 1985. 1 Fig, 1 Tab.

Descriptors: *Nile River, *Ethiopia, *Egypt, *Sudan, *Kenya, *Water demand, Water supply development, Irrigation water, Water resources development, Blue Nile, White Nile, Water management.

The main tributaries of the Nile River are the Blue Nile and the White Nile. The source and nearly the entire catchment area of the Blue Nile are in Ethiopia, while the White Nile basin is shared by several countries. The Nile Water is being used for irrigation, hydropower production, domestic and industrial water supply, navigation, as well as for other purposes. It is likely that Ethiopia will claim about 40 x 10 to the 9th power cu m of Nile water for irrigation. The Nile flow through Sudan and Egypt will be reduced by the same water quantity. Similarly, but on a smaller scale, water used for irrigation in Uganda, Kenya and Tanzania would reduce the White Nile flow. The gain in water after possible reclamation of the Sud and other swampy areas also needs to be taken into account. Sudan and particularly Egypt need all the water they can get and are highly dependent on the water claimed by the other countries involved. Obviously a compromise needs to be found, because if upstream countries maximally satisfy their needs, this could have severe implications for Sudan and particularly Egypt. It seems unlikely that satisfactory agreement can be achieved in the near future between all the parties involved. In order to develop criteria to be used for future water division, all countries need to prepare studies that justify their water demands. Preliminary agreement on the size, accuracy and standards for these studies are needed in order to make them comparable. (Baker-IVI)
W86-01379

TRADING 404 PERMITS FOR ENHANCED FISH HABITAT,
For primary bibliographic entry see Field 6G.
W86-01681

MEASURING VALUES FOR ENVIRONMENTAL RESOURCES UNDER UNCERTAINTY,
New South Wales Univ., Kensington (Australia). School of Economics.
For primary bibliographic entry see Field 6A.
W86-01685

WINNING THE WAR AGAINST UNACCOUNTED FOR WATER,
Pitometer Associates, Upper Montclair, NJ.
M. Siedler.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 119-135, June, 1985.

Descriptors: *Water distribution, *Monitoring, *Metering, Water use, Water demand, Water conveyance, Water audit, Leakage.

An efficiently designed, operated and maintained water distribution system will save money for the utility and its ratepayers. The do it yourself water audit method involves the performance of a self improvement water audit, which is aimed at isolating the problem by the use of per capita water consumption data. In order to work the audit through the process, the water system must have available the following information: accurate plant production figures showing the gross volume of water delivered to the system, two ways to determine total water sold to residential customers only, total residential population served by the utility, and true per captia residential consumption. Once benchmark data are established for the representative sub network, the information can be used to determine if the unaccounted for water problem for the total network is caused by leakage or by under registration of domestic meters. Ways to determine the extent of a metering problem are considered. (Baker-IVI)
W86-01751

HYPERGAME ANALYSIS OF THE LAKE BIWA CONFLICT,
Tottori Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W86-01762

MUNICIPAL WATER DEMAND STUDY, OKLAHOMA CITY AND TULSA, OKLAHOMA,
Oklahoma Water Resources Board, Oklahoma City.
R. Cochran, and A. W. Cotton.
Water Resources Research, Vol. 21, No. 7, p 941-943, July, 1985. 2 Tab, 13 Ref, 2 Append.

Descriptors: *Water demand, *Oklahoma City, *Tulsa, *Oklahoma, Income, Price, Precipitation, Air temperature, Municipal water, Household size.

Although population is an important variable in forecasting future water demands, it does not account for all of the variation in quantity demand. A multiple regression model was used to study the

factors which influence water consumption in Oklahoma City and Tulsa, Oklahoma during the 20-year period of 1961 through 1980. The explanatory variables utilized in the model include the average price of water per thousand liters; constant per capita income; average monthly precipitation measured in millimeters; average monthly temperatures in C; and number of households per thousand population. Whether considered alone or included with other variables, the income factor was always found to be a significant determinant of water demand. Although price was significant in each city when used alone, it did not have as high a correlation value as income and was not found to be significant in Tulsa when joined to other variables. The consistent decline of real average price of water in both cities over a 20-yr period should be noted. As a single explanatory variable for Tulsa, the number of households per thousand populations was found to be as significant and as highly correlated to water consumption as per capita income. In Oklahoma City the statistic relating to households was significant, though not as highly correlated as other factors. Environmental factors were not found to be correlated to water use. This may be partly due to the inability to separate the various classes of water users within the category of total water use. (Moore-IVI)
W86-01765

6E. Water Law and Institutions

NORTH DAKOTA GARRISON DIVERSION PROJECT AND INTERNATIONAL ENVIRONMENTAL LAW,
Edinburgh Univ. (Scotland).
C. M. Carvell.
North Dakota Law Review, Vol. 60, No. 4, p 603-657, 1984. 308 Ref.

Descriptors: *North Dakota, *Garrison Diversion Project, *International law, *Canada, Legal aspects, Water resources development, Diversions, Water supply development.

The Garrison Diversion Unit (GDU) will divert water from the lake formed by Garrison Dam and Lake Sakakawea to central and southeastern North Dakota. The project is primarily intended to provide supplementary water supplies to 14 communities and 4 industrial areas and to provide for fish and wildlife conservation, recreation, and flood control. Furthermore, 250,000 acres are to be irrigated by the diverted waters. The GDU project has caused opposition based primarily on environmental considerations. On the whole, during this dispute, international law has been neglected even though its environmental concepts are relevant to the development of North Dakota's water project. A short review of the Garrison Diversion history is provided and the Canadian environmental objections to it. An overview is presented of two aspects of international law. First, substantive international environmental law is inspected. Second, a survey is made of international procedural law relevant to an activity having possible harmful effects of an international drainage basin. The conformity of the United States with this substantive and procedural law is reviewed. (Baker-IVI)
W86-01682

WATERS AND WATER COURSES - TORTS - OWNERS OF PROPERTY DAMAGED BY UNLAWFUL DITCHING OR UNREASONABLE DISCHARGE OF WATERS MAY OBTAIN RELIEF BY STATUTE OR BY THE TORT CONCEPT OF REASONABLE USE,
J. G. Golembeck.
North Dakota Law Review, Vol. 60, No. 4, p 741-749, 1984. 65 Ref.

Descriptors: *Water law, *Drainage, *North Dakota, *Torts, *Reasonable use, Legal aspects, Water rights, Surface waters, Civil law.

Several landowners in LaMoure County constructed a series of drainage ditches from the numerous natural ponds, soughs, and depressions on their land between 1967 and 1974. This activity caused water to deposit in a natural depression on plaintiff Young's land, causing, he charged, damage to his crops and farmland and decreasing the value of his farming operations. Three doctrines of surface water law are applicable. The oldest is civil law rule, which states that the owner of the highland or dominant estate has a natural easement or servitude in the low lying or servient estate, allowing the owner of the dominant estate to discharge all natural waters flowing or accumulating upon his land onto the land of the servient owner. The common enemy rule of surface water suggests a landowner may deal with surface water as he sees fit regardless of the effect on adjoining land. The common enemy rule encourages the full use and exploitation of land. A major flaw is that it forces adjoining landowners to bear the burden of surface water expulsion rather than the landowners who undertake the improvement projects. The reasonable use rule sets forth well defined guidelines including determinations of whether reasonable necessity requires the drainage and balancing the burden against the benefit of the drainage. As this particular case came to trial, it was noted that the plaintiff constructed dams on his own land, thus reducing the gravity of the harm. The trial court denied Young relief because his self-help measures were not legal under section 61-01-07. Moreover, the trial court stated that these self help measures in building dams also precluded Young from recovering under the reasonable use rule. The North Dakota Supreme Court stated that the statements of the trial court were based on an erroneous conception of the reasonable use doctrine. The court also noted that reasonable use should not be confused with negligence or contributory negligence. (Baker-IVI)
W86-01683

EFFLUENT REGULATION AND LONG-RUN OPTIMALITY,
University of Southern California, Los Angeles. Dept. of Economics.
D. F. Spulber.
Journal of Environmental Economics and Management, Vol. 12, No. 2, p 103-116, June, 1985. 1 Fig, 18 Ref.

Descriptors: *Public policy, *Regulations, *Effluents, Standards, Water pollution control, Economic aspects.

A regulator faced with free entry of firms is concerned not only with the implications of public policy for the discharges from a representative firm but also with the total pollution observed at the long run market equilibrium. The long run efficiency properties of regulatory instruments are examined in a multiple input framework. The effluent tax and tradeable permit are shown to be efficient with free entry and exit of small firms. The across-the-board effluent standard results in excessive entry and excessive industry pollution. The results of the study indicate the importance of directing public policy toward pricing the use of the environment. The policy instruments which achieve long run optimality in a competitive market with small firms are the effluent tax and the tradeable effluent permit. Direct intervention through output taxes or output controls, entry tariffs, or restrictions, or effluent constraints will create further distortions in the allocation of resources. Given an effluent charge or permit price equal to marginal social damages, the total of firm payments equals the sum of environmental rent and external damages. These two components provide optimal incentives for entry in the long run. (Baker-IVI)
W86-01684

MEASURING VALUES FOR ENVIRONMENTAL RESOURCES UNDER UNCERTAINTY,
New South Wales Univ., Kensington (Australia). School of Economics.
For primary bibliographic entry see Field 6A.
W86-01685

SOUTHERN OCEAN AND MARINE POLLUTION: PROBLEMS AND PROSPECTS,
George Washington Univ., Washington, DC. Dept. of Political Science.
For primary bibliographic entry see Field 6B.
W86-01686

KEEP YOUR POLLUTION TO YOURSELF: INSTITUTIONS FOR REGULATING TRANSBOUNDARY POLLUTION AND THE UNITED STATES-MEXICO APPROACH,
N. Glickman.
Virginia Journal of International Law, Vol. 25, No. 3, p 693-727, Spring, 1985. 188 Ref.

Descriptors: *Water pollution control, *International law, *United States, *Mexico, Water quality control, Water resources, Legal aspects, International agreements.

The variety of approaches to the control of transboundary pollution that have been tried around the world suggests that there is no simple solution to the ever-increasing international pollution problem. Nevertheless, the willingness of many countries to experiment with novel regulatory schemes bodes well for the future. Although the international law in this area is currently underdeveloped, as more countries submit themselves to specific and enforceable agreements there may well develop a body of customary international environmental law binding on all countries. Until that happens, however, transboundary pollution control will come about only through international agreement. A consideration of the different European and North American approaches to pollution regulation yields several important conclusions. First, that so many countries are beginning to involve themselves in transboundary pollution control represents a positive step in the effort to preserve and protect global natural resources. Second, the wide range of agreements signed in the past twenty years suggests an increasing awareness by the international community that pollution regulation should prevent disasters and not just respond to then. Third, the most effective agreements have been those that either specifically address a narrow problem, or provide a general framework for cooperation and establish procedures whereby the parties can develop solutions to narrow problems as they arise. (Baker-IVI)
W86-01688

HAZARDOUS WASTE CLEANUP: THE PRELIMINARIES,
Environmental Protection Agency, New York. Region II.
For primary bibliographic entry see Field 5G.
W86-01738

LAW OF THE COAST IN A CLAMSHELL; PART XIV: THE MARYLAND APPROACH,
San Francisco, California.
P. H. F. Graber.
Shore and Beach, Vol. 52, No. 1, p 3-10, January, 1984. 1 Fig, 94 Ref.

Descriptors: *Coastal waters, *Water rights, *Legal aspects, *Maryland, Public rights, Public access, Uplands, Tidal waters, Navigation, Erosion, Littoral zone.

As defined in the Maryland Coastal Management Program, the state's coastal zone embraces Baltimore City and 16 counties bordering the Atlantic Ocean, Chesapeake Bay and the Potomac River upstream from Washington, D.C. Coastal zone lands may be divided into uplands, tidelands and submerged lands. With some qualifications, Maryland follows the usual rule that property boundaries of lands adjoining tidal waters shift with those gradual, imperceptible physical changes termed accretion and erosion. Unlike courts in other coastal states, the Maryland Court of Appeals has not expansively applied the public trust doctrine, the concept dealing with the public's rights of navigation and fishing in tidal waters. However, the state's high court has recognized public rights in tide covered lands. Public access rights, private littoral rights, and the leasing and regulation of coastal zone lands and waters as currently practiced in Maryland are discussed. (Baker-IVI)

W86-01829

LAW OF THE COAST IN A CLAMSHELL; PART X: THE NORTH CAROLINA APPROACH,
California Dept. of Justice, San Francisco. Office of the Attorney General.
For primary bibliographic entry see Field 2L.
W86-01833

LAW OF THE COAST IN A CLAMSHELL; PART XV: THE SOUTH CAROLINA APPROACH,
For primary bibliographic entry see Field 2L.
W86-01836

LAW OF THE COAST IN A CLAMSHELL; PART XVI: THE MAINE APPROACH,
For primary bibliographic entry see Field 2L.
W86-01838

LAW OF THE COAST IN A CLAMSHELL; PART XVII: THE CONNECTICUT APPROACH,
For primary bibliographic entry see Field 2L.
W86-01840

LAW OF THE COAST IN A CLAMSHELL; PART XVIII: THE VIRGINIA APPROACH,
For primary bibliographic entry see Field 2L.
W86-01842

6F. Nonstructural Alternatives

GOVERNMENT SUBSIDIES FOR POLLUTION CONTROL INVESTMENTS - DO OTHER COUNTRIES ENJOY AN UNFAIR ADVANTAGE,
Environmental Resources Ltd., London (England).
R. Bidwell.
Chemistry and Industry, Vol. 85, No. 12, p 395-402, June, 1985. 2 Fig, 6 Tab, 3 Ref.

Descriptors: *Water pollution control, *Political aspects, *Investment, Economic aspects, Subsidies, Industries, Costs, Taxes.

A study was conducted to survey and assess the extent to which government subsidies are made available to industry for pollution control investments in selected countries; to assess the impact that these subsidies have on the net cost to industry of pollution control investments; to assess the extent to which the subsidy schemes conform to the European Community recommendation of 1975; taking account of possible financial assistance, and to determine whether there is evidence that environmental subsidies significantly distort competition. The study identified 36 schemes which might be used to assist industry with pollution control investments. Twenty-eight of these were specifically designed to provide aid for pollution control investments. Four of the schemes focus on particular industry sectors or groups of firms; a number of the schemes focus on particular geographical areas. Eight of the schemes identify research and development as one of their objectives or as their principal objective. Eight schemes were identified that provided general investment aid. These are schemes such as the UK regional allowance or general investment tax allowances that could be used to benefit industrial pollution control investments but which are not specifically designed for that purpose. Pollution subsidies available in the four continental European countries studied, The Netherlands, Italy, Germany, and France, in most cases were designed to assist existing firms with the investment cost of their pollution control plants. The UK does not offer environmental aid of this type. It does make available tax allowances on new investment amounting to around 14%. These environmental assistance schemes are undoubtedly of considerable benefit to firms required to comply with pollution control measures. (Baker-IVI)
W86-01612

6G. Ecologic Impact Of Water Development

FACTORS INFLUENCING THE SALINITY REGIME OF LAKE PONTCHARTRAIN, LOUISANA, A SHALLOW COASTAL LAGOON: ANALYSIS OF A LONG-TERM DATA SET,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
W. B. Sikora, and B. Kjerfve.
Estuaries, Vol. 8, No. 2A, p 170-180, June, 1985. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake Pontchartrain, *Louisiana, *Salinity, *Canals, Water resources development, Environmental effects, Flow discharge, Lagoons.

Lake Pontchartrain is a brackish water lagoon in southeastern Louisiana. Numerous chemical and physical changes have resulted in this region due to the expansion of the city of New Orleans. The greatest potential for change in the lake arose from the completion of the Mississippi River-Gulf Outlet deep water canal in 1963. While a large increase in salinity of the lake waters was expected, less than half the expected increase actually occurred. The most important factor controlling salinity variations in the lake is discharge. Seventy-four percent of low frequency salinity variations are explained by freshwater discharge and the completion of the deep water canal. Annual variations of salinity are somewhat high in the lake. There has been a die back of freshwater swamps and a retreat of lagoon shorelines, but these are not felt to be a result of the deep water canal completion. (Baker-IVI)
W86-01335

NILE INSIDE THE SUDAN - INCREASING DEMANDS AND THEIR CONSEQUENCES,
King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.
For primary bibliographic entry see Field 6D.
W86-01377

CHEMICAL ZONATION IN GROUNDWATER OF THE CENTRAL PLAINS, CANTERBURY,
North Canterbury Catchment Board, Christchurch (New Zealand).
For primary bibliographic entry see Field 5B.
W86-01387

IMPACT OF RIVER CHANNELIZATION; IV. THE ECOLOGICAL EFFECTS OF CHANNELIZATION,
Welsh Water Authority, Nelson. South East District.
M. P. Brooker.
Geographical Journal, Vol. 151, No. 1, p 63-69, March, 1985. 1 Fig, 56 Ref.

Descriptors: *Channeling, *Environmental effects, *Rivers, *United Kingdom, *Channelization, Wildlife, Vegetation, Fish, Invertebrates, Birds.

River corridors (the channel and the immediate local environment) form one of the major linear habitats in the United Kingdom and sustain important wildlife resources. Channelization can result in changes which effect the in-stream and bankside ecology. In general, fish populations are severely affected by channelization, natural channels supporting higher densities, greater biomass and more species, and any recovery is usually slow. The response of macroinvertebrates to channelization is variable but recovery is often rapid. Aquatic vegetation forms an intimate part of the ecology of rivers and streams yet the effects of channalization on in-stream vegetation are poorly documented. Channelization often devastates bankside tree and ground cover. Channelization has a direct impact on riverine birds and, where such works are related to land drainage schemes, changes in water status of the catchment and subsequent land use substantially reduce areas available to breeding and wintering wetland birds. There is a need to describe, more fully, wildlife resources in river corridors, both instream and bankside, and to explore their relationships with habitat features in order to provide scientifically robust management recommendations designed to mitigate the effects of channelization. (Baker-IVI)
W86-01404

EFFECTS OF DREDGING OPERATIONS ON NUTRIENT AND SUSPENDED SEDIMENT CONCENTRATIONS,
Army Engineer District, New York.
For primary bibliographic entry see Field 5B.
W86-01563

LAKE GREVELINGEN: FROM AN ESTUARY TO A SALINE LAKE. AN INTRODUCTION,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
B. A. Bannink, and J. H. M. Van der Meulen.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 179-190, December, 1984. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Ecosystems, *Saline lakes, *Lake Grevelingen, *Netherlands, Water quality, Environmental effects, Water resources development, Eutrophication, Nutrients, Algae, Denitrification.

In 1972 an ecosystem study was started, mainly aiming at an analysis of the cycle of organic matter in the new evolving saline Lake Grevelingen, a former estuary, closed for reasons of flood prevention in 1971. The changing environmental conditions are described. Nitrogen and silica apparently limit phytoplankton primary production. A competitive interaction for nutrients between phytoplankton and microphytobenthos has been postulated. Nitrogen appeared to be the key factor in the aquatic system, assuming a denitrification rate of 3 to 4 g N/sq m/a. Long term observations indicate a slow eutrophication process during the period 1977-1980. Studies on population dynamics of dominant species and food-chain dynamics indicate a changing aquatic ecosystem with low predictability. (Baker-IVI)
W86-01567

PHYTOPLANKTON AND NUTRIENT DYNAMICS IN SALINE LAKE GREVELINGEN (SW NETHERLANDS) UNDER DIFFERENT HYDRODYNAMICAL CONDITIONS IN 1978-1980,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
C. Bakker, and I. De Vries.
Netherlands Journal of Sea Research, Vol. 18, No. 3/4, p 191-220, December, 1984. 11 Fig, 3 Tab, 32 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Hydrodynamics, *Lake Grevelingen, *Netherlands, Saline lakes, Silicon, Nitrogen, Primary productivity, Estuarine environment, Biomass, Flagellates, Seasonal variation.

Hydrographical and phytoplankton biomass parameters were studied in Lake Grevelingen, stressing the period of 1978-80. Clear salinity stratifications were observed during periods of flushing with North Sea water. This phenonenon was accompanied by strong gradients of water temperature, oxygen content, pH, silicon- and ammonium-concentration. High nutrient concentrations resulted from release from the bottom sediments. Under stratified (water depth more than 4-5 m) conditions, minimum silicon fluxes of more than 100 mg Si/sq m/day were estimated. The phytoplankton assemblage of Lake Grevelingen represents an impoverished version of the neritic community of the Southern Bight of the North Sea and of the Eastern Scheldt estuary. In summer it consists mainly of diatoms; some flagellates dominate in spring. The availability of silicon in spring was not correlated with the increase of planktonic biomass, because cryptomonad flagellates dominated during that period. The phytoplankton biomass may have been limited by silicon and nitrogen during summer. Some diatom species changed their morphological appearance, showing a more delicate

structure in Lake Grevelingen than in the tidal estuary of the Eastern Scheldt. The hydrodynamic changes in Lake Grevelingen, as a consequence of the functioning of the sluice in the closing dam with the North Sea, markedly influenced the environmental factors controlling species composition, biomass and productivity of the phytoplankton. Under semi-stagnant conditions in 1980 biomass values declined strongly but primary productivity even rose to a higher level. This indicates that the pelagic compartment of the lake was still far from stable. The highly productive phytoplankton assemblage, growing under limiting nutrient conditions in summer, was based on low biomass values and evidently underwent rapid processes of elimination of biomass. (Baker-IVI)
W86-01568

NUTRIENT CYCLING AND ECOSYSTEM BEHAVIOUR IN A SALT-WATER LAKE,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01569

PHYTOPLANKTON PRIMARY PRODUCTION IN BRACKISH LAKE GREVELINGEN (SW NETHERLANDS) DURING 1976-1981,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01570

CHANGES OF SEDIMENT DISTRIBUTION PATTERNS IN LAKE GREVELINGEN, AN ENCLOSED ESTUARY IN THE SW NETHERLANDS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01571

SEDIMENT-WATER EXCHANGE IN LAKE GREVELINGEN UNDER DIFFERENT ENVIRONMENTAL CONDITIONS,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W86-01572

TRADING 404 PERMITS FOR ENHANCED FISH HABITAT,

S. E. Clyde.
Natural Resources and Environment, Vol. 1, No. 1, p 37-41, Winter, 1985.

Descriptors: *Negotiations, *Environmental effects, *Water resources development, *Bonneville Unit, *Central Utah Project, Water supply development, Irrigation, Water supply, Fisheries, Planning, Governmental interrelations.

The controversy over the loss of fish habitat in the Bonneville Unit of the Central Utah Project has a long history. The plan report to Congress in 1964 called for the development of about 315,000 acre ft of water for municipal and industrial use and some irrigation use. Transbasin diversions proposed would deplete the flows of nine streams resulting in the loss of fish habitat. The Army Corps of Engineers reviewed the permit application, and declined to issue a permit to construct the Vat diversion dam because of opposition from the Forest Service, the Fish and Wildlife Service, EPA, and the Utah Division of Wildlife Resources because of concerns over the amount of water for fishery releases. The repayment contract only allowed for fishery releases of 6,500 acre-ft of water, while the Forest Service demanded annual releases of 39,000 acre-ft of water, and fish and wildlife groups demanded that 44,000 acre-ft of water be released. The various parties finally entered into serious negotiations. A compromise agreement was reached which would provide 44,000 acre-ft of water annually for stream fisheries during the construction of the Strawberry Aqueduct and Collection System. After Strawberry Reservoir is filled, the agreement provides for 22,300 acre-ft of water and an additional 15,800 acre-ft to be acquired or developed through conservation, modification of deliveries, and through the acquisition of existing water rights. The state and federal agencies agreed to use their resources to acquire an additional 22,100 acre-feet. As a result of the compromise the permits were issued, and the project has been allowed to go forward. (Baker-IVI)
W86-01681

WATER QUALITY EFFECTS OF CLEARCUTTING UPPER COASTAL PLAIN LOBLOLLY PINE PLANTATIONS,

Southern Forest Experiment Station, Oxford, MS. Forest Hydrology Lab.
D. C. McClurkin, P. D. Duffy, S. J. Ursic, and N. S. Nelson.
Journal of Environmental Quality, Vol. 14, No. 3, p 329-332, 1985. 3 Tab, 12 Ref.

Descriptors: *Clear-cutting, *Forest management, *Pine trees, *Water quality, *Environmental effects, *Tennessee, Nitrogen, Phosphorus, Potassium, Nutrients, Soil types.

The effect of clearcutting loblolly pine (Pinus taeda L.) on concentrations of sediment and nutrients in stormflows was studied on small cathchments near Lexington, TN. The plantation were established on eroded and abandoned agricultural lands with fragile soils. Soil series on the catchments include Lexington silt loam (fine-silty, mixed thermic Typic Paleudalfs), Providence silt loam (fine-silty, mixed, thermic Typic Fragiudalfs) and Ruston sandy loam (fine-loamy, silicious, thermic Typic Paleudults). Eight catchments (0.17-0.56 ha) were instrumented with flumes equipped with water stage recorders to measure stormwater and Coshocton wheel samplers to obtain integrated samples of the flow. Plantations on four catchments were clearcut; the other four were left as uncut controls. Stormflow samples were analyzed for sediment total Kjeldahl nitrogen (TKN) and total phosphorus (TP) and solution-phase TKN, TP, and potassium (K). Results indicated that a third or more of the TKN and two-thirds of the TP exported in stormflow from the catchments was via sediment. Solution-phase TKN and TP concentrations in storm-flow were similar on clearcut and control catchments. Solution K concentrations were consistently higher from clearcut catchments. Rainfall inputs of TKN, TP, and K exceeded stormflow losses. The study demonstrated that pine plantations established on fragile soils can be clearcut without significant impact on water quality if recommended practices are used. (Author's abstract)
W86-01705

CAN WE SAVE THE OGALLALA,

Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-01737

PERSISTENCE OF STREAM FISH ASSEMBLAGES: EFFECTS OF ENVIRONMENTAL CHANGE,

University of Southern Mississippi, Hattiesburg. Dept. of Biology.
S. T. Ross, W. J. Matthews, and A. A. Echelle.
American Naturalist, Vol. 126, No. 1, p 24-40, July, 1985. 3 Fig, 5 Tab, 60 Ref.

Descriptors: *Fish behavior, *Fish populations, *Environmental quality, *Brier Creek, *Oklahoma, Drought, Temperature effects, Water stress, Brier Creek, Oklahoma, Piney Creek, Arkansas.

Fish assemblage stability and persistence are contrasted in an intermittent, prairie-margin stream (Brier Creek, Oklahoma) and a permanent upland stream (Piney Creek, Arkansas). The duration of the study encompassed three to four turnovers in the populations of most of the species studied and a major environmental perturbation in Brier Creek. Knowledge of temporal stability and persistence of ecological communities is critical to an understanding of the importance of biotic interactions in the maintenance of community structure. Persistence, as indicated by present data, was high for both stream assemblages over approximately one decade. Assemblage stability, as determined from measures of abundance, indicated greater change in the overall fish fauna of Brier Creek than that of Piney Creek. Southeastern Oklahoma had a severe summer drought in 1980 resulting in heat death of fishes in Brier Creek. Although some species were transiently affected, the harsh summer did not have a lasting effect on the Brier Creek fish assemblage overall. Upstream stations subjected to regular summer drying showed greater variability in numerical species ranks within a characteristic suit of upstream species, compared with downstream stations. Station-level changes in both Piney and Brier creeks were significant in several cases, even though the overall fauna of the former did not change significantly in species-abundance ranks. Geographic scale may have had a major effect on the assessment of assemblage stability and persistence. In the absence of detailed knowledge of home ranges of component species, an assessment of assemblage stability should be based on at least several localities within a watershed. (Baker-IVI)
W86-01756

ABUNDANCE OF WEST INDIAN MANATEES (TRICHECHUS MANATUS) AROUND SELECTED FLORIDA POWER PLANTS FOLLOWING WINTER COLD FRONTS, 1982-1983,

Eckerd Coll., St. Petersburg, FL. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-01758

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,

Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
D. W. Davis.
Shore and Beach, Vol. 51, No. 4, p 30-39, October, 1983. 5 Fig, 71 Ref.

Descriptors: *Wetlands, *Erosion, *Louisiana, Economic aspects, Social aspects, Fishing, Hunting, Recreation, Land use, Farming, Oil industry, Environmental effects, Flood control structures, Drainage.

Louisiana's coastal zone is presently out of balance - a great natural catastrophe is occurring. Land is disappearing. For the entire Louisiana coast, marsh losses in 1980 exceeded 25,000 acres per year. Land building in the deltaic plain has been replaced by a projected rate of loss of approximately 40 sq mi/yr. The land that is eroding at a record rate is a result of sediment deposition associated with the Mississippi River. The construction of flood levees and the dredging of drainage, navigation, petroleum and logging canals upset the sedimentation balance, influence saltwater intrusion and disrupt the natural flow regimes. Landloss forces now supersede constructive forces, thus threatening the jobs, industries and lifestyles of people whose lives are tied directly or indirectly to the coast. Trapping (a multimillion dollar industry), fishing, shrimp harvesting, the oyster industry, menhaden landings, and even recreational use of the waters are threatened. Movement from agricultural ventures to oil industry along the coastal line has brought with it changes in the erosional aspect of the coastal lands. (Baker-IVI)
W86-01835

BIOLOGICAL IMPACTS ON BEACH REPLENISHMENT AND BORROWING,

Coastal Engineering Research Center, Fort Belvoir, VA.
E. J. Pullen, and S. M. Naqvi.
Shore and Beach, Vol. 51, No. 2, p 27-31, April, 1983. 1 Fig, 32 Ref.

Descriptors: *Shoreline, *Beach replenishment, *Environmental effects, Great Lakes, Sand, Benthic animals, Corals, Turtles, Habitats, Fish, Lake shores, Habitats, Dredging.

Shore erosion is a major problem along many ocean beaches and the shoreline of the Great

Lakes. The Corps of Engineers replenishes and nourishes eroding beaches by pumping sand onto the beach. Beach replenishment creates a new habitat that is uninhabited by benthic animals, except for those that may have survived being pumped to the beach with the replenishment sediments or those that survived by vertical migration through deposited sediments. Timing of the replenishment operation may also be a critical factor in reestablishment of benthic animals. Adjustment of benthic animals to replenishment is generally expected since the animals are accustomed to natural disturbances and have demonstrated the ability to recover rapidly. Corals pose a special problem along replenished beaches in Florida. The mobility of fish and some invertebrates render them less vulnerable to the adverse effects of beach replenishment than the nonmotile benthic communities. Destruction of habitat rather than suspended sediment seems to be greater potential problem to fish. Moderate to complete recovery of motile animals will usually occur within less than a year unless a required habitat or food source is permanently lost. Sea turtles are one of the most vulnerable motile vertebrate animals to the effects of beach replenishment. The major physical impact of dredging borrow material is the mechanical disturbance of the substrate and the subsequent redistribution of suspended sediments and turbidity. Potentially, the most serious impacts of offshore dredging are the loss or damage to major commercial species of benthic shellfish, seagrass beds, and corals. Repopulation of a dredged area by benthic animals will depend on the magnitude of the disturbance, the new sediment interface, and the water quality in the borrow pit. (Baker-IVI)
W86-01844

7. RESOURCES DATA

7A. Network Design

LAKE ERIE NUTRIENT LOADS, 1970-1980,
Corps of Engineers, Buffalo, NY. Lake Erie Wastewater Management Study.
For primary bibliographic entry see Field 5G.
W86-01344

CORBICULA FLUMINEA (MOLLUSCA: PELECYPODA) AS A BIOLOGICAL INDICATOR OF HEAVY METALS IN THE KANAWHA RIVER, WV,
Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
J. E. Joy, A. J. Pritchard, and D. Danford.
Proceedings of the West Virginia Academy of Science, Vol. 55, No. 2/3/4, p 113-117, 1983. 8 Ref. Virginia Environmental Endowment grant 81-101.

Descriptors: *Clams, *Bioindicators, *Heavy metals, *Kanawha River, *West Virginia, Cadmium, Iron, Metals, Indicators, Zinc, Copper, Manganese.

Two hundred large (16 to 24 mm) Corbicula fluminea individuals were monitored for 10 heavy metals at four different sites (50 clams at each site) on the Kanawha River over a nine week period. Analysis of the viscera revealed silver in the smallest concentrations (between 0.1 and 0.2 micro-g/g) of the metals at all four sites. Cadmium was also found in low concentrations (between 0.2 and 0.4 micro-g/g). Iron was found in the highest concentrations, in some cases surpassing 500 micro-g/g. Magnesium levels were also high, generally ranging between 100 and 200 micro-g/g at all sites. Concentrations of zinc were interesting because of their virtually unchanging levels (approximately 30 micro-g/g) at all four sites over the nine weeks. Copper concentrations were also very constant (between 7.0 and 9.0 micro-g/g) at all sites with the exception of weeks 7 and 9 at Marmet when copper levels reached 17.0 and 12.0 micro-g/g, respectively. While generally low, chromium levels were quite variable, ranging from 0.5 micro-g/g at London, to a high of 12.0 micro-g/g at Glen Ferris. Manganese levels were also quite variable, ranging from a low of 9.2 micro-g/g at Winfield to a high of 100 micro-g/g at London. (Author's abstract)
W86-01596

HETEROTROPHIC BACTERIA IN WATER DISTRIBUTION SYSTEMS. II. SAMPLING DESIGN FOR MONITORING,
Centre des Sciences de l'Environment, Metz (France).
For primary bibliographic entry see Field 5F.
W86-01915

7B. Data Acquisition

EVALUATION ON POLLUTION IN THE XIANG JIANG RIVER BY USING ZOOBENTHOS,
Academia Sinica, Lochiaschan (China). Inst. of Hydrobiology.
L. Baoyuan, W. Shida, and H. Deliang.
Acta Hydrobiologica Sinica, Vol. 8, No. 2, p 225-236, May, 1984. 3 Fig, 7 Tab, 11 Ref.

Descriptors: *Water pollution, *Bioindicators, *Zoobenthos, *Xiang Jiang River, China (Peoples Republic), Species diversity, Mayflies, Indicators, Water pollution effects.

Studies on zoobenthos in the Xiang Jiang River were carried out five times between July, 1980 and December, 1981. Artificial substrate was used for sampling in all stations in the river, especially the heavily polluted area between Zhuzhou and Xiangtan. Based on the data obtained from the survey, the Shannon diversity index was calculated and used for the biological evaluation of water quality of the river. The relationship between the number of zoobenthos and the chemical content was also calculated in some stations. Results show that the mayfly naiads are more sensitive to heavy metals and pesticides and may be used as monitors for water pollution in the river. The percentage of ephemeropterans and trichopterans as compared with that of the other aquatic insects used for water monitoring was also determined. In nearly all stations the diversity indices were more than 2.11, except the Xiawan station, where the index was only 0-0.73. (Author's abstract)
W86-01323

HABITAT REQUIREMENTS AND BIOINDICATOR VALUE OF THE MAIN COMMUNITIES OF AQUATIC VEGETATION IN NORTH-EAST POLAND,
Warsaw Univ. (Poland). Dept .of Phytogeography.
For primary bibliographic entry see Field 2H.
W86-01326

EFFECTS OF EFFLUENT OF MUNICIPAL WASTEWATER ON THE GROWTH OF PORPHYRA YEZOENSIS IN THE CASE OF STATIC CULTURE (IN JAPANESE),
Tokyo Univ. of Fisheries (Japan).
For primary bibliographic entry see Field 5C.
W86-01363

SLEEVE AND CASING LYSIMETERS FOR SOIL PORE WATER SAMPLING,
Wisconsin Univ.-Madison. Dept. of Soil Science.
R. Morrison, and J. Szecsody.
Soil Science, Vol. 139, No. 5, p 446-451, May, 1985. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Lysimeters, *Pore water, *Water sampling, *Sleeve lysimeters, *Casing lysimeters, Particle size, Monitoring wells, Wells.

Two pore water samplers were designed for the purpose of incorporating a lysimeter into the casing of a monitoring well and to provide multiple sampling capabilities in a single retrievable section. A sleeve lysimeter was fabricated for use with a monitoring well and provided multiple sampling points to depths of about 15 m. The casing lysimeter provides multiple sampling points to depths in excess of 15 m by incorporating several lysimeters with threaded PVC well casing. The minimum vertical distance between the porous sections of two lysimeters was calculated using a linearized solution of the matric potential and steam functions for various soils at finite and infinite depths. A vertical spacing not less than 20 times the lysimeter radius (20 r sub 0) is appropriate for most soils. The radius of sampling influence is maximized if the borehole diameter is only slightly larger than the lysimeter, and a fine-grained silica flour (grain size 0.032 mm) is used for an optimum backfill around the porous section of the lysimeter. (Author's abstract)
W86-01422

DESIGN OF A SENSITIVE AND PRACTICAL CLOSED-TOP INFILTROMETER,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
For primary bibliographic entry see Field 2G.
W86-01423

IRRIGATION SCHEDULING USING CROP INDICATORS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. J. Reginato, and J. Howe.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 2, p 125-133, June, 1985. 5 Fig, 24 Ref.

Descriptors: *Irrigation scheduling, *Water stress, *Plant physiology, Soil water, Cotton, Canopy temperature, Petioles, Crop yield.

Plant stress utilizing crop temperature under field conditions may be quantified utilizing a crop water stress index (CWSI). Petiole water content and canopy temperature of cotton were used as indicators of stress in cotton. Air temperature was defined as the value obtained with an aspirated sling psychrometer at the time canopy temperaure was measured each afternoon. Canopy temperatures were taken daily about an hour past solar noon, four looking east and four looking west, down the rows. Solar radiation was measured with a silicon sensor each minute and integrated into an hourly basis, ultimately yielding daily totals. Petiole water content was measured daily by weighing petioles and determining the weight difference after being oven dried for 24-hrs. Crop yield was obtained from each plot using a standard cotton picker. A CWSI using remotely sensed canopy temperature was a better indicator of plant stress than was petiole water content. This point was most evident when using these parameters as a potential tool for scheduling irrigations and for estimating lint cotton yield prior to harvest. Petiole water content does not possess the sensitivity of a CWSI for assessing crop stress. PWC involves a labor intensive destructive plant sampling procedure which yields data for a single plant part, whereas a CWSI is derived from a measurement that surveys many plants. For a rapid assessment of crop stress to schedule irrigation and estimate yield, it seems appropriate to use the CWSI. (Collier-IVI)
W86-01433

THERMAL INFRARED DETECTION OF SUBMARINE SPRINGS ASSOCIATED WITH THE PLYMOUTH LIMESTONE,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2F.
W86-01443

UPTAKE AND RELEASE OF SOME TRACE METALS BY AQUATIC BRYOPHYTES IN ACIDIFIED WATERS IN SCOTLAND,
Freshwater Fisheries Lab., Pitlochry (Scotland).
L. A. Caines, A. W. Watt, and D. E. Wells.
Environmental Pollution (Series B), Vol. 10, No. 1, p 1-18, 1985. 10 Fig, 3 Tab, 24 Ref.

Descriptors: *Bryophytes, *Bioconcentration, *Bioindicators, *Trace metals, *Aluminum, *Acidity, *Scotland, *Loch Ard Forest, *Galloway, Indicators, Metals, Moss, Liverwort, Indicators, Water pollution effects, Manganese, Zinc, Hydrogen ion concentration, Acid rain.

Bryophytes can be considered as thin sheets of largely undifferentiated cells in more or less intimate contact with their physical and chemical surroundings and therefor can reflect the chemical status of their environment. Aquatic bryophytes have been analyzed for aluminum, manganese and zinc to assess the feasibility of using these plants as bioindicators of metal loadings to acid streams and lochs in Loch Ard Forest (30 km N of Glasgow) and the Galloway area of southwest Scotland. Special care was taken in sample preparation to remove all extraneous mineral particles from the liverwort and moss samples. Bioconcentration occurred in all waters but increased hydrogen ion concentrations in the water were associated with decreased metal concentrations in the bryophytes. The interdependence between Al and H(+) concentration was demonstrated in the Loch Ard Forest stream water samples; the maximum concentration of Al in a stream with pH 6.62 was 25 micro-g/l compared with 400 micro-g/l in a stream with an annual mean pH of 4.43. The seasonal variation in Al concentration which occured in the most acid stream had a maximum concentration of 394 micro-g/l in February, which declined rapidly to 35 micro-g/l in May (1980); this sharp decrease coincided with a prolonged dry spell with low rainfall which resulted in a rise in stream pH and a greatly reduced leaching of Al from the catchment. Release of aluminum, manganese and zinc from the bryophytes by hydrogen ions may make a significant contribution to the loadings of these metals in acid waters. While the pH remains above 5.5, trace metals such as Al and Mn are taken up and retained by the bryophyte. At lower pH values this reservoir of metal ions may be released into the stream water. It is possible that a sharp drop in pH could release sufficient trace metals to exceed lethal threshholds for fish and other organisms. (Collier-IVI)
W86-01452

LONG-TERM STREAMFLOW OBSERVATIONS IN RELATION TO BASIN DEVELOPMENT,

National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 4C.
W86-01472

STUDY OF THE HYDROGEOPHYSICAL PROPERTIES OF FISSURED AQUIFERS USING A DOUBLE POROSITY MODEL,

Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
For primary bibliographic entry see Field 2F.
W86-01478

USE OF AERIAL PHOTOGRAPHY AND IMAGE PROCESSING TO MEASURE DYE DISPERSION FROM A LONG SEA OUTFALL,

Royal Military Coll. of Science, Shrivenham (England). Dept. of Civil Engineering.
W. B. Wilkinson, and P. J. Curran.
Proceedings of the Institution of Civil Engineers, Vol. 79, p 327-348, June, 1985. 7 Fig, 9 Tab, 35 Ref.

Descriptors: *Aerial photography, *Image processing, *Dye dispersion, *Outfalls, Remote sensing, Effluents, Dye releases, Tracers, Wastewater disposal.

Aerial photography and image processing to measure dye dispersion was carried out as part of an extensive study to assess the performance of a 3500 m long sea outfall discharging off the south coast of England. A slug of Rhodamine WT dye was mixed with the sewage at the pumping station on the shore. The tracer emerging from the outfall's diffuser section and its subsequent dispersion in the sea was measured by boat survey and by aerial photography. The black and white aerial photographs were digitized and manipulated using a digital image processor so that the red reflectance of the dye could be correlated with the concentration of dye measured in the sea. A high level of correlation between red reflectance and the dye concentration was achieved. This correlation was then used as the basis for predictive mapping of dye concentration from other black and white aerial photographs, and detailed contours of dye concentration for a number of time frames were prepared. A high level of accuracy was obtained when the dye concentrations determined from the processed black and white aerial photographs were compared with direct measurements. (Author's abstract)
W86-01518

REPLACEMENT OF THE TELEMETRY SYSTEM OF THE SUNDERLAND AND SOUTH SHIELDS WATER COMPANY,

R. T. Heslop.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 231-237, June, 1985. 2 Fig.

Descriptors: *Telemetry, *Water conveyance, Water management, Water distribution, Planning, Automation, Monitoring, Water quality, Water treatment.

A telemetry system is described as it was applied to the Sunderland and South Shields Water Company which currently supplies 140 ml/d of water to a population of 554,000 in the 342 sq km area covering the coastal strip south of the river Tyne to just north of Hartlepool, England. Originally the 23 principal outstations were linked by rented land line omnibus circuits to the Company. The 25 minor outstations were linked to the nearest principal outstation by direct land line conveying data from the satellite in analogue form. Early proposals for the replacement of the master station involved the use of purpose-built computers designed by the telemetry manufacturer. The original intention was to retain the original outstations, but the cost of providing a special director unit required to enable original outstations to communicate via the omnibus circuits with the new master station was very high. Thus it was decided to replace the original hard wired outstations with CMOS equipment. The use of the telemetry system has long since progressed from the simple activity of monitoring. Presently the Company uses its central control functions and infomation in matters of waste prevention and efficient source utilization. Projected applications of the system are in the following areas: dynamic network analysis of the distribution network; waste location, assessment, and prevention; trunk main management; monitoring of flow meters, efficiency service intervals and optimized locations; pressure zoning and control; water quality distribution and zoning, including effects of system alterations on the processes of sensitive industrial consumers; complaints monitoring and management; control of use of fire hydrants; system chlorination control; discolored water preventive measures; control of animal infestation in mains; correlation of rainfall and hydrological data; pollution of souces; monitoring of groundwater well levels and correlation with source output; and groundwater source interaction and correlation. (Baker-IVI)
W86-01521

ASSESSING HABITATS USED BY WARMWATER STREAM FISHES,

Illinois Natural History Survey, Champaign.
For primary bibliographic entry see Field 2H.
W86-01599

METHOD FOR LOCATING SEDIMENT ANOMALIES IN LAKEBEDS THAT CAN BE CAUSED BY GROUNDWATER FLOW,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 2H.
W86-01667

STRIPPING ANALYSIS AND CHROMATOGRAPHIC SNIFFING FOR THE SOURCE IDENTIFICATION OF ODOROUS COMPOUNDS IN DRINKING WATER,

Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
R. Savenhed, H. Boren, and A. Grimvall.
Journal of Chromatography, Vol. 328, p 219-231, June, 1985. 4 Fig, 5 Tab, 27 Ref.

Descriptors: *Pollutant identification, *Organoleptic properties, *Stripping analysis, *Chromatographic sniffing, Odors, Water pollution sources, Water analysis.

Chemical and sensory methods have been combined into an improved technique for the source identification of odorous compounds in drinking water. A simple device for gas chromatographic sniffing, in which the capillary column is lead to the odor observer via heated copper tubing, has been developed. This system is highly sensitive and highly accurate for the determination of retention times. A stripping technique that permits high stripping temperatures without technical problems has also been developed, and it has been shown to increase significantly the number of odorous compounds detected by column sniffing. The design of the stripping system gives a very low blank level that results in almost no compounds detected on column sniffing of extracts from odor-free water. Odor profiles from a river basin with discharges from agriculture, industry and municipalities are presented. Special attention has been given to the effects of pulp mill discharge, and it is shown that they are mainly of local importance with regard to odorous compounds. (Author's abstract)
W86-01696

OPERATIONAL RANGES FOR SUCTION LYSIMETERS,

Kaman Tempo, Santa Barbara, CA.
For primary bibliographic entry see Field 2G.
W86-01697

FACTORS REQUIRING RESOLUTION IN INSTALLING VADOSE ZONE MONITORING SYSTEMS,

Woodward-Clyde Consultants, Santa Ana, CA.
G. A. Robbins, and M. M. Gemmell.
Ground Water Monitoring Review, Vol. 5, No. 3, p 75-80, 1985. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Vadose water, *Monitoring, *Pollution detection, *Aeration zone, Path of pollutants, Fate of pollutants, Waste disposal, Wells, Lysimeters, Vapor probes, Tensiometers, Conductivity.

Increasingly, regulations by federal, state and local agencies are being developed that require the installation of vadose zone monitoring systems for hazardous chemical facilities in addition to, or in lieu of, conventional groundwater monitoring wells. Compared to a ground water monitoring approach, vadose zone monitoring systems may permit earlier detection of chemical leakage and less costly cleanup of contamination. The effective use of vadose zone monitoring systems in detecting contamination dependes on many factors. Without proper consideration of these factors, a vadose zone monitoring system may not give as high a level of reliability as a groundwater monitoring system. Major factors to consider in installing a vadose zone monitoring system are: type of instrument to use, number of instruments, depths and location of instruments, and frequency of monitoring. Means to evaluate these factors in a comprehensive fashion have been lacking. Based on recent experience in installing and operating vadose zone monitoring systems, criteria and methods useful in resolving the preceeding factors have been developed. Types of instruments can be classified as either direct (lysimeter, vapor probe) or indirect (tensiometer, conductivity probe). A combination of the two is needed for reliability. The depth, location and number of instruments depend on the geometry of the facility, the number and size of likely contaminant leakage points in engineered barriers, properties of the material being monitored, the effective radius of monitoring for each instrument, vadose zone properties, and types of remedial actions that are available. The frequency of monitoring largely depends on the rate of movement of the contaminant. Evaluating the preceding

factors requires some level of modeling and preliminary field testing. (Author's abstract)
W86-01701

DETERMINATION OF INDIUM IN MINERALS, RIVER SEDIMENTS AND COAL FLY ASH BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITH PALLADIUM AS A MATRIX MODIFIER,
Academia Sinica, Beijing (China). Inst. of Environmental Chemistry.
X.-Q. Shan, Z.-M. Ni, and Z.-N. Yuan.
Analytica Chimica Acta, Vol. 171, p 269-277, 1985. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Indium, *Chemical analysis, *Electrothermal Atomic Absorption Spectrometry, *Atomic absorption, *Trace metals, *Sediments, *Fly ash, Palladium, Metals, Spectrometry.

Due to the low levels of indium found in minerals and rocks, analyses have depended on neutron activation and spark-source mass spectrometry. A method is described for the determination of indium (10-40 micro-g/g) in lead-zinc ores and magnetic pyrites. Graphite furnace atomic absorption spectrometry is used with palladium as a matrix modifier. Indium (down to 0.085 micro-g/g) in river sediments and coal fly ash can be determined after pre-extraction with ammonium iodide into 4-methyl-2-pentanone. The low sensitivity for indium was assumed to be due to the vaporization of molecular species of indium during the preatomization stages, and efforts were made to find suitable matrix modifiers which might prevent such a vaporization loss. Of several metal salts tested for this purpose, palladium was shown to be the best modifier, although all metals tested at least doubled the sensitivity. The indium absorbance in the absence of matrix modifier obtained after ashing at 600 C was used as a baseline against which the enhancement properties were measured. In the presence of palladium, the maximum tolerable ashing temperatures for indium in aqueous solution or organic extract can be raised to 1200 C or 1000 C, respectively. The sensitivity is improved by a factor of three compared to that obtained for pure aqueous indium solutions. It is assumed that the addition of palladium stabilizes indium by forming more thermostable compounds or alloys and decreases the formation of volatile species such as InO, thus enhancing the atomic absorbance. (Collier-IVI)
W86-01718

DISCRIMINATION OF SOIL PHYSICAL PARAMETERS, THERMAL INERTIA, AND SOIL MOISTURE FROM DIURNAL SURFACE TEMPERATURE FLUCTUATIONS,
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2G.
W86-01772

APPROXIMATE ANALYSIS OF THE BOREHOLE PERMEAMETER IN UNSATURATED SOIL,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W86-01774

INSTRUMENT FOR MEASURING THE AVERAGE STOMATAL CONDUCTANCE OF CONIFER SEEDLINGS,
British Columbia Univ., Vancouver. Dept. of Soil Science.
For primary bibliographic entry see Field 2I.
W86-01782

SET OF REMOTE-SENSING APPARATUS FOR QUICK METHODS OF HYDROLOGIC OBSERVATIONS ON INLAND WATER BODIES,
Limnologeskii Inst., Moscow (USSR).
G. V. Druzhinin, V. M. Ivanov, O. E. Korotkevich, A. M. Kryuchkov, and V. B. Rumyantsev.
Water Resources, Vol. 11, No. 3, p 273-280, May-June, 1984. 5 Fig, 15 Ref. Translated from Vodnye Resursy, No. 3, p 147-154, May-June, 1984.

Descriptors: *Water quality, *Monitoring, *Remote sensing, Water quality control, Evaluation, Measuring instruments, Computers.

One of the most important problems of monitoring inland water bodies is to obtain a prompt determination of the water quality. Quick methods of observation are needed by means of which the actual state of water masses, elements of their dynamics, presence of wastewaters in water bodies, routes of their spreading, and other parameters can be determined. A set of remote-sensing apparatus meeting these indicated requirements has been developed and is undergoing testing. A description is given of the various parts of the system including the resistance thermometer, conductometer, oximeter, water transparency meter, and the meter used to determine the depth of submergence of the group of sensors. Further improvements are expected to be accomplished by increasing the number of measured physical and chemical characteristics through the addition to the set of new sensors for a more reliable identification of water masses in the basin and through the conversion of the recording of the measured parameters to a form convenient for input into a computer and also the possibility of transmitting the information over a radio channel. The solution of these problems will considerably increase the promptness of monitoring water bodies. (Baker-IVI)
W86-01828

RADIO-TELEMETRY AS AN AID TO ENVIRONMENTAL CONTAMINANT EVALUATION OF MOBILE WILDLIFE SPECIES,
Battelle Pacific Northwest Labs., Richland, WA.
L. E. Eberhardt, and L. L. Cadwell.
Environmental Monitoring and Assessment, Vol. 5, No. 3, p 283-289, September, 1985. 2 Fig, 17 Ref. DOE contract DE-AC06-76RLO 1830.

Descriptors: *Telemetry, *Wildlife, *Radioactive wastes, Remote sensing, Monitoring, Radioactive waste disposal, Waste ponds, Ducks, Deer, Hanford, Washington.

Programs monitoring wildlife species for environmental contaminants from localized sources can maximize the amount of information obtained from an individual animal by using radio-telemetry to ascertain residence history. The use of radio-telemetry techniques on two mobile wildlife species, mule deer (Odocoileus hemionus) and mallard ducks (Anas platyrhynchos), to document their use of and movement from low-level radionuclide contaminated waste ponds are described. The study was conducted on or near two man-made waste management ponds located approximately in the center of the Hanford Site in southcentral Washington. Both ponds, which now support dense stands of aquatic and riparian species, receive effluent water from chemical and waste processing plants associated with the nuclear facilities. Radio-telemetry techniques provided the opportunity to ascertain the residence history of highly mobile wild animals and to select those few individuals for sampling that have a known residence history within the area of interest. Radio-telemetry techniques can provide data on the extent, direction or location, and seasonality of movement by mobile wildlife species that may aid in interpreting potential impact to consumers (man) from ingestion pathways. (Moore-IVI)
W86-01886

COMPARISON OF THREE FIELD METHODS FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 2G.
W86-01909

7C. Evaluation, Processing and Publication

COMPUTER AIDED MAPPING PROJECT AIDS SEVERN TRENT,
For primary bibliographic entry see Field 6A.
W86-01631

CALCULATING WITH MICROCOMPUTERS,
For primary bibliographic entry see Field 6A.
W86-01632

GROUND-WATER RESOURCES OF TOWNER COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01917

8. ENGINEERING WORKS

8A. Structures

NOTE ON THE SHAPES OF FLEXIBLE DAMS,
University of Manchester Inst. of Science and Technology (England).
R. Watson.
Journal of Hydraulic Research, Vol. 23, No. 2, p 179-194, 1985. 19 Fig, 1 Tab, 11 Ref.

Descriptors: *Dam design, *Flexible dams, Dam construction, Inflatable dams, Temporary structures.

Flexible dams are in use as both temporary and permanent structures in a number of countries. The types considered here are usually constructed of a textile fabric heavily impregnated and covered wth a synthetic rubber. The inflatable variety is more common and consists of a sheet of fabric anchored to the channel bed at two edges and inflated with either air or water. Tension in water inflated dams is usually rather higher but, in many cases, they are easier to operate. Some properties of completed dams are examined. These include the product of tension per unit width and fabric length - the latter being roughly proportional to the cost of the material. Also shown are the fabric lengths, the volume enclosed, the base length and the total perimeter. The change of shape of a dam during inflation with water or with air is discussed. The information provided should help to clarify the mechanics of inflatable dams and allow suitable dam shapes to be designed to fit any required static conditions and their behavior during inflation predicted. (Baker-IVI)
W86-01394

ROCKBURST DRAMA IN NORTHERN INDIA,
Bhakra Dam (India).
R. K. Malhotra.
Tunnels and Tunnelling, Vol. 17, No. 4, p 32-34, April, 1985. 4 Fig, 1 Tab.

Descriptors: *Tunnels, *Rockbursts, *Construction, *India, *Beas-Satluj Link Project, Rocks, Mass wasting, Rock mechanics, Geological fractures.

Problems encountered during the excavation of two pressure tunnels, involving 25.55 km of tunnelling, in the gigantic inter-river basin transfer Beas-Satluj Link Project in India are reviewed. The Project involved tunnelling through weak strata of the geologically young Himalayan ranges. Problems were manifold due to encountering incompetent strata with faults, shear zones, water-bearing crushed rock and pressure-exerting strata and secondly, as it was the first time that tunnels of such length and diameter were designed and excavated totally by Indian skill, there were problems caused by inexperience. In actual excavation, phyllites, quartzites and granites in relatively dry conditions, proved to be good tunneling media. In the granite reach, massive to moderately jointed granites con-

stituted 55% while the percentage of highly jointed to blocky granites came to about 30% with the saturated shear zones and highly kaolinized pockets making up the remaining 15%. While tunneling through weak geological formations, there were numerous incidents associated with rock bursts, convergence and shearing of steel supports leading to a virtual collapse of the heading. (Baker-IVI)
W86-01462

DEWATERING FOR THE WELL-BEING OF TUNNELLING,

M. Jones.
Tunnels and Tunnelling, Vol. 17, No. 5, p 46-48, May, 1985. 5 Fig.

Descriptors: *Tunnel construction, *Tunnels, *Groundwater management, *Wellpoints, Construction, Dewatering.

Groundwater control by wellpointing is a standard weapon in the armory of tunnelling engineers. Wellpointing is frequently employed in combination with other methods, whether simultaneously or at different stages of the same project. Where the amount of water is substantial, pumping from wells surrounding the excavation site is desirable as there is rarely enough room in the tunnel to install dewatering equipment of sufficient capacity. When used in conjunction with other methods of ground improvement, this can reduce materials consumption. Many factors considerably restrict the application of dewatering by wellpoints. Pump capacity, geological structure of the ground itself, permeability, and type of strata each affect the outcome. Wellpointing is mainly used with shallow excavations whether cut and cover or true tunnelling. When water bearing strata is expected during pipe jacking it is usual to work under compressed air. Dewatering by wells can frequently speed the completion of a tunnelling project. Specific examples of the use of these dewatering techniques are briefly considered. (Baker-IVI)
W86-01463

DYNAMIC ANALYSIS OF SHORT-LENGTH GRAVITY DAMS,

Johns Hopkins Univ., Baltimore, MD. Dept. of Civil Engineering.
A. A. Rashed, and W. D. Iwan.
Journal of Engineering Mechanics, Vol. 111, No. 8, p 1067-1083, August, 1985. 7 Fig, 1 Tab, 19 Ref.

Descriptors: *Gravity dams, *Dam stability, *Dynamics, Dams, Mathematical equations, Reservoir water, Vibration, Compressibility, Ground motion.

A preliminary investigation of the dynamic behavior of short-length gravity dam reservoir systems is presented. A simplified and economical procedure for the dynamic analysis of such structures is developed, based on the Rayleigh-Ritz method and the substructure concept. The dam is modeled as a thick plate of uniform thickness, whose out of plane deformation is governed by a pure shear theory. The water in the reservoir is treated as a continuum, and its compressibility and the flexibiltiy of the reservoir floor and sides are taken into consideration. Neglecting water compressibility, free vibration analyses are performed on dams having different length-to-height ratios, with empty and totally full reservoir conditions. As expected, the natural frequencies are reduced in value due to the presence of water, and antisymmetric modes of vibration are developed. Compared to the two-dimensional case of infinitely long dams, the natural frequency of a dam increases in value as its length to height ratio decreases. A forced vibration analysis is carried out in the frequency domain, including water compressibility and flexibility of reservoir boundaries. Crest displacement and acceleration responses of dams with various length to height ratios to all three components of harmonic ground motion are obtained. The change in the length to height ratio significantly affects these frequency domain responses: a decrease in the value of B/D shifts the resonant frequencies to the right, and alters the resonant amplitudes. Also, the transverse component of ground motion contributes a small amount to the dam response, as compared to the longitudinal component contribution, while the vertical component contributes a significant amount. (Baker-IVI)
W86-01529

COMPACTION CHARACTERISTICS OF RIVER TERRACE GRAVEL,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W86-01532

WAYS TO IMPROVE THE TECHNOLOGY OF CONSTRUCTING CONCRETE HYDRAULIC STRUCTURES,

For primary bibliographic entry see Field 8F.
W86-01622

STABILITY OF THE ZHITOMIR CELLULAR BUTTRESS DAM,

V. I. Zeryukov, and S. I. Karlin.
Hydrotechnical Construction, Vol. 18, No. 11, p 533-537, November, 1984. 4 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 15-18, November, 1984.

Descriptors: *Abutments, *Butress dams, *Dam stability, Overflow dams, Cellular construction, Reinforced concrete, Dam construction, Monitoring.

The Zhitomir overflow dam, constructed in 1962-1965 on the Teterev River on the western outskirts of Zhitomir city, has been in operation for more than 15 years. The hydraulic structures include a precast reinforced-concrete overflow cellular buttress dam with a standard-shaped head, abutments, and a 1-m-diameter dewatering pipe outlet enclosed in the left-bank abutment. Ten cracks were found in the abutments, of which 8 were in the right-bank abutment and 2 in the left-bank abutment. Visual inspections of the Zhitomir overflow dam in 1980 showed that during its operation the negligible cracks that appeared have not affected the strength of the structure. As a rule, all cracks were due to temperature effects. In order to improve monitoring of the condition of hydraulic structures, it is recommended that they be equipped with measuring instruments such as height markers and piezometers. (Keenan-IVI)
W86-01626

DESIGN CRITERIA FOR RESERVOIR BOTTOM OUTLETS,

Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserbau.
H. Blind.
International Water Power and Dam Construction, Vol. 37, No. 7, p 30-32, July, 1985. 6 Fig.

Descriptors: *Design criteria, *Reservoirs, *Outlets, Drawdown, Dam construction, Reservoir operation, Dam design, Flood control.

Based on experience, the provision of a bottom outlet in a dam is generally necessary. The bottom outlet, in addition to serving the purpose of normal reservoir emptying, should be designed to provide adequate discharge capacity for operational conditions such as emptying the reservoir for emergency repair work. According to the requirements and limitations of the scheme, the capacity of a bottom outlet can vary considerably. If enough discharge structures are available, the capacity of the bottom outlet can be kept relatively small. An essential factor to consider is the desired time for emptying the dead reservoir storage. Should large discharge structures be available, it will be necessary to install a very efficient bottom outlet for operational and safety reasons. The possibility of drawing down the water level rapidly in case of damage to the dam or within the storage area can be very important. In addition it might be necessary, for repair work, to have an additional outlet available during drawdown. In recent years these aspects have been taken into account at many dam projects throughout the world. According to operational characteristics, the size of the dam and its storage volume as well as inflow and outflow quantities, bottom outlets with capacities of up to 500 cu m/second have been constructed. Designers are advised to examine and determine carefully and conscientiously the arrangement and capacity of a bottom outlet. (Baker-IVI)
W86-01690

WATERPROOF ELEMENT FOR EMBANKMENT DAMS,

A. D. M. Penman.
International Water Power and Dam Construction, Vol. 37, No. 7, p 33-36, 41-48 and 112, July, 1985. 17 Fig, 2 Tab, 42 Ref.

Descriptors: *Embankments, *Earth dams, Clay, Concrete, Rolled concrete, Construction, Walls, Membranes, Cutoffs, Dam cores.

The purpose of the waterproof element for embankment dams is to limit the flow of water so that material is not carried away, and so that the downstream drains can cope with the flow to ensure that porewater pressures do not exceed design assumptions. This overview looks at developments in techniques over the years for the construction of the waterproof element for embankment dams. Homogeneous dams, central clay cores (puddled clay cores and rolled clay cores), central core walls (concrete, asphalt, and plastic concrete, upstream membranes (concrete, asphalt, thin sheets), below ground cutoffs (grout curtain, diaphragm walls), and the connection between a dam and an underground cutoff are each discussed. (Baker-IVI)
W86-01691

CONSTRUCTION OF THE RIDRACOLI DAM,

Consorzio Acque per le Province di Forli e Ravenna (Italy).
P. P. Marini, and F. Bavestrello.
International Water Power and Dam Construction, Vol. 37, No. 7, p 52-56, July, 1985. 7 Fig, 2 Tab.

Descriptors: *Ridracoli Dam, *Italy, Dam construction, Rocks, Dam foundations, Sandstone, Rock mechanics, Gravity dams, Arch dams.

The Ridracoli Dam (Italy) is of the concrete gravity-arch type and was completed in the spring of 1982. The dam has a rock foundation of alternating layers of marl and sandstone. The structural and mechanical characteristics of this rock caused problems during excavation as a danger was foreseen of rock layers slipping along the bedding planes. Detailed studies were therefore required, including lab tests, to ensure that stability would not be jeopardized by excavations for the dam. Work on the dam began in 1975 and took about seven years to complete, three of which were spent solely on extensive base excavations. The pouring of the concrete began in the summer of 1978 and was completed in the spring of 1982. The operation to stabilize the excavations and the work of sealing and consolidating the foundation rock were carried out under a sub-contract. (Baker-IVI)
W86-01692

SADD-EL-KAFARA: THE WORLD'S OLDEST LARGE DAM,

Technische Univ. Braunschweig (Germany, F.R.). Leichtweiss-Inst. fuer Wasserbau und Grundbau.
G. Garbrecht.
International Water Power and Dam Construction, Vol. 37, No. 7, p 71-76, July, 1985. 3 Fig, 8 Ref.

Descriptors: *Dam construction, *Sadd-el-Kafara, *Egypt, *History, *Flood control, Design criteria, Flood damage.

The Sadd-el-Kafara dam was investigated in detail for the first time in 1982. The dam was constructed in the era of the Old Egyptian Empire, about 1600 BC, and represents the first attempt at storing water on a large scale. The purpose of the dam was apparently to protect installations in the lower wadi and in the Nile valley from the frequent and sudden floods following heavy rainfalls. The dam, by modern standards, is stable and would have withstood the floods reasonably to be expected if it had been completed. A flood during the construc-

tion period appears to have led to destruction, followed by a catastrophic flood wave. Construction was abandoned. The design was basically correct and the dam was adequately protected from damage caused by water bypassing the dam on the left bank or overtopping. Thus it was a tragedy that an unexpected flood created such a disaster. Even after 4500 years and on the basis of all present day knowledge and experience, the greatest respect must be paid to the Egyptian engineers for having the courage to construct the dam with the limited technological means and scarce scientific knowledge at their disposal. (Baker-IVI)
W86-01693

POWER CONDUITS FOR HIGH-HEAD PLANTS; PART TWO,

Innsbruck Univ. (Austria). Inst. fuer Konstruktiven Wasserbau und Tunnelbau.
G. Seeber.
International Water Power and Dam Construction, Vol. 37, No. 7, p 95-98, July, 1985. 5 Fig, 15 Ref.

Descriptors: *Dam construction, *Power head, *Design criteria, Construction, Dams, Conduits, Pressure tunnels, Shafts, Tunnels, Linings.

The criteria which govern the selection of the technique used to line a power conduit are assessed. The increasing number of high-head storage and pumped-storage schemes built during the past quarter of a century has called for a more critical assessment of the relative benefits of the various methods of lining pressure tunnels and shafts. Applications are given for the following methods: concrete lining plus seal; concrete lining plus thin steel seal; and thickwalled steel linings. In the case of peak load power stations with marked fluctuations in dynamic pressure, special emphasis must be place on engineering and installing the lining with an eye to achieving optimum fatigue strength. In particular, one must take care to avoid notches, sudden changes in thickness, obstacles to expansion, and compound stress. (Baker-IVI)
W86-01695

8B. Hydraulics

FLOW CHARACTERISTICS OF THE HYDRAULIC JUMP IN A STILLING BASIN WITH AN ABRUPT BOTTOM RISE,

Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, and R. Sinniger.
Journal of Hydraulic Research, Vol. 23, No. 2, p 101-113, 1985. 11 Fig, 17 Ref.

Descriptors: *Hydraulic jumps, *Flow characteristics, *Stilling basins, Hydraulic properties, Fluid mechanics, Jets.

The flow characteristics in prismatic stilling basins with an abrupt rise of the channel bottom are analyzed. Proper accounting for the pressure distribution at the step leads to an expression for the conjugate flow depths in terms of the in flow Froude-number and the relative step height. It is found that the pressure distribution just in front of the step is not hydrostatic but must be augmented by the dynamical pressure head. For a given energy head and Froude-number at the upstream zone of the stilling basin, the dissipated energy is independent of the step height and corresponds to the value of a hydraulic jump on a horizontal bottom. For a given inflow Froude-number, transition between hydraulic jump and jet formation over the step depends on the relative step height. For vertical steps sweeping out and refilling of the stilling basin occurs at identical downstream conditions, whereas downstream flow depth must be higher for refilling when the step is positively inclined. The length of the roller and the jump are slightly longer in stilling basins with positive steps than for ordinary hydraulic jumps on horizontal bottoms. The present study allows a simple and rapid determination of all pertinent design quantities for stilling basins consisting of an abrupt bottom rise. (Baker-IVI)
W86-01391

PREDICTION OF CHARACTERISTICS FOR VERTICAL ROUND BUOYANT JETS IN STABLY LINEAR STRATIFIED ENVIRONMENT,

Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
W. Li, and C. J. Chen.
Journal of Hydraulic Research, Vol. 23, No. 2, p 115-129, 1985. 9 Fig, 15 Ref.

Descriptors: *Turbulent flow, *Buoyance, *Stratification, *Jets, Model studies, Hydraulic models, Water pollution, Turbulence, Heat flux, Shear stress, Kinetic energy.

The vertical turbulent buoyant jet discharging into a linear stratified environment is one of the most important and basic flow patterns related to environmental pollution. A turbulent model is used to study the behavior of round buoyant jets before the point of neutral buoyancy in stably linear stratified environments. The calculation of the center line velocity, density, turbulent kinetic energy, half-width of buoyancy jets and the profiles of turbulent kinetic energy, turbulent shear stress and turbulent heat flux are made for exit densimetric Froude numbers of 1.0 and 450.0 and strengths of stratification S = 0.0-0.11. A unified scaling law in non-uniform environments is derived for normalization of these results. The correlation of the predicted results shows that the established zone of buoyant jets in the stably linear stratified environment may be similarly divided into three regions for the uniform environment namely non-buoyant region, intermediate region, and plume region. The variation of centerline velocity, density and turbulent kinetic energy along the axial line for both uniform and linearly stratified environments is shown to fall into a single curve under the scaling law derived. The predicted results are compared with the experimental data with fair agreement. The spread of velocity half-width along the axial line for different strengths of stratification in a given exit densimetric Froude number converges to a single curve under the unified scaling law. Unlike the spread of velocity half-width the spread of temperature half-width first spreads and then converges near the established zone for the case of small ambient temperature gradients. For large ambient temperature gradients the spread tends to be convergent. The dimensionless mean velocity profile in the zone of established flow for different exit densimetric Froude numbers and strengths of stratification may be approximated by a Gaussian profile, and the dimensionless mean temperature profile can be expressed in two segments by two Gaussian profiles. The turbulent field does not reach the state of self-similarity at the location closed to the point of neutral buoyance. The predicted results of dimensionless turbulent transport properties are given at two locations for different exit densimetric Froude number. At each location the predicted results are shown to converge into a single curve for different ambient strengths of stratification. (Baker-IVI)
W86-01392

PLANE TURBULENT BUOYANT SURFACE JETS AND JUMPS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and S. Subramanyan.
Journal of Hydraulic Research, Vol. 23, No. 2, p 131-146, 1985. 7 Fig, 1 Tab, 17 Ref.

Descriptors: *Turbulence, *Jets, *Hydraulic jumps, *Fluid mechanics, Richardson numbers, Froude numbers, Buoyance, Surface jets, Entrainment.

Based on an experimental study of plane turbulent buoyant surface jets, the distinction between surface jets and surface jumps has been sharpened. For the surface jet, the growth of the thickness of surface jet in terms of the jet thickness at the outfall with the dimenionless longitudinal distance for a wide range of source Richardson numbers has been evaluated. The structure of the mean velocity in the surface jet has also been studied for a range of Richardson numbers. For surface jumps with supercritical densimetric Froude numbers as large as about 9 there is hardly any entrainment on its lower side. The dimensionless surface profile of the surface jump is the same as that of the more familiar open channel hydraulic jump. The mean velocity field in the surface jump has also been studied. A comprehensive diagram has been developed to predict whether a surface jet, or surface jump or drowned jump will occur for given Richardson numbers and the downstream depth of stratified flow in terms of the source thickness. (Baker-IVI)
W86-01393

IMPACT OF RIVER CHANNELIZATION; II. CHANNELIZATION: SOME ENGINEERING ASPECTS,

North West Water Authority, Warrington (England). Rivers Div.
For primary bibliographic entry see Field 4A.
W86-01402

IMPACT OF RIVER CHANNELIZATION; III. DOWNSTREAM MORPHOLOGICAL CONSEQUENCES OF RIVER CHANNELIZATION IN ENGLAND AND WALES,

Miljoestyrelsen, Silkeborg (Denmark). Freshwater Lab.
For primary bibliographic entry see Field 4A.
W86-01403

NUMERICAL ANALYSIS OF KIELDER DAM SPILLWAY,

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. Ellis.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 3, p 254-270, June, 1985. 15 Fig, 6 Ref.

Descriptors: *Spillways, *Planning, *Kielder Dam, *England, Dam design, Mathematical models, Management, Decision making, Design criteria, Model studies, Computers.

Two different numerical models are described which enable the engineer to assess the effectiveness of alternative spillway arrangements both quickly and economically. The first of these models discussed is used to predict the water surface profiles of the spatially varying flow within the collector channel of a side-discharge weir, for both free and part submerged weir flow conditions. The second model computes the superrelevation of water level on the supercritical flow profile for a steep channel which is curved in plan. The models are used to analyze performance of the Kielder reservoir spillway and comparisons are made with observations undertaken on a physical model of this spillway. Comparisons between computed water surface profiles and physical model observations show good agreement. These findings indicate that numerical models may be used with some confidence in preliminary design of spillways. Primary advantages of the numerical model are its flexibility of application and relative economy of operation. The numerical and physical models are seen as complementary in their roles. Numerical models may best be employed to optimize the main dimensions and alignment of the spillway. Having established the final configuration of the channel the physical model may be used to test the numerical model predicts are refine the design. (Baker-IVI)
W86-01523

EXPERIMENTAL MEASUREMENTS OF MULTIPLE-JET INDUCED FLOW,

Hong Kong Univ. Dept. of Civil Engineering.
J. H. W. Lee, and C. W. Li.
Journal of Engineering Mechanics, Vol. 111, No. 8, p 1087-1092, August, 1985. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Flow mechanics, *Jets, Turbulence, Mathematical equations, Water flow, Shallow water, Water currents.

Basic experimental data on the flow generated by N closely spaced non-buoyant turbulent jets all oriented in the positive x direction into a uniform

coflowing current are reported. The submerged jets discharge close to the bottom of a large receiving water of uniform undisturbed depth, H. The theoretical predictions of the flow induced by a line momentum source in a coflowing shallow water current are satisfactorily corroborated by simple, carefully designed laboratory experiments. The mechanics of such line jet groups in an inclined crossflow is currently under investigation. (Baker-IVI)
W86-01530

CALCULATION OF WAVE DIFFRACTION ON RESERVOIRS OF HYDROELECTRIC AND NUCLEAR POWER STATIONS,

N. N. Zagryadskaya.
Hydrotechnical Construction, Vol. 18, No. 11, p 538-543, November, 1984. 3 Fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 19-22, November, 1984.

Descriptors: *Breakwaters, *Wave diffraction, *Reservoirs, Hydroelectric powerplants, Nuclear powerplants, Waves, Mathematical equations.

Wave diffraction by moles is an essential factor when determining the wave regime on protected water areas. In reservoirs of nuclear and hydroelectric power stations, the role of moles is performed by guide banks. The conventional method (Zhukovets') of calculating wave diffraction on water areas protected by single or convergent moles (breakwaters) is not applicable to cases of protection by offset or overlapping moles when the projection of the width of the inlet is b < or = 0 and secondary deformation occurs. The method is also difficult to use when a successive (repeated) arrangement of the sites of protective structures is encountered. A new method of calculating wave diffraction is presented which is free as far as possible of these shortcomings. Results from the new method are compared with experimentally developed data. The proposed method can be used when solving important practical problems, such as a determination of the wave regime on water areas with a variable depth and with consideration of the spectral structure of the field of initial waves. (Keenan-IVI)
W86-01627

NEW FLOW MODELS CAN HELP SOLVE PUMP-CAVITATION PROBLEMS,

R. Behrens.
Power, Vol. 129, No. 7, p 49-50, July, 1985. 3 Fig.

Descriptors: *Cavitation, *Pumps, *Mathematical models, *Synergetic geometry, Model studies, Flow, Computers,.

Problems in pump cavitation can involve the frequently described classical forms on impeller or casing or less well known localized phenomena. One of the techniques of analysis which can permit construction of flow models that are simultaneously real time, interactive and predictive concerns a relatively obscure branch of mathematics, called synergetic geometry. A computer model of a system with a cavitation problem was created. The volume of water in the space from the low pressure header to the low pressure header was divided into convenient units called DROs. Each DRO received a number and all were observed from a point inside the system, so that they appeared to be stationary. In accordance with the laws of synergetic geometry, the DROs formed into certain patterns. As the pressure, temperature, or velocity changed, their volume changed, and consequently the pattern changed. The computer then identified areas of tetrahelical patterns, in which tetrahedra are joined in corkscrew chains by the sharing of a plane by an adjacent pair of tetrahedra. The computer then identified all patterns upstream of the tetrahelices until it had identified octal flow for a distance of two pipe diameters. The problem then was obvious and steps for a solution were undertaken. A semicircular vane was installed two pipe-diameters upstream of the inlet; with the vane installed, the cavitation and vibration ceased. (Baker-IVI)
W86-01680

VORTEX TOWER FOR THE EL CAJON SPILLWAY INTAKE,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
D. Schulthess.
International Water Power and Dam Construction, Vol. 37, No. 7, p 27-30, July, 1985. 8 Fig, 4 Ref.

Descriptors: *Hydraulics, *Vortex towers, *Intakes, *El Cajon, *Honduras, Spillways, Fluid mechanics, Flow, Model studies.

There is a risk that the gates around the intake zone at the El Cajon Dam, Honduras, could be damaged by the high velocity vortices. With partial gate openings, it is quite likely that logs that have been sucked in by a vortex will cause further damage by colliding with the gates. Further, air bubbles can expand under the gate lips and create instabilities in the uniform flow causing pressure fluctuations with large peaks. Some devices for the prevention of vortex formation have been described earlier. In a way, the vortex tower functions in a similar manner to an injector, and can be used to prevent vortex formation in a large secondary flow region. Tests have been performed with such a vortex tower, and these indicated that vortex formation is able to be controlled for a spillway intake of 1800 cu m/sec capacity. The tower, which has a diameter of 8 m and a height of 20 m, is at present being constructed. At the maximum storage level the tower is submerged by 8.5 m. Flow through the tower accounts for about 10% of the discharge through the spillway. (Baker-IVI)
W86-01689

ENERGY APPROACH TO ESTIMATING SCOUR DOWNSTREAM OF A LARGE DAM,

Vancouver (British Columbia).
K. J. W. Spurr.
International Water Power and Dam Construction, Vol. 37, No. 7, p 81-89, July, 1985. 6 Fig, 3 Tab, 52 Ref.

Descriptors: *Scour, *Estimating, *Dam, Fluid mechanics, Water flow, Design criteria, Plunge pools, Spillways.

The prediction of scour is presented for estimating the equilibrium scour downstream of large dams is necessary to ensure the safety of the toe of the dam as well as stability of its abutments. To assess plunge pool scour accurately, the influence of the spillway layout, the spill duration, the geology and the relative rates of scour developent between the outer pool and the live-scour hole must be taken into account. A rationalized, indexed approach is presented for estimating scour downstream of large dams in terms of the mean surplus jet power and rock threshold energy levels. Although the method proposed could have been more usefully illustrated had the necessary equilibrium spill times, hydraulic and geological data at another large dam been available for checking, this approach offers an advantage over previous procedures. (Baker-IVI)
W86-01694

8C. Hydraulic Machinery

MECHANICAL EQUIPMENT OF THE DNESTER MULTIPURPOSE HYDROPOWER DEVELOPMENT,

M. V. Beketov, Ya. S. Oservaser, and B. A. Fedorov.
Hydrotechnical Construction, Vol. 18, No. 11, p 525-528, November, 1984. 3 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 10-12, November, 1984.

Descriptors: *Mechanical equipment, *Dam construction, *Hydroelectric plants, Cranes, Gates.

The Dnester multipurpose hydropower development located on Dnester River in the Chernovtsy region is intended for power generation, irrigation, water supply, and flood control. The mechanical equipment employed was designed with consideration of its use in the construction period and has a number of distinctive characteristics. The construction of a trestle with the service gantry cranes on the gated wall of the upper pool made it possible to operate the gates before construction was completed, which provided start-up of all units on time. Unlike the traditional designs, these cranes have two-legged portals and the grabs have a sectional construction. This made it possible to reduce the weight by 203 tons. The use of service gates during construction eliminated the construction of additional temporary flashboards and corresponding consumption of metals. The use of structural elements of the concrete-buggy trestle of the Sayano-Shushenkoe hydrostation instead of the earlier specified reinforced-concrete elements of the bridge and crane beams considerably simplified fabrication and shortened the assembly time. The timely design developments for the mechanical equipment in the construction period, correlated to the actual conditions at the construction site, made it possible to accomplish the assembly works in the shortest possible time. (Shieh-IVI)
W86-01624

RESULTS OF INVESTIGATING THE EFFECT OF CAVITATION IN HYDROABRASIVE WEAR OF ELEMENTS OF THE WATER PASSAGEWAY OF AXIAL-FLOW PUMPS,

M. M. Mamazhonov, and A. I. Denisov.
Hydrotechnical Construction, Vol. 18, No. 11, p 544-553, November, 1984. 10 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 22-27, November, 1984.

Descriptors: *Cavitation, *Turbidity, *Pumps, *Abrasion, Hydraulic machinery, Turbines, Suspended sediments, Suction head, Costs.

On-site observation of the operation of hydraulic machines and long experience in operating stations and pumping stations show that abrasive and cavitation-abrasive wear play the main role in the failure of parts of hydraulic turbines and pumps operating on streams with high turbidity. Data is presented which was derived from an experimental facility designed to study the combined effects of cavitation and abrasion due to sediments on failure of hydraulic turbines and pumps. A definite effect of solid particles on the development of cavitation phenomena was found. General principles of selecting the permissible cavitation margin or permissible suction head from the viewpoint of minimum wear rate of pump parts are established. This in turn will impact upon the capital investments required for the construction of pump units. (Keenan-IVI)
W86-01628

NOISE IN THE WATER INDUSTRY,

R. Hobbs.
Water and Waste Treatment, Vol. 28, No. 6, p 10-11, June, 1985. 2 Fig, 1 Tab.

Descriptors: *Noise, *Hydraulic equipment, *Water conveyance, Mechanical equipment, Design criteria,.

There are practical cost effective solutions to combat the problem of noise generated in the water industry due to the movement of water by various mechanical devices. Noise related problems fall into two distinct categories, occupational and involving the employees; and community involving the neighbors. Case studies reveal that even the most difficult projects can be engineered for noise control. These results are not achieved by luck, they are planned for and designed for. When faced with a noise problem whether occupational or community the water authorities can have confidence in the performance of noise reduction and acoustic treatments. (Baker-IVI)
W86-01633

PREVENTING CAVITATION WITH MULTISTAGE ORIFICES,

S. H. Lin.
Hydrocarbon Processing, Vol. 64, No. 7, p 93-95, July, 1985. 2 Tab, 2 Ref.

Descriptors: *Cavitation, *Multistage orifices, Orifices, Erosion control, Water flow, Fluid mechanics, Hydraulics.

A multistage orifice is essentially a series of sharp-edged orifices installed in a line. It prevents cavitation by gradually reducing the pressure. If designed properly, it is highly effective, inexpensive and easy to fabricate when compared to other sophisticated devices. Two types of multistage orifice design are considered. The first type is constant-cavitation index design, and the second is constant-orifice diameter design. The first type of design is to determine the number of orifice stages with such a constant cavitation index so that the given upstream and downstream pressure heads are satisfied. For this case, the pressure drop across an orifice and the orifice diameter will vary from stage to stage. The second type of design utilizes a constant orifice diameter for all orifices and allows the cavitation index to vary. (Baker-IVI)
W86-01721

8D. Soil Mechanics

EFFECT OF LEACHING ON THE INTEGRITY OF A NATURAL CLAY,

McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
For primary bibliographic entry see Field 5E.
W86-01457

PHYSICAL AND CHEMICAL BEHAVIOUR OF CLAY-BASED BARRIERS UNDER PERCOLATION WITH TEST LIQUIDS,

Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Grundbau und Bodenmechanik.
For primary bibliographic entry see Field 5G.
W86-01458

COMPACTION CHARACTERISTICS OF RIVER TERRACE GRAVEL,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
V. K. Garga, and C. J. Madureira.
Journal of Geotechnical Engineering, Vol. 111, No. 8, p 987-1007, August, 1985. 15 Fig, 6 Tab, 12 Ref.

Descriptors: *Compaction, *Gravelly soils, *Construction materials, *Earth dams, *Dams, Permeability, Particle size, Soil types, Soil properties.

Gravelly soils consisting of sound gravel-size particles in a matrix of finer material have proved to be a satisfactory construction material for several large earth dams. The gravel fraction of these soils imparts a relatively high shear strength, high compacted density and low compressibility, while the permeability of the soil is governed by the properties of the matrix material. Large-scale field and laboratory tests were carried out to investigate compaction characteristics of a river terrace gravel soil at the 120-m high Sao Simao Dam in Brazil where approximately 10,000,000 cu m of this material were used as compacted fill. The course fraction of the deposit was typically 3 in. (7.5 cm) maximum size, while the matrix (defined as material passing No. 4 sieve) was basically a clayey sand with LL = 30-35%, PI = 5-15 and 35-50% passing the No. 200 sieve. Field compaction trials were carried out to establish procedures for embankment construction and to evaluate the efficiency of two vibratory rollers. The maximum density for a specific compaction effort was obtained at a gravel content of 65-70%. Shockley's expression for maximum density is not valid for gravel content greater than 25%. The particle size does not significantly affect compaction for gravel content in the 40-60% range for the equipment used in this study. The measured densities are insensitive to the gradation of the gravel fraction. Field compacted density control can be exercised satisfactorily by using elimination and substitution methods: In the substitution method, the plus 3/4 in. fraction size is substituted in a sample by an equal percentage of minus 3/4 in. to plus No. 4 sieve size fraction, and compacted using the intermediate energy; in the elimination method, only the minus 3/4 in. size fraction in a sample is compacted using the standard Procter energy. (Collier-IVI)
W86-01532

REDUCTION OF THE TIME OF PLACING MATERIALS IN THE CONSTRUCTION OF THE DAM AT THE ROGUN HYDROELECTRIC STATION,

T. I. Adam'yants, E. P. Karpoy, and S. Y. Lashchenov.
Hydrotechnical Construction, Vol. 18, No. 11, p 520-525, November, 1984. 4 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 6-9, November, 1984.

Descriptors: *Earth dams, *Dam construction, Rollers, Vibrators, Construction, Earthworks, Construction equipment.

The placement of materials in the dam is the main factor determining the rate of construction in the cyclic production-line technology used for construction of the earth-rock dam at the Rogun hydrostation. Because the geotechnical characters of the materials being used at the Rogun hydrostation are similar to those of Nurek dam, the experience of constructing the dam at the Nurek hydrostation is the basis for recommendations on the parameters and technological operating regimes of vibrating rollers and on the organization of the next investigations for advanced development of the optimal technology for construction of the earth-rock dam at the Rogun hydrostation. To increase the rate and reduce the work time for placing materials in the Rogun dam it is necessary to provide intensive methods of placing the earth materials in layers > 1 m thick with rolling speeds up to 4 km/h and reduction of the number of passes with overlapping by using effective vibrating machines. It is necessary to be oriented mainly towards the use of medium (5-10 tons) and heavy (10-15 tons) mobile vibrating rollers. The parameters and technological operating conditions of the rollers should be refined based on the results of experimental rolling. (Shieh-IVI)
W86-01623

LIQUEFACTION OF FINE SAND DUE TO WAVE ACTION,

Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ingenieria.
L. Zeevaert.
Shore and Beach, Vol. 51, No. 2, p 32-36, April, 1983. 6 Fig.

Descriptors: *Liquefaction, *Sand, *Waves, *Grijalva River, *Mexico, Erosion, Jetties, Clay, Subsidence, Sediment transport, Erosion.

In connection with an investigation for the construction of two new long jetties at the mouth of the Grijalva River in order to permit safe navigation to reach the Port of Frontera in the State of Tabasco, Mexico, liquefaction in fine sand was also studied. Subsoil investigations indicated a surface deposit of about 5 mts thick of the fine sand with a mean diameter ranging between 0.15 and 0.20 mm. From 10 to 29.5 mts depth a thick bluish-gray clay deposit with microscopic shells was encountered and is underlain by gray silty snd with small shells. The average water content of the clay deposit is about 55% and is practically constant with depth. The shearing strength of the clay deposit, between 10 and 29.5 mts depth, was obtained from unconfined compression tests and showed an erratic value, probably because of the strong difference in the salinity of the water during the process of sedimentation and flocculation of the fine grains. The large subsidence of the rock jetties found may be attributed only to the simultaneous action of spontaneous liquefaction and base erosion. Instantaneous liquefaction may be visualized as a pumping action produced by the waves in the fine sand at the toe of the jetty, permitting a gradual subsidence of the rock into the sand up to a depth where the effective stress in the sand is greater than zero. The water flow at the foundation grade elevation of the jetty facilitated the transport of the fine sand, permitting the spreading of the rock slope of the jetty because of the reduction in the foundation support. (Baker-IVI)
W86-01845

8E. Rock Mechanics and Geology

RESULTS OF EXPERIMENTAL DRILLING AND BLASTING OPERATIONS IN PREPARING THE ROCK FOUNDATION OF THE KRAPIVINSKII HYDROELECTRIC STATION,

A. E. Azarkovich, and V. N. Yanovskii.
Hydrotechnical Construction, Vol. 18, No. 11, p 529-533, November, 1984. 3 Fig, 3 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 12-15, November, 1984.

Descriptors: *Blasting, *Foundation rocks, *Dam construction, Dam foundations, Hydroelectric plants, Foundations, Blasthole charges.

Drilling and blasting operations near the lower contour of the foundation pits of important hydraulic structures should be performed so that the necessary preservation of the rock foundation is provided. A new method of calculating the parameters for blasting is evaluated. The objective of the new method is to allow loosening of the layer of rock directly above the foundation contour by reduced blasthole charges rather than by shothole charges. The suitability of the new method was confirmed by blasting at the Krapivinskii hydrostation. The methods of investigation used did not show disturbance of the foundation after the blasts. (Keenan-IVI)
W86-01625

8F. Concrete

PERFORMANCE OF WATER PIPELINE MATERIALS,

R. L. Klein, and A. J. Rancombe.
Chemistry and Industry, Vol. 11, p 353-358, 1985. 15 Ref.

Descriptors: *Pipelines, *Water supply, *Water distribution, *Cement, Construction materials, Concrete, Corrosion, Iron, Bacteria, Joints.

The performance of the principal materials in general use for water supply pipelines has been reviewed. It will be evident that no single material is without its shortcomings and that, despite considerable advances in technology, the hazards associated with each material remain imperfectly understood, as do the most appropriate methods of overcoming them. Ductile iron is an excellent material which in most circumstances can be expected to give long and trouble-free service. But, instead of the half measures of zinc spraying and polyethylene sleeving, the industry should be looking at a more durable method of coating. Cement mortar lining will in most cases last as long as the pipe, but may be vulnerable to very soft waters. Perhaps fusion bonded epoxy or some similar plastic system will in the future take the place of present methods of protection. Steel pipe, generally the only material appropriate to high pressure transmission mains, is unsuitable for distribution purposes for two reasons: the full strength of the material is not utilized at low pressures and the pipe is therefore uneconomical. Secondly, the application of cathodic protection is impracticable in an urban environment because of interference with other services. Both prestressed concrete amd asbestos cement pipes will give good long term service in most circumstances, but it is disappointing that manufacturers have not applied themselves more diligently to developing protective coatings which will guarantee performance in environments corrosive to cement. (Baker-IVI)
W86-01611

WAYS TO IMPROVE THE TECHNOLOGY OF CONSTRUCTING CONCRETE HYDRAULIC STRUCTURES,

A. D. Osipov.
Hydrotechnical Construction, Vol. 18, No. 11, p 517-520, November, 1984. 1 Tab, 1 Ref. Translated

from Gidrotekhnicheskoe Stroitel'stvo, No. 11, p 4-6, November, 1984.

Descriptors: *Hydraulic structures, *Concrete technology, Arch dams, Dam construction, Rolled concrete, Retaining walls, Reinforced concrete, Concrete additives.

A number of measures have been taken recently in the construction of high arch dams in order to ensure a high-strength concrete and solidity of the concrete masonry. However, the implementation of these measures significantly increases the cost of concrete masonry of a dam. Several new approaches can be taken to reduce the cost, construction time, and labor expenditures associated with the construction of concrete dams. When constucting dams, retaining walls, and other massive structures it is possible to use a very stiff low-cement rolled concrete (80-100 kg/cu m) placed in thin layers on a large area. The use of such concretes in dam construction makes it possible to eliminate both the frequent sectionalizing into blocks and other measures for controlling thermal stresses. All thin-walled reinforced-concrete structures should be made of poured self-compacting concrete mixes delivered by concrete pump with the use of plasticizing and air-entraining additives, which will make it possible to have the required physical and mechanical properties of concrete without the overconsumption of cement. Stiff fine-grained concrete mixes placed and compacted by rotary throwers or vibrating rollers should be used for revetting the slopes of earth structures. (Shieh-IVI)
W86-01622

8G. Materials

HYDRAULIC CONDUCTIVITY OF TWO PROTOTYPE CLAY LINERS,

Geo-Con, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5G.
W86-01531

PROTECTIVE COATINGS FOR WATER STORAGE TANKS AND WATER TREATMENT FACILITIES,

Mobil Chemical Co., Edison, NJ.
T. P. Delany, and J. Zawacki.
Journal of the New England Water Works Association, Vol. 99, No. 2, p 164-186, June, 1985. 8 Ref.

Descriptors: *Water storage tanks, *Water treatment facilities, *Coatings, Requirements, Specifications, Water tanks.

A good protective coating job requires the teamwork of several people, the engineer, the applicator, the coatings manufacturer, and the inspector. Some of the many considerations regarding the selection and use of protective coatings in water treatment and storage facilities are presented. Specific areas considered include: a properly written painting specification, surface preparation, proper inspection, and paint systems. (Baker-IVI)
W86-01753

8I. Fisheries Engineering

EFFECTS OF ANNUAL DRAINING ON WATER QUALITY AND PRODUCTION OF CHANNEL CATFISH IN PONDS,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
W. D. Hollerman, and C. E. Boyd.
Aquaculture, Vol. 46, No. 1, p 45-54, May, 1985. 5 Fig, 4 Tab, 16 Ref.

Descriptors: *Aquaculture, *Catfish ponds, *Ponds, *Draining, *Fish farming, Catfish farming, Water quality, Chlorophyll a, Phosphorus, Chemical oxygen demand, Nitrates, Nitrites, Ammonia, Nitrogen.

Concentrations of chlorophyll a, total phosphorus, chemical oxygen demand, nitrite-nitrogen, total ammonia-nitrogen, and dissolved oxygen were measured frequently in channel catfish ponds, of which four were drained annually and four were not drained for 3 years. Average concentrations of total phosphorus increased from year to year in undrained ponds, and they were higher ($P < 0.01$) in undrained ponds than in drained ponds during the second and third years of the study. Phytoplankton abundance, as evident from chlorophyll a concentrations, did not differ ($P > 0.05$) within or between treatments during the 3 years. Water quality was similar between treatments. One difference in production of channel catfish occurred during the third year and was related to a parasite infection of fish rather than water quality. The findings suggest that the recent trend in not draining channel catfish ponds at harvest will not lead to rapid deterioration of water quality in ponds. (Author's abstract)
W86-01322

SETTING OF THE AMERICAN OYSTER CRASSOSTREA VIRGINICA IN THE JAMES RIVER, VIRGINIA, USA: TEMPORAL AND SPATIAL DISTRIBUTION,

Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W86-01504

FACTORS AFFECTING GROWTH AND RECRUITMENT OF YELLOW PERCH, PERCA FLAVESCENS MITCHILL, IN SOUTH BAY, LAKE HURON,

Ontario Ministry of Natural Resources, Toronto. Lake Huron Fisheries Research Unit.
B. A. Henderson.
Journal of Fish Biology, Vol. 26, No. 4, p 449-458, April, 1985. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Perch, *Lake Huron, *Recruitment, *Growth, Lakes, Population dynamics, Water temperature, Water level, Fish populations.

Several hypotheses were tested which explain the large variations in recruitment and growth observed in yellow perch. The five hypotheses are: recruitment is positively correlated with water temperature; recruitment is a function of parental stock-size; recruitment is a function of water levels; growth is related to population abundance; and growth is dependent upon water temperature. The ratio of recruits to spawners was principally determined by variations in water levels, which presumably reflected the effect of variations of the quality and quantity of spawning substrates on egg or fry survival. The recruitment was then dependent upon the combination of stock-size and the survival of the eggs or fry. Thus, good recruitment could only be achieved if a large parental stock size produced eggs that survived well. In recent years, the parental stock-size in South Bay was small, but the survival was good; as a result, the recruitment was relatively poor compared with the earlier years when both parental stock-size was large and early survival was high. There was no indication that recruitment and the ratio of recruits to spawners was dependent upon stock density; therefore, a stock-recruitment relationship did not exist. Variations in R/P were a function of water levels and not parental stock-size. Growth was not dependent upon water temperatures, but was affected by population abundance. The number of recruits, and not the total population size determined the rate and increment of growth. The implication is that competition for food takes place between perch of a similar size and age. The environment determined the ratio of recruits to spawners, and the population size affected growth. (Baker-IVI)
W86-01508

ESTIMATING THE POPULATION DYNAMICS OF COHO SALMON (ONCORHYNCHUS KISUTCH) USING POOLED TIME-SERIES AND CROSS-SECTIONAL DATA,

Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 2H.
W86-01585

WATER TEMPERATURE AS THE PRIMARY INFLUENCE ON TIMING OF SEAWARD MIGRATIONS OF ATLANTIC SALMON (SALMO SALAR) SMOLTS,

Direktoratet for Vilt og Ferskvannsfisk, Sandnes (Norway). Forskningsstasjion for Ferskvannsfisk.
For primary bibliographic entry see Field 2H.
W86-01589

RESERVOIR FISHERY RESEARCH NEEDS AND PRIORITIES,

Tennessee Valley Authority, Chattanooga.
G. E. Hall.
Fisheries, Vol. 10, No. 2, p 3-5, March-April, 1985. 17 Ref.

Descriptors: *Fisheries, *Management, *Reservoir fisheries, Operation, Planning, Reservoir operation, Fish stocking, Water quality, Surveys, Research priorities.

In surveys conducted in 1983 and 1984 approximately 80 professional fisheries biologists with reservoir experience were asked to furnish information and ideas on gaps in current reservoir knowledge, pressing needs for additional information, appropriate directions for research and the kind of organization best suited to conduct a reservoir fisheries program. Knowledge gaps identified by the largest number of respondents in both surveys were: the absence of a clear understanding of predator/prey interactions; need for information on optimum stocking procedures; knowledge of factors affecting the recruitment of fish; and information concerning impacts of harvest regulations on individual species and population balance. Highest priorities for needed information concerned a better knowledge of water quality/fish interactions and the ability to predict impacts of reservoir drawdowns and/or water level fluctuations plus more information on proven reservoir management techniques. The majority of respondents thought the development of models for managing reservoir problems should receive the greatest attention. Over 90% of the survey respondents considered reservoir research to be a federal responsibility. Although most of the respondents felt that reservoir research was a federal responsibility deserving national attention, there is a lack of concensus concerning how it should be funded and administered. (Baker-IVI)
W86-01598

MANAGEMENT OF LACUSTRINE FISHERIES IN THE TROPICS,

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
R. T. Oglesby.
Fisheries, Vol. 10, No. 2, p 16-19, March/April, 1985. 2 Tab, 15 Ref.

Descriptors: *Fish management, *Reservoirs, *Tropical regions, Resources management, Fish populations, Fisheries, Developing countries, Regional development.

Lake and impoundment fisheries of many developing countries have the potential to provide accessible, relatively inexpensive animal protein in quantities approaching a hundred kilograms per hectare of surface per year. These fisheries in the lowland tropics currently yield an average catch of 80 kg/ha/hr. There are two kinds of harvest limitations: those imposed by constraints on fish production and those resulting from underdevelopment of fisheries. A first, critical step in the management of these fisheries is to predict potential yields and to compare them with current harvests. Site specific management programs can then be developed by taking into account stocking, assistance to fishermen, data collection and analysis, and program evaluation. Most impoundments now being built or planned in developing countries are primarily for the production of power and the storage of water for crop irrigation. Fisheries are an add-on and their management becomes complicated by the presence of trees not removed during site preparation and extreme water level fluctuations that occur both seasonally and between years. Inclusion of fishery personnel in making operation decisions as well as in initial planning activities may result in substantially improved fishery development oppor-

tunities. Management of lake and impoundment fisheries in developing tropical countries is at an early stage but seems to be evolving rapidly. (Collier-IVI)
W86-01600

9. MANPOWER, GRANTS AND FACILITIES

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For primary bibliographic entry see Field 5D.
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SELECTED WATER RESOURCES ABSTRACTS

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

VOLUME 19, NUMBER 6
JUNE 1986

W86-01920 -- W86-02419
CODEN: SWRABW

.94/2:

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 6
JUNE 1986

W86-01920 -- W86-02419

MARCH 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

READEX FICHE best copy available

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SUBJECT FIELDS AND GROUPS

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,

Geological Survey, Menlo Park, CA.
J. D. Hem.
IN: Water Analysis, Academic Press, Orlando, FL. 1982, Volume 1: Inorganic Species, Part 1. p 137-161, 7 fig, 28 ref.

Descriptors: *Conductance, *Physical properties, *Chemical properties, *Conductivity, *Specific conductivity, Dissolved solids, Natural waters, Salinity, Ions, Irrigation water, Trace elements, Physiochemical properties.

The physical basis for electrical conductance in aqueous solutions, the influence of solute concentrations and related factors on conductance, and the ways in which these influences are evaluated are examined. The specific conductance of a substance is the conductance over 1 cm of a segment of the material having a cross-sectional area of 1 sq cm. The equivalent conductance of a solute is the conductance of one gram of the material dissolved in water. Major factors affecting limiting equivalent conductances include ionic size, charge and speed. Increased temperatures bring about increased ion movement. Conductivity cells usually have platinum electrodes. Compensations that can be made for temperature effects, and types of measuring instruments are described. Conductivity values are related to salinity and have been used to evaluate the usability of water for irrigation or other purposes or the need for correcting undesirable salinity levels in soils. The conductivity of natural waters varies considerably depending upon dissolved solids content. Conductivity measurements may also be applied to the calculation of total ionic concentrations in equivalents per liter, the estimation of ionic strength of solutions, and the estimation of the gravimetric dissolved solute concentration. (Geiger-PTT)
W86-02261

2. WATER CYCLE

2A. General

WATER RESOURCES AND EFFECTS OF DEVELOPMENT IN HERNANDO COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
J. D. Fretwell.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4320, 1985. 83 p, 33 fig, 7 tab, 61 ref.

Descriptors: *Groundwater, *Water supply, Water quality, *Saltwater intrusion, Karst Floridan aquifer system, Hernando County, *Florida.

In spite of the hill and valley terrain in the Brooksville Ridge area of Hernando County, Florida, little surface drainage occurs within the county. Recharge to the Floridan aquifer system occurs as infiltration of precipitation within the county or as ground-water flow from Sumter County to the east and Pasco County to the south. Discharge is principally to the Gulf of Mexico, but some ground water flows north into Citrus County before it reaches the Gulf. The Floridan aquifer system is generally unconfined. Water quality is generally good except near the coast where high chloride occurs. Water from the Floridan aquifer system accounted for 87 percent of the water used for irrigation, industry, and rural and public supply in 1982. Sixty-seven percent of this water was used by industry. Rock mining, the major industry, used 99 percent of the industrial water. The anticipated increase in population in the county between 1982 and 2000 will increase demand for water primarily from public water-supply systems. This higher demand will cause about a 1 percent reduction in flow from Weeki Wachee Springs, but little change in lake levels or saltwater intrusion will occur if the projected additional supplies are developed far enough inland from the coast. (USGS)
W86-01931

HABITAT SUITABILITY INDEX MODELS: REGRESSION MODELS BASED ON HARVEST OF COOLWATER AND COLDWATER FISHES IN RESERVOIRS,

Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
L. R. Aggus, and W. M. Bivin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-147348, Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-82/10.25, September 1982. 38 p, 1 fig, 5 tab, 14 ref, 4 append.

Descriptors: *Habitat, *Fisheries, *Reservoir fisheries, *Mathematical models, *Fish harvest, Reservoirs, Fish, Lake fisheries, Regression analysis, Models, Model studies.

Habitat suitability index models were developed for selected coolwater and coldwater fishes in reservoirs. The models were based on estimates of harvest and were designed for use in existing and proposed coolwater and coldwater reservoirs in the contiguous United States. The analysis of reservoir harvest data consisted of development of multiple regression equations to predict harvest of selected fishes; conversion of these values to indices of habitat suitability; and exploration of discriminant analysis as an alternate quantitative approach. The feasibility of classifying reservoirs on the basis of grouped harvest of selected sport fishes, then predicting group membership based on environmental characteristics of a reservoir was also tested with discriminant analysis. The multiple regression equations presented herein are easily programmed to permit users to input environmental data and receive harvest and cumulative frequency values as output. The use of environmental factors to predict harvest in coolwater and coldwater reservoirs may remain relatively imprecise. Discriminant analysis did not produce precise classification schemes in reservoirs. Quantitative methods for identifying appropriate levels of harvest should be sought and tested before the procedure is abandoned. (Geiger-PTT)
W86-01985

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN GROUNDWATER MODELING: SELECTION, TESTING AND USE,

Michigan Dept. of Natural Resources, Lansing.
For primary bibliographic entry see Field 2F.
W86-02034

RAINFALL-RUNOFF RELATIONSHIPS AND WATER-QUALITY ASSESSMENT OF COON CREEK WATERSHED, ANOKA COUNTY, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
A. D. Arntson, and L. H. Tornes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4013, 1985. 97 p, 17 fig, 17 tab, 42 ref.

Descriptors: *Rainfall-runoff relationships, *Hydrograph modeling, Streams, Antecedent moisture, HEC-1, Water quality, Urbanization, Chemical properties, Biological properties, Regression techniques, Bottom materials, Loading, Sediment, Coon Creek, Anoka County, *Minnesota, Anoka Sand Plain.

Rainfall-runoff relationships were studied and a water-quality assessment was done for the 96.9-square-mile Coon Creek watershed, Anoka County, Minnesota. Data were collected from March 1979 to November 1980 at three continuously recording rainfall sites, five continuously recording streamflow sites, and seven creststage sites. Hydrograph analyses showed larger peak flows, shorter times to peak, and shorter duration of high flows in streams draining urban areas than in streams draining rural areas. Constrictions at roadways resulted in attenuation of hydrograph peaks in urban areas. Eight storms produced 19 hydrographs suitable for simulation with the HEC-1 model program. Parameter-optimization techniques were used to produce synthetic hydrographs that closely resemble observed hydrographs. Linear regression was used to relate rainfall and antecedent-moisture conditions in each of the subbasins to HEC-1 input parameters, resulting in generalized models that satisfactorily match 15 of 19 observed hydrographs. Water quality was determined from 1 bottom-material and 14 water samples from each of 4 sites. Results showed that urban runoff carried the highest areally adjusted loads of several metals, chloride, dissolved solids, and suspended sediment. The highest areally adjusted loads of most nutrients were found in mainstem segments of streams in rural areas. (USGS)
W86-02370

APPLICATION OF THE U.S. GEOLOGICAL SURVEY'S PRECIPITATION-RUNOFF MODELING SYSTEM TO THE PRAIRIE DOG CREEK BASIN, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
L. E. Cary.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4178, 1984. 98 p, 16 fig, 30 tab, 64 ref.

Descriptors: *Parametric hydrology, Hydrologic models, Model Studies, Model testing, *Rainfall-Runoff relationships, *Semiarid lands, Prairie Dog Creek basin, Tongue River basin, *Montana.

The U.S. Geological Survey's precipitation-runoff modeling system was tested using 2 year's data for the daily mode and 17 storms for the storm mode from a basin in southeastern Montana. Two hydrologic response unit delineations were studied. The more complex delineation did not provide superior results. In this application, the optimum numbers of hydrologic response units were 16 and 18 for the two alternatives. The first alternative with 16 units was modified to facilitate interfacing with the storm mode. A parameter subset was defined for the daily mode using sensitivity analysis. Following optimization, the simulated hydrographs approximated the observed hydrograph during the first year, a year of large snowfall. More runoff was simulated than observed during the second year. There was reasonable correspondence between the observed snowpack and the simulated snowpack the first season but poor the second. More soil moisture was withdrawn than was indicated by soil moisture observations. Optimization of parameters in the storm mode resulted in much larger values than originally estimated, commonly larger than published values of the Green and Ampt parameters. Following optimization, variable results were obtained. The results obtained are probably related to inadequate representation of basin infiltration characteristics and to precipitation variability. (USGS)
W86-02390

CALIBRATION PROCEDURE FOR A DAILY FLOW MODEL OF SMALL WATERSHEDS WITH SNOWMELT RUNOFF IN THE GREEN RIVER COAL REGION OF COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
J. M. Norris, and R. S. Parker.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4263, 1985. 32 p, 18 fig, 8 tab, 10 ref.

Descriptors: *Model studies, *Snowmelt, *Calibrations, Soil water, *Runoff prediction, *Colorado, *Precipitation-Runoff Modeling System.

A calibration procedure was developed for the U.S. Geological Survey's Precipitation-Runoff Modeling System for watersheds in which snowmelt is the major contributor to runoff. The model uses daily values of air temperature and precipita-

tion as input and the output is mean daily discharge. The procedure appears sufficient to calibrate both streamflow volume and the timing of mean daily discharge if other model parameters are reasonably estimated. Model structure and sensitivity analysis suggest that one of the most important parameters is the available water-holding capacity of the soil (SMAX). Changing this parameter through a series of iterations, the calibration procedure minimizes the error between observed and predicted annual discharge. The calibration suggests that the single parameter SMAX may be sufficient for optimizing both the volumes and the timing of runoff, assuming other model parameters are adequately estimated. Additional optimization on parameters sensitive to timing does not appear to improve prediction. This indicates that these parameters were estimated accurately prior to calibration. Further investigation is needed on more watersheds to determine SMAX's ability to calibrate volume and tuning with a constant set of other model parameter values. (USGS)
W86-02403

2B. Precipitation

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 JANUARY 1979 THROUGH 30 SEPTEMBER 1984: VOLUME ONE - EXECUTIVE SUMMARY,

Atmospherics, Inc., Fresno, CA..
Final Report, September 1984. 35 p, 1 fig. 9-07-85-V0020.

Descriptors: *Weather modification, *Precipitation, *Data collections, Orographic precipitation, Supercooling, Meteorological data collections, Cloud physics, Cloud seeding, *Sierra Cooperative Pilot Project, Sierra Nevada Mountains, Measuring instruments, Snow, Ice, *California.

This volume (1 of 3) briefly summarizes all weather modification data collection and analysis tasks performed by Atmospherics Incorporated during the period 1 January 1979 through September 1984 within the Sierra Cooperative Pilot Project. The major categories of work included the installation, operation, and maintenance of, plus data collection and analysis from (1) a network of precipitation gages, (2) ground-based instrumentation for the detection of supercooled liquid water, (3) a network of surface meteorological stations, (4) a fixed microphysics station, (5) snow and high-volume air samplers and (6) NCAR Ice Nucleus counters. Summaries of work performed during the six seasons of field activities, including data acquition, data processing, instrument calibration, and maintenance and anlaysis efforts, are presented. (Author)
W86-01984

THUDERSTORMS: A SOCIAL, SCIENTIFIC, AND TECHNOLOGICAL DOCUMENTARY. VOLUME 3: INSTRUMENTS AND TECHNIQUES FOR THUNDERSTORM OBSERVATION AND ANALYSIS.

National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-146076, Price codes: A14 in paper copy, A01 in microfiche. April 1982. Edited by Edwin Kessler. 313 p.

Descriptors: *Thunderstorms, *Radar, *Data acquisition, *Satellite technology, *Meteorological data collections, Storms, Tornadoes, Rainstorms, Photogrammetry, Hail, Networks, Acoustics, Data collections, Weather data collections, Instrumentation, Networks.

This third and last volume of a comprehensive documentation of thunderstorms presents tools and techniques for acquisition and analysis of data on thunderstorms. Topics covered include: station networks for storm observation, tornado interception with mobile teams, observations from instrumented aircraft, photogrammetry of thunderstorms, storm acoustics, infrasound from thunderstorms, sferics and other electrical techniques for storm investigations, observation and measurement of hailfall, and the use of satellite observations. An appendix to the chapter on measuring storm rainfall is included which provides mathematical equations to adjust for various biases caused by receivers, rainfall, attenuation, clouds and atmospheric gases. (Geiger-PTT)
W86-02003

STATION NETWORKS FOR STORM OBSERVATION,

National Weather Service, Sterling, VA. Test and Evaluation Div.
For primary bibliographic entry see Field 7B.
W86-02004

OBSERVATIONS FROM INSTRUMENTED AIRCRAFT,

National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
For primary bibliographic entry see Field 7B.
W86-02005

OBSERVATION AND MEASUREMENT OF HAILFALL,

National Center for Atmospheric Research, Boulder, CO. Convective Storms Div.
For primary bibliographic entry see Field 7B.
W86-02007

QUALITY AND QUANTITY OF URBAN RUNOFF AND ATMOSPHERIC DEPOSITION IN URBAN AREAS OF SALT LAKE COUNTY, UTAH, 1980-1981,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02346

FLOODS OF APRIL 18, 1983 ON ST. THOMAS AND ST. JOHN, U.S. VIRGIN ISLANDS,

Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02362

2D. Evapcration and Transpiration

APPLICATION OF A PLANT-ENVIRONMENT MODEL TO PROBLEMS IN IRRIGATION,

Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W86-02128

INSTRUMENTATION FOR MEASURING LAKE AND RESERVOIR EVAPORATION BY THE ENERGY-BUDGET AND MASS-TRANSFER METHODS,

Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-02379

2E. Streamflow and Runoff

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1984,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-01926

EVALUATION OF THE SURFACE-WATER DATA NETWORK, SUWANNEE RIVER BASIN, FLORIDA, 1982,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-01936

HYDROLOGY OF AREA 11, EASTERN COAL PROVINCE, OHIO, KENTUCKY, AND WEST VIRGINIA,

Geological Survey, Columbus, OH. Water Resources Div.
D. K. Roth, and S. C. Cooper.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-233, 1984. 66 p, 45 fig, 4 tab, 73 ref.

Descriptors: *Coal Mines, *Environmental Effects, Mine Drainage, Water Quality, Erosion, Sedimentation, *Eastern Coal Province, *Ohio, Kentucky, West Virginia.

The Eastern Coal Province is divided into 24 separate hydrologic reporting areas. The division is based on hydrologic factors, location, size, and mining activity. Area 11 of the Eastern Coal Province comprises 3,190 square miles of southeastern Ohio, northeastern Kentucky, and western Virginia. Except for the wide, flat flood plain along the Ohio River, it consists mainly of rolling hills. Most of the area is forested. Precipitation in the area ranges from 39 inches per year in the north to 45 inches per year in the south. Coal seams 1 to 4 feet thick are found in rocks of Pennsylvanian age that crop out in Area 11. Surface mining of coal is concentrated in the Ohio part; surface mines are scattered throughout the Kentucky part, and there are no known mines in the West Virginia part. Most of the streams that drain less than 100 square miles normally approach zero flow from late June through October. The average value of the 50-percent daily duration flow (based on eight stations) is 0.37 cubic feet per second per square mile. The 2-year flood-peak magnitude (based on seven stations) ranges from 10.8 to 138 cubic feet per second per square mile; the average 2-year flood peak is 43.8 cubic feet persecond per square mile. The pH of sampled streams ranged from 2.6 to 8.8. The median pH at mined sites was 5.4 whereas the median pH at unmined sites was 7.3. Dissolved iron concentrations ranged from 0 to 150,000 micrograms per liter; medians were 893 micrograms per liter at mined sites and 90 micrograms per liter at unmined sites. Sulfate concentrations ranged from 9.8 to 2,100 milligrams per liter; medians were 203 milligrams per liter at mined sites and 50 milligrams per liter at unmined sites. Although water wells in alluvium along the Ohio River produce up to 1,500 gallons per minute, bedrock wells throughout most of Area 11 typically yield only 1 or 2 gallons per minute. Chemical analyses of ground water indicate that bicarbonate is the major anion in Area 11; calcium and sodium are the major cations. (USGS)
W86-01937

EFFECTS OF URBANIZATION OF THREE PONDS IN MIDDLETON, WISCONSIN,

Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-01949

EVALUATION OF RAINFALL-RUNOFF DATA FOR THE DENVER FEDERAL CENTER, LAKEWOOD, JEFFERSON COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
R. D. Jarrett, and J. E. Veenhuis.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4050, 1984. 67 p, 11 fig, 7 tab, 24 ref.

Descriptors: *Storm runoff, *Streamflow, Water management, *Rainfall-runoff relations, *Hydrograph analysis, *Floods, Flow discharge, Thunderstorms, Streamflow gages, Rain gages, Data collections, Stage-discharge relations, *Colorado, Jefferson County, Lakewood, Denver Federal Center.

An investigation was made to monitor the storm runoff in McIntyre Gulch basin to determine the rainfall-runoff chracteristics. Results may now be used to evalute the effects of future development

on storm runoff from the Denver Federal Center, which is located in the McIntyre Gulch basin in Lakewood, CO. Rainfall and runoff data were collected at eight streamflow stations and three auxiliary rainfall stations in and adjacent to the Denver Federal Center. The outflow peak discharges from McIntyre Gulch in the Denver Federal Center were higher than the inflow peak discharges for eight of the storms by an average of 38 percent. Outflow peak discharges for eight of the storms were lower by an average of 12 percent. The study demonstrated that runoff varies with location of a storm--even for a relatively small basin. Peak discharges of McIntyre Gulch outflow from the Denver Federal Center were 27 percent greater than the inflow for all storms, but only 15 percent greater for evenly distributed storms. Runoff from the Denver Federal Center increased storm-runoff volumes in McIntyre Gulch by an average of 46 percent. Proper management of storm runoff in the Denver Federal Center requires that proposed improvements to the existing storm-runoff system maintain peak flows at their present levels. (USGS)
W86-01956

DETERMINATION OF REAERATION COEFFICIENTS FOR OHIO STREAMS,

Geological Survey, Columbus, OH. Water Resources Div.
J. Hren.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4139, 1984. 25 p, 1 fig, 3 tab, 10 ref.

Descriptors: *Aeration, *Ohio, Streams, *Reaeration, Regression analysis, Tracers, *Reaeration coefficients, Hydrocarbon tracers.

The hydrocarbon gas tracer technique was used to determine reaeration coefficients on 30 reaches of Ohio streams. The studies were done from September 1979 through August 1982 to determine the reaeration coefficients for the individual reaches and to develop general equations that could be used to estimate the coefficients. Multiple linear regression was used to determine relationships among the reaeration coefficients and physical stream characteristics. Four special equations based on the general information were developed from various combinations of discharge, slope, width, depth, measured velocity, and estimated velocity. The standard errors of estimate for these equations ranged from 37 to 46 percent. The variables that resulted in the lowest standard error of estimate were discharge, slope, width, depth, and measured velocity. The most significant variables were depth and velocity. (USGS)
W86-01958

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-01961

COMPILATION OF DATA COLLECTED AND DERIVED FOR WATER YEARS 1980 AND 1981 FOR THE PURPOSE OF WATER-QUALITY MODELING OF THE LOWER OUACHITA RIVER AND SELECTED TRIBUTARIES, SOUTH-CENTRAL ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01965

STREAMFLOW ROUTING IN THE SCHOHARIE CREEK BASIN, NEAR NORTH BLENHEIM, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
S. W. Wolcott.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4054, 1983. 20 p, 4 fig, 3 tab, 7 ref.

Descriptors: *Flood Routing, *River Forecasting, *Model Studies, Historic Flood, Hydrographs, *New York, Schoharie Creek, HEC-1 model.

A flow-routing model of the upper Schoharie Creek basin, New York, was developed and used to simulate high flows at the inlet of the Blenheim-Gilboa Reservoir. The flows from Schoharie Creek at Prattsville, the primary source of flow data in the basin, and tributary flows from the six minor basins downstream, are combined and routed along the 9.7 mile reach of the Schoharie Creek between Prattsville and the reservoir inlet. Data from five historic floods were used for model calibration and four for verification. The accuracy of the model as measured by the difference between simulated and observed total flow volumes, is within 14 percent. Results indicate that inflows to the Blenheim-Gilboa Reservoir can be predicted approximately 2 hours in advance. One of the historical floods was chosen for additional model testing to assess a hypothetical real-time model application. Total flow-volume errors ranged from 30.2 percent to -9.2 percent. Alternative methods of obtaining hydrologic data for model input are presented for use in the event that standard forms of hydrologic data are unavailable. (USGS)
W86-01968

ASSESSMENT OF WATER RESOURCES AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO,

Geological Survey, Pueblo, CO. Water Resources Div.
G. J. Leonard.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4270, 1984. 124 p, 21 fig, 18 tab, 32 ref.

Descriptors: *Surface water, *Groundwater, *Water quality, *Colorado, El Paso County, Fort Carson Military reservation, Arkansas River Valley, Front Range Urban Corridor, Water supply, Data collections.

The Fort Carson Military Reservation adjoins the rapidly growning Colorado Springs metropolitan area, where locally available water supplies are limited and strictly administered. Fort Carson purchases about 3,400 acre-feet of treated water annually from the city of Colorado Springs. The major streams entering Fort Carson have an estimated average annual discharge of 6,240 acre-feet of water per year upstream from diversions for municipal and domestic water supplies. The streamflow is unevenly distributed in time and consequently not dependable as a large or sole source of water. Ground water is available from alluvial and bedrock aquifers. Wells with yields greater than 100 gallons per minute can be expected from the alluvium along Rock and Little Fountain Creeks and from some parts of the Dakota-Purgatoire aquifer. The quality of surface water entering Fort Carson is generally suitable for irrigation and drinking but deteriorates eastward across Fort Carson. Water from the alluvial aquifer along Rock and Little Fountain Creeks in the eastern part of Fort Carson contains fluoride in concentrations exceeding drinking-water standards. Water from the Dakota-Purgatoire aquifer characteristically contains radiochemical constituents in concentrations that exceed drinking-water standards. (USGS)
W86-01969

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME I: DRAINAGE REGIONS A, B-THE LIMPOPO-OLIFANTS SYSTEM,

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
B. J. Middleton, W. V. Pitman, D. C. Midgley, and R. M. Robertson.
Report No. 10/81; Part 2 (Appendices), March 1982. 331 p.

Descriptors: *Surface-groundwater relations, *Groundwater, *Data processing, Rivers, Limpopo River, Olifants River, South Africa, Data collections, Computer programs, Runoff, Reservoirs, Frequency analysis, Sediment yield, Rainfall, Streamflow, Evaporation, Meteorological data collection, Synthetic hydrology, Watersheds, Hydrology, Flow duration, Land use, Precipitation.

The appendices to Part 1 contain the following information on the Limpopo-Olifants system of South Africa: (A) hydrometeorological data (rainfall, streamflow, evaporation), (B) land use (irrigation, afforestation, reservoirs), (C) breakdown of tertiary catachments, (D) synthetic hydrology, (E) quaternary subcatchments, (F) storage requirements (flow duration-frequency plots, hydrological zones, evaporation loss, sediment yield), and (G) users guide to computer programs. (Cassar-PTT)
W86-01990

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME IV: DRAINAGE REGIONS E, G, H, J, K, L - THE WESTERN CAPE,

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
W. V. Pitman, D. J. Potgieter, B. J. Middleton, and D. C. Midgley.
Report No 13/81: Part 2(Appendices), May 1982. 521 p.

Descriptors: *Hydrologic data, *Surface waters, Surface-groundwater relations, *Groundwater, *Data processing, Rivers, *South Africa, Data collections, Computer programs, Runoff, Reservoirs, Frequency analysis, Sediment yield, Rainfall, Streamflow, Evaporation, Meteorological data collection, Synthetic hydrology, Watersheds, Hydrology, Flow duration, Land use, Precipitation.

The appendixes to Part 1 contain the following information on the Western Cape region of South Africa: (A) hydrometeorological data (rainfall, streamflow, evaporation), (B) land use (irrigation, afforestation, reservoirs), (C) breakdown of tertiary catchments, (D) synthetic hydrology, (E) quaternary subcatchments, (F) storage requirements (flow duration-frequency plots, hydrological zones, evaporation loss, sediment yield), and (G) users guide to computer programs. (Cassar-PTT)
W86-01997

MAGNITUDE AND FREQUENCY OF FLOOD VOLUMES FOR URBAN WATERSHEDS IN LEON COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
M. A. Franklin.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4233, 1984. 20 p, 2 fig, 5 tab, 32 ref.

Descriptors: *Regression analysis, *Flood recurrence interval, *Rainfall-runoff, *Unit hydrograph, Data collections, *Leon County, *Florida.

Techniques are provided for estimating runoff magnitudes for urban-flow streams in Leon County, Florida, for recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years. Synthetic runoff volumes were generated by using a calibrated lumped-parameter rainfall-runoff model, pan evaporation data from Milton, Florida, and long-term unit rainfall records from Thomasville-Coolidge, Georgia, and Pensacola, Florida. The synthetic runoff volumes were used to develop station runoff-frequency relations which were used in multiple linear regression analyses to derive regional equations relating runoff to basin characteristics. The significant basin characteristic was impervious area. The average standard error of regression was + or - 16 percent for all recurrence intervals except the 2-year, + or - 18 percent and the 500-year + or - 17 percent. (USGS)
W86-02354

FLOODS OF APRIL 18, 1983 ON ST. THOMAS AND ST. JOHN, U.S. VIRGIN ISLANDS,

Geological Survey, San Juan, PR. Water Resources Div.
R. E. Curtis.
Available from OFSS, USGS, Box 25425 Lake-

Field 2—WATER CYCLE

Group 2E—Streamflow and Runoff

wood, CO 80225. USGS Water-Resources Investigations Report 84-4184, 1984. 12 p, 6 fig, 1 tab, 4 ref.

Descriptors: *Flood flow, Flood frequency, Peak flow, Flood profiles, Excess rainfall, Flood damage, *U.S. Virgin Islands, *St. Thomas, *St. John.

The U.S. Virgin Islands of St. Thomas and St. John experienced the most intense rainfall event in recorded history on April 18, 1983. Rainfall intensities of 2.5 inches per hour, and more than 16 inches in 18 hours were recorded. Almost instantaneous runoff caused widespread flood near the coastlines of both islands. Parts of Charlotte Amalie in St. Thomas were inundated with 4 feet or more of mud and flood water. Harry S. Truman Airport was flooded for 2 days with 2 to 3 feet of ponded water. On St. John, rural areas near Guinea Gut, Fish Bay, and Coral Bay were flooded. (USGS)
W86-02362

GEOLOGIC AND HYDROLOGIC DATA COLLECTED DURING 1976-1984 AT THE SHEFFIELD LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE AND ADJACENT AREAS, SHEFFIELE, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
J. B. Foster, G. Garklava, and G. W. Mackey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 83-926, 1984. 261 p, 2 fig, 9 tab, 7 ref.

Descriptors: *Groundwater, *Geology, *Glacial soils, *Radioactive wastes, Waste disposal sites, *Illinois, Bureau County, Sheffield, Water quality.

Hydrogeologic studies were conducted at the low-level radioactive-waste disposal site near Sheffield, Illinois, from 1976-1984. Data in this report include water levels in wells, lake stages, inorganic, organic, and radiometric chemical analyses of ground and surface water, hydraulic conductivities of glacial materials, grain-size distribution, clay and carbonate mineralogy, and cation exchange capacities of the glacial materials. Also included are results of petrographic analyses, physical measurements of wells, stratigraphy and lithology of cores collected from test wells, and horizontal coordinates of wells. (USGS)
W86-02372

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
L. E. Stullken.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4162, 1985. 49 p, 11 fig, 2 tab, 17 ref.

Descriptors: Hydrology, Steady-state model, Groundwater flow, Recharge, Discharge, Base flow, *Hydrogeology, Surface-groundwater relationships, Model studies, *Prairie Dog Creek Valley, *Kansas.

Development of water resources has been a major factor in the economy of Prairie Dog Creek valley in north-central Kansas. Releases from Norton reservoir to the Almena Irrigation District averaged 6,900 acre-feet per year during 1967-76. The number of irrigation wells increased from 4 to 147 during 1947-78. Ground water in the valley is derived mostly from the alluvial aquifer. The effects of irrigation on the aquifer are indicated by water-level changes. The water in storage increased from 130,000 to 136,000 acre-feet during 1947-78 due to recharge from surface-water irrigation. A steady-state model of the aquifer prior to irrigation (1947) indicated that most recharge was from precipitation (88 percent) and most discharge was to streams (54 percent) and evapotranspiration (26 percent). Although aquifer storage increased in this area, storage generally decreased in other areas of western Kansas. (USGS)
W86-02377

PHASE I SUMMARY AND PHASE II PLAN FOR COMPARING REGULATED WITH UNREGULATED STREAMFLOW IN THE YAKIMA RIVER AT UNION GAP, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02378

GAZATTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--MERRIMACK RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02381

TIME OF TRAVEL, WATER QUALITY, AND BED-MATERIAL QUALITY FOR THE CUYAHOGA RIVER WITHIN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02389

APPLICATION OF THE U.S. GEOLOGICAL SURVEY'S PRECIPITATION-RUNOFF MODELING SYSTEM TO THE PRAIRIE DOG CREEK BASIN, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02390

SELECTED HYDROLOGIC DATA FOR THE SOUTH PLATTE RIVER THROUGH DENVER, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02391

SURFACE-WATER INFLOW TO PUGET SOUND, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02395

CALIBRATION PROCEDURE FOR A DAILY FLOW MODEL OF SMALL WATERSHEDS WITH SNOWMELT RUNOFF IN THE GREEN RIVER COAL REGION OF COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02403

WATER RESOURCES OF THE COTTONWOOD WASH WATERSHED, UTE MOUNTAIN, UTE INDIAN RESERVATION, SOUTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
A. L. Geldon.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4027, 1985. 56 p, 13 fig, 10 tab, 48 ref.

Descriptors: Watersheds, Intermittent streams, *Alluvial aquifers, *Springs, *Water supply, *Water quality, Hydrologic budget, *Groundwater-surface water relations, *Colorado, Montezuma County, *Four Corners area, Ute Mountain, Ute Indian Reservation, Towaoc, Cottonwood Wash, Sleeping Ute Mountain.

Cottonwood Wash, near Towaoc, Colorado, is a 16-square-mile watershed with an estimated average annual precipitation influx of 14,600 acre-feet. Most of this water is consumed by evapotranspiration. Except for snowmelt in the spring months and infrequent rain storms, all flow in the wash is from springs issuing from talus, block rubble, alluvium, colluvium, and Mancos Shale. Flow is greatest during the spring months when the ground is saturated from snowmelt and least during the early fall when many springs cease flowing. Most of the water in the wash upstream from Towaoc is diverted to Cottonwood Reservoir. Springs in the wash downstream from Towaoc are distributary. Most of the water from these springs, however, seeps back into the alluvium. One of these springs supplies about 19 acre-feet of water per year to Towaoc. The cumulative flow from 17 springs and diffuse seepage was about 290 acre-feet in the 1982 water year. The quantity of recoverable water in the younger of two pediment deposits is about 2,000 to 4,000 acre-feet, depending on seasonal and yearly variations in precipitation. Estimated underflow from the wash in the 1982 water year was 740 acre-feet; estimated recharge to bedrock was 850 acre-feet. Water from block rubble and talus is suitable for most purposes; water from Mancos Shale and alluvium may contain concentrations of dissolved solids that are unacceptable for domestic use. (USGS)
W86-02404

STREAM DISCHARGE IN MICHIGAN--MISCELLANEOUS MEASUREMENTS,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02409

STATISTICAL MODELS FOR ESTIMATING FLOW CHARACTERISTICS OF MICHIGAN STREAMS,

Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag, and H. M. Croskey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4207, 1984, [illegible]0 p, 8 fig, 15 tab, 15 ref.

Descriptors: *Regression analysis, *Estimating equations, *Flow characteristics, River basins, Hydrometeorology, Average flow, Low flow, Duration curves, Peak discharge, Regional analysis, *Michigan, *Statistical models.

Multiple-regression equations provide statistical models to estimate flow characteristics at ungaged sites in Michigan. The equations require determination of several readily measureable basin and metereological characteristics and an areal adjustment factor. Flow characteristics for which estimating equations have been prepared include mean and mean monthly flow, flow-duration, low flow, peak discharge, and flood volume. The precision of the flow estimate varies with the flow characteristics being estimated and the basin characteristics have the lowest standard errors, whereas peak flow and low flow characteristics have the highest standard errors. Sites that have basin characteristics similar to the basin characteristics used to develop the regression equations can be estimated more precisely. Confidence limits can be computed about the estimates using information included in the report. Need for additional gaging stations is assumed to be proportional to the standard error of residuals found among five regions designated in Michigan. Additional continuous-record stations may be most beneficial in region 3 for reducing the standard error of mean and mean monthly flow equations. Additional partial-record stations may be useful in region 4 for reducing the standard error of low flow and peak flow estimates. (USGS)
W86-02411

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--HUDSON RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02416

PRAGMATIC APPROACH TO EVALUATING A MULTIPURPOSE STREAM-GAGING NETWORK,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02417

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--COASTAL RIVER BASINS OF THE NORTH SHORE,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02418

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--CONNECTICUT RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02419

2F. Groundwater

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA, MAY 1985,

Geological Survey, Tampa, FL. Water Resources Div.
G. L. Barr.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-482, 1985. 1 p, 2 fig, 2 ref.

Descriptors: *Potentiometric level, Potentiometric flow, Hydrology, Hydrogeology, *Florida, *Maps.

A May 1985 potentiometric surface map of the Upper Floridan aquifer in west-central Florida depicts the annual low water-level period. Most areas of west-central Florida were experiencing drought conditions and water levels were at or approaching near-record low levels. Water levels in most wells measured in May 1985 were lower than in September 1985. May levels averaged about 5 feet lower than September levels in areas north of latitude 28 degrees 07' and about 13 feet lower in southern areas. Generally, water levels in May 1985 averaged about 4 feet lower than May 1984 levels in the north and about 6 feet lower in the south. (USGS)
W86-01920

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,

Geological Survey, Lakewood, CO. Water Resources Div.
W. H. Langer, W. R. Moyle, L. R. Woolfender, and D. A. Mulvihill.
Available from OFSS, USGS BOX 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4116-B, 1983. 6 p, 3 fig, 40 ref.

Descriptors: *Groundwater levels, *Springs, Hydrogeology, *Groundwater data, Basin and Range province, *California.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the southern California part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to ground water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas are shaded where the depth to the water table is generally greater than 500 feet. (USGS)
W86-01921

GEOHYDROLOGY OF VOLCANIC TUFF PENETRATED BY TEST WELL UE-25BNO1, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Lahoud, D. H. Lobmeyer, and M. S. Whitfield.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4253, 1984. 44 p, 25 fig, 5 tab, 24 ref.

Descriptors: *Nevada, *Radioactive waste disposal, *Water levels, Hydrogeology, *Hydrologic properties, Igneous rocks, *Yucca Mountain, Nevada Test Site.

Test well UE-25bNo1, located on the east side of Yucca Mountain in the southwestern part of the Nevada Test Site, was drilled to a total depth of 1,220 meters and hydraulically tested as part of a program to evaluate the suitability of Yucca Mountain as a nuclear-waste repository. The well penetrated almost 46 meters of alluvium and 1,174 meters of Tertiary volcanic tuffs. The composite hydraulic head for aquifers penetrated by the well was 728.9 meters above sea level (471.4 meters below land surface) with a slight decrease in loss of hydraulic head with depth. Average hydraulic conductivities for stratigraphic units determined from pumping tests, borehole-flow surveys, and packer-injection tests ranged from less than 0.001 meter per day for the Tram Member of the Crater Flat Tuff to 1.1 meters per day for the Bullfrog Member of the Crater Flat Tuff. The small values represented matrix permeability of unfractured rock; the large values probably resulted from fracture permeability. Chemical analyses indicated that the water is a soft sodium bicarbonate type, slightly alkaline, with large concentrations of dissolved silica and sulfate. Uncorrected carbon-14 age dates of the water were 14,100 and 13,400 years. (USGS)
W86-01923

COMPUTER MODEL OF ONE-DIMENSIONAL EQUILIBRIUM CONTROLLED SORPTION PROCESSES,

Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01925

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1984,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-01926

HYDROGEOLOGY AND EFFECTS OF TAILINGS BASINS ON HYDROLOGY OF SANDS PLAIN, MARQUETTE COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
N. G. Grannemann.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4114, 1984. 98 p, 31 fig, 21 tab, 32 ref.

Descriptors: *Hydrogeology, Groundwater recharge, Groundwater movement, Groundwater runoff, *Surface water - groundwater relationships, Obstruction to flow, Hydraulic conductivity, Leakage, Computer models, Marquette Iron Range, Marquette County, *Michigan.

A hydrogeological study of Sands Plain, a sandy outwash area in the north-central part of Michigan's Upper Peninsula, was conducted during 1979-82. Parts of the area are being considered as possible sites for construction and operation of iron mining tailings basins. Gribben Basin, an existing tailings basin in the western part of Sands Plains, covers 2.5 square miles; hypothetical tailings basins may cover as much as 11 square miles. Glacial deposits are the area's principal aquifer. The general direction of ground-water flow is from the outwash area toward Lake Superior. Before reaching Lake Superior, however, most ground water is discharged in a series of nearly parallel streams. Ground water accounts for 95 percent of the discharge of these streams. Precipitation collected at two sites had average pH values of 4.0. Dissolved solids concentrations in water from wells ranged from 41 to 246 milligrams per liter; in water from streams, they ranged from 82 to 143 milligrams per liter. Calcium and bicarbonate were the principal dissolved ions. A two-dimensional digital model of ground-water flow was used to simulate ground-water levels and runoff. The predictive computer simulations indicate that construction and operation of Gribben tailings basin, located in the western part of the study area, decreased ground-water flow to Goose Lake Outlet by 0.9 to 1.6 cubic feet per second. Construction and operation of four hypothetical tailings basins covering a total of 11 square miles is estimated to reduce ground-water flow to the area's streams by 7 to 18 cubic feet per second depending on the hydraulic properties of material comprising the basin boundaries. Leakage from all of the basins is estimated to range from 0.7 to 7 cubic feet per second. (USGS)
W86-01927

WATER RESOURCES AND EFFECTS OF DEVELOPMENT IN HERNANDO COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-01931

GROUND-WATER HYDROLOGY OF VOLUSIA COUNTY, FLORIDA, WITH EMPHASIS ON OCCURRENCE AND MOVEMENT OF BRACKISH WATER,

Geological Survey, Orlando, FL. Water Resources Div.
A. T. Rutledge.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4206, 1985. 84 p, 42 fig, 6 tab, 19 ref.

Descriptors: Brackish water, *Saltwater intrusion, *Drawdown, *Freshwater-saltwater interface, *Saline water intrusion, Path of pollutants, *Florida, Volusia County.

Brackish water is present in the eastern and western fringes of Volusia County, Florida in the surficial aquifer and in the Floriden aquifer system. Average pumpage in 1980 in Volusia County was 66 million gallons per day. Water levels in the Floridan aquifer system declined more than 10 feet over an area of 70 square miles from 1955 to 1982. The annual water budget of the budget of the Floridan aquifer system consists of 5 inches downward leakage inflow, 1 inch upward leakage outflow, 1 inch horizontal inflow, 1.5 inches horizontal outflow, 2.5 inches discharge from springs and flowing wells, and 1 inch pumpage. Saltwater intrusion is occurring in the surficial aquifer on the barrier island. There is little evidence that intrusion is occurring uniformly over large areas in the Floridan aquifer system. Vertical intrusion is occurring at sites of public-supply pumping. Many of these wells in the fringes of the county have been abandoned and replaced by wells closer to the central part of the county. Minimizing well depth is probably the single most effective step against intrusion. (USGS)
W86-01932

USE OF DOUBLE-MASS CURVES TO DETERMINE DRAWDOWN IN A LONG-TERM AQUIFER TEST IN NORTH-CENTRAL VOLUSIA COUNTY, FLORIDA,

Geological Survey, Orlando, FL. Water Resources

Div.
A. T. Rutledge.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4309, 1985. 29 p, 17 fig, 1 tab, 10 ref.

Descriptors: Drawdown, Aquifer test, Capture, Double-mass curve, Leakage, *Groundwater levels, Water yield, *Florida, Volusia County.

A test well withdrew water from the upper Floridan aquifer system at an average of 530 gallons per minute from June 1978 to July 1979. Ground-water levels were monitored in wells open to the upper Floridan (artesian) aquifer system and in wells open to the surficial (water-table) aquifer. Double-mass curves were used to separate drawdown from natural water-level fluctuations. Drawdowns in the Floridan were 4.3 feet at a site 350 feet away from the pumped well, 4.1 feet at a site 1,000 feet away, 1.0 foot at a site 1.0 mile away, and 0.4 foot at a site 5.8 miles away. After an initial drawdown of 0.2 foot at a surficial aquifer well 1,000 feet from the pumped well, there was some recovery, and long-term drawdown averaged less than 0.2 foot. In a five-day aquifer test during a period of no rainfall in 1976, the ratio of surficial aquifer drawdown to Floridan aquifer system drawdown reached equilibrum at 0.05. The results of the long-term test indicate that this ratio is the upper limit of long-term drawdown because of capture of evapotranspiration and runoff during the long-term test. (USGS)
W86-01933

WIRELINE-ROTARY AIR CORING OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-01934

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01938

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFF AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01939

OCCURRENCE OF SALINE WATER IN THE ALLUVIAL AQUIFER IN THE BOEUF-TENSAS BASIN, ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01940

NITROGEN, SULFATE, CHLORIDE, AND MANGANESE IN GROUND WATER IN THE ALLUVIAL DEPOSITS OF THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, WELD COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01941

POTENTIOMETRIC MAP OF THE PALEOZOIC AQUIFER IN NORTHEASTERN MISSISSIPPI, NOVEMBER AND DECEMBER 1982,

Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4254, 1984. 1 sheet, 3 fig, 6 ref.

Descriptors: *Potentiometric map, *Water level, Groundwater, Aquifers, Hydrogeology, *Mississippi, Paleozoic rock.

The Paleozoic rocks that outcrop in Tishomingo County, Mississippi, supply water to public, industrial, and domestic wells in two counties in the northeastern part of the State. Paleozoic rocks in the area consist mostly of beds of sandstone, shale, and limestone which dip about 30 feet per mile to the southwest. The potentiometric surface of the Paleozoic aquifer slopes generally to the west away from the area of outcrop and is strongly affected by large groundwater withdrawals at Corinth. The water level at Corinth has declined about 160 feet from 1954 to 1974 and recovered about 45 feet by 1982. Wells that were near the center of the cone of depression have been replaced by new wells located away from the center. (USGS)
W86-01942

POTENTIOMETRIC SURFACE MAP OF THE ALLUVIAL AQUIFER, EASTERN ARKANSAS, SPRING 1983,

Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds, and D. J. Fitzpatrick.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4264, 1984. 1 sheet, 5 fig, 7 ref.

Descriptors: Potentiometric level, *Water level, Hydraulic gradient, *Arkansas, *Missippi River alluvial aquifer, *Arkansas County, *Poinsett County.

The Mississippi River Alluvial Aquifer is a major source of water supply for irrigation in much of eastern Arkansas. Hydrologic maps of the potentiometric surface, water-level changes and depths to water in the aquifer, based on Spring 1983 measurements, are presented. The Mississippi River Alluvial Aquifer is comprised of Quaternary alluvial flood-plain and terrace deposits. The aquifer generally is partially-confined. Recharge to the aquifer is principally through precipitation and surface-water bodies. The potentiometric surface map indicates two cones of depression occurring in the aquifer beneath Arkansas, Poinsett, and Cross Counties as a result of heavy pumpage within these areas. A comparison of water-level data from 1982 and 1983 shows water levels in the aquifer generally decreasing in the area within the cones of depression. Water levels generally increased in the remainder of the area south and west of the White River, and along the Mississippi River. A map showing the depth to water below land surface indicates that water levels are generally shallowest near the Mississippi River and the Fall Line and deepest within the cone of depression. (USGS)
W86-01943

POTENTIOMETRIC SURFACE MAP OF THE SPARTA SAND AND MEMPHIS SAND AQUIFERS IN EASTERN AND SOUTH-CENTRAL ARKANSAS, SPRING 1983,

Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds, and D. J. Fitzpatrick.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4265, 1984. 1 sheet, 3 fig, 5 ref.

Descriptors: *Potentiometric level, *Groundwater levels, Groundwater, Water levels, *Arkansas, *Sparta Sand aquifer, *Memphis Sand aquifer.

The Sparta Sand and the Memphis Sand aquifers are a major source of industrial and public water supply and a minor but locally significant source of water for agricultural purposes in eastern and south-central Arkansas. The potentiometric surface map for this aquifer, compiled from water-level measurements made during the spring of 1983, indicates a generally southward potentiometric gradient. The potentiometric surface also illustrates the existence of three major cones of depression; one centered in Columbia County, one in Union County, and one in Jefferson County. Within the cones of depression, the majority of water withdrawn is utilized for industrial and public supply. The water-level change map for the Sparta Sand and the Memphis aquifer for the period between the springs of 1982 and 1983 shows overall a rise in water levels across the study area, including the cones of depression in Jefferson and Union Counties; however, water levels within the cone depression in Columbia County generally declined. (USGS)
W86-01944

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY ARGILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01945

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01946

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01947

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY AGRILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01948

GROUND-WATER DATA FOR MICHIGAN–1983,

Geological Survey, Lansing, MI. Water Resources Div.
G. C. Huffman.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-623, 1984. 47 p, 5 fig, 2 tab, 100 ref.

Descriptors: *Water resources, *Groundwater, *Groundwater hydrographs, Water levels, Water use, Water quality, *Michigan.

Water levels, locations, depths, and aquifers tapped are given for 115 observation wells in Michigan. Tabulated data include extremes of water levels for 1983 and for the period of record, pumpage of most major ground-water users in the state and quality data on selected wells. The largest reported user of ground water, the city of Lansing, pumped 8.1 billion gallons from the Saginaw Formation and glacial deposits. (USGS)
W86-01950

OCCURRRENCE OF BEDS OF LOW HYDRAULIC CONDUCTIVITY IN SURFICIAL DEPOSITS OF FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
H. G. Healy, and J. D. Hunn.
Available from OFSS, USGS Box 25425. USGS Water-Resources Investigations Report 84-4210, 1984. 1 p, 1 fig, 1 tab, 59 ref.

Descriptors: Permeability coefficient, *Hydrologic maps, Infiltration, Percolation, *Groundwater, *Geohydrology, *Florida.

The disposal of municipal and industrial wastes on or at shallow depths below land surface can result in contamination of ground water--the source of

drinking water for more than 90 percent of Florida's residents. This threat to public health has resulted in new State groundwater regulations. Knowledge of the ability of surficial deposits to retard movement of contaminants is important to the implementation of these regulations. This map report shows areas where beds of at least 10 feet thickness with a hydraulic conductivity (saturation) of less than 0.1 foot per day occur within 50 feet below land surface, based mainly on interpretations of lithology. The map is intended as a guide for making preliminary assessments and should not be considered definitive of permeability beneath a specific site. Available determinations of hydraulic conductivities of surficial deposits in Florida are shown in table format. (USGS)
W86-01951

HYDROGEOLOGIC DATA FROM PARTS OF THE DENVER BASIN, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
T. J. Major, S. G. Robson, J. C. Romero, and S. Zawistowski.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-274, 1983. 425 p, 7 fig, 13 tab, 111 ref.

Descriptors: *Aquifers, *Groundwater, *Hydrogeologic data, Surface water, Water quality, *Colorado, *Denver basin.

This report presents hydrogeologic data collected and compiled during 1956-81 as part of a comprehensive hydrogeologic data collected and compiled during 1956-81 as part of a comprehensive hdryogeologic investigation of the Denver basin, Colorado, by the U.S. Geological Survey in cooperation with the Colorado Department of Natural Resources, Division of Water Resources, Office of the State Engineer. The data, in tabular and graphic form, consist of records for 870 wells which include water-level data for 158 wells and water-quality analyses for 561 wells; geophysical logs from three wells which include resistivity, self potential, and natural gamma logs; and gain-and-loss data of streamflow measured at 54 sites. (USGS)
W86-01952

GROUND-WATER-QUALITY MONITORING NETWORK DESIGN FOR THE SAN JOAQUIN VALLEY GROUND-WATER BASIN, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-01953

GROUND-WATER RESOURCES OF LANFAIR AND FENNER VALLEYS AND VICINITY, SAN BERNARDINO COUNTY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
D. A. Freiwald.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4082, 1984, 78 p, 4 fig, 4 tab, 10 ref.

Descriptors: Wells, Springs, *Water Quality, Well logs, Geology, Hydrology, Well yield, Precipitation, *Groundwater, Surface water, Water supply, Water yield, *California, Fenner, Lanfair, San Bernadino County.

Lanfair and Fenner Valleys and vicinity cover about 1,300 square miles in eastern San Bernardino County, California. Average annual precipitation ranges from 3 to 10 inches over the area. Ground water is utilized primarily for stock and domestic purposes, and occurs in the unconsolidated deposits as well as in the highly fractured consolidated rock. Ground-water levels in wells range from 5 to 600 feet below land surface, and well yields range from 3 to 1,200 gallons per minute throughout the study area. Records indicate that water levels are at or near their predevelopment levels. Springs occur along faults and formational contacts and generally discharge less than 5 gallons per minute. Measured ground-water outflow from Lanfair Valley at Piute Spring ranged from 100 to 630 acre-feet per year. Most of the water is of good quality for domestic and stock use. However, water from two wells indicates a concentration of sulfate that is above the recommended limit for drinking water. Water supplies are adequate for present needs. However, large-scale pumping would result in the lowering of the water table and a reduction of the ground water in storage. (USGS)
W86-01955

IRRIGATION DATA FROM CHASE, DUNDY, AND PERKINS COUNTIES, NEBRASKA,

Geological Survey, Lakewood, CO. Water Resources Div.
D. M. Stephen, F. J. Heimes, and R. R. Luckey.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-471, 1984. 31 p, 2 fig, 12 tabs, 5 ref.

Descriptors: *Pumpage, Ground-water irrigation, *Discharge measurement, High Plains, *Nebraska, Chase, Dundy, Perkins, Clampitron, Irrigation water, Water supply, Data collections, Hydrologic data.

This report summarizes data collected by the U.S. Geological Survey in Chase, Dundy, and Perkins Counties, southwest Nebraska. It includes data collected from 52 randomly selected wells that were monitored during the 1983 irrigation season to obtain measurements of discharge and the rate of energy consumption. The data were collected as part of a study to better define the relationship between pumpage and return flow from applied water. (USGS)
W86-01957

JANUARY 1984 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst, and B. J. Dague.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-613, 1984. 163 p, 2 fig, 1 tab, 15 ref.

Descriptors: *Groundwater, Water-level changes, *Hydrologic data, *Kansas, Data collections.

Water-level measurements were made, mostly during January 1984, in about 1,450 wells in western and south-central Kansas. The measurements were made in mid-winter when pumping was minimal and water levels had recovered, for the most part, from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water-level changes from a 'base-reference year' (predevelopment year), a year of abnormally high rainfall and minimum pumpage (1966 or 1974), and each of 7 consecutive years of measurement (1978-84). The 'base-reference year' is designated as 1940 for the southwestern area, 1944 for the south-central area, and 1950 for the northwestern and west-central areas. Water levels for the 'base-reference year' are established by measurements made during that year and by interpretation of maps showing water-level altitudes. Data also are provided for relating the average annual water-level changes, saturated thicknesses of the deposits, and percentage changes in saturated thicknesses.
W86-01960

AVAILABILITY AND CHEMISTRY OF GROUND WATER ON THE BRUNEAU PLATEAU, SOUTH-CENTRAL IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
R. L. Moffatt, and M. L. Jones.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4065, 1984. 88 p, 15 fig, 7 tab, 31 ref.

Descriptors: Available groundwater, Available water, *Ground-water availability, *Groundwater irrigation, Available irrigation water, Bruneau plateau, *Idaho, *Groundwater chemistry.

The Bruneau plateau in south-central Idaho consists of about 889,600 acres of potentially irrigable land. About 112,200 of these acres have been developed for agriculture; 11,200 acres are irrigated with ground water, and the remaining acreage is irrigated with water from the Snake and Bruneau rivers and Salmon Falls Creek. On the basis of present usage, about 158,000 acre-feet of water per year are needed to develop an additional 63,000 acres. About 438,000 acre-feet per year are needed to irrigate existing and newly developed lands in dry years when streamflow in the Snake River at Milner Dam is inadequate to meet appropriated needs. Pumping lifts of about 400-600 feet and low well yields on the Bruneau plateau probably preclude large-scale irrigation development solely from local ground-water resources. However, supplemental sources of irrigation water are available from a perched-water aquifer, a thermal aquifer, and the regional aquifer adjacent to the plateau. About 100,000-115,000 acre-feet per year of water probably could be withdrawn from the perched and regional aquifers and conveyed to the plateau without serious impact on local ground-water resources. The amount of water that could be safely withdrawn from the thermal aquifer was not determined. (USGS)
W86-01963

GROUND-WATER LEVEL DATA AND PRELIMINARY POTENTIOMETRIC-SURFACE MAPS, YUCCA MOUNTAIN AND VICINITY, NYE COUNTY, NEVADA.

Geological Survey, Lakewood, CO. Water Resources Div.
J. H. Robison.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4197, 1984. 20 p, 2 fig, 1 tab, 2 ref.

Descriptors: *Ground-water level, *Potentiometric level, Hydrologic maps, *Nevada, Nye County, Yucca Mountain, Hydrologic data.

The report contains a table of ground-water level data and two preliminary potentiometric-surface maps for the Yucca Mountain area. The water-level surface shown on the maps generally represents water-table (unconfined) conditions. The water table in the Yucca Mountain area occurs in ash-flow and air-fall tuffs of tertiary age. West of the crest of Yucca Mountain, water-level altitudes are about 775 meters above sea level. Along the eastern edge and southern end of Yucca Mountain, the potentiometic surface generally is nearly flat, is about 728 to 730 meters above sea level, and has a southeastward slope. (USGS)
W86-01964

ASSESSMENT OF WATER RESOURCES AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO,

Geological Survey, Pueblo, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-01969

GEOCHEMICAL PROCESSES IN THE GASCOYNE LIGNITE MINING AREA, BOWMAN COUNTY, NORTH DAKOTA,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01970

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
W. H. Langer, D. A. Mulvihill, and T. W. Anderson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-B, 1984. 7 p, 3 fig, 41 ref.

Descriptors: *Groundwater levels, *Springs, Aquifers, Maps, *Basin and Range province, *Arizona.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Arizona part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the ground-water table, and the location, temperature, and flow of large springs. The altitude of the ground-water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to ground water is less than 500 feet, the depth is shown by lines of equal depth to ground water or data points where data are insufficient to draw lines. Areas are shaded where the depth to the ground water table is generally greater than 500 feet. (USGS)
W86-01971

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFFS AND VOLCANICLASTIC ROCKS, BASIN AND RANGE PROVINCE,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01972

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND PRE-QUATERNARY ASH-FLOW TUFFS, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01973

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-01974

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME I: DRAINAGE REGIONS A, B-THE LIMPOPO-OLIFANTS SYSTEM,

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2E.
W86-01990

SURFACE WATER RESOURCES OF SOUTH AFRICA; VOLUME IV: DRAINAGE REGIONS E, G, H, J, K, L - THE WESTERN CAPE,

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2E.
W86-01997

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN GROUNDWATER MODELING: SELECTION, TESTING AND USE,

Michigan Dept. of Natural Resources, Lansing.
D. A. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-143214, Price codes: A08 in paper copy, A01 in microfiche. Volume 2: Appendices, September 1982. 174 p.

Descriptors: *Groundwater management, *Models, *Aquifers, *Groundwater movement, *Groundwater pollution, Model studies, Path of pollutants, Fate of pollutants, Landfills, Hydrologic models, Finite element method, Mathematical models.

This volume is comprised of four appendices. The first describes an assessment of the two-dimensional flow model at the Southwest Ottawa County Landfill. The two-dimensional methodology used at the site should be applicable to similar sites. The second appendix describes an investigation of contaminant transport parameters in Michigan Aquifers. The third appendix discusses aquifer dispersivities from field data with examples of contaminant transport in Michigan aquifers. The fourth appendix deals with a groundwater management strategy for Michigan using finite-element modelling of contaminant transport. The strategy uses the finite element groundwater/transport model GEOFLOW. The utility and accuracy of GEOFLOW is demonstrated by comparison with an analytical solution and by modeling an idealized flow situation. Further refinement of GEOFLOW would be achieved by delineating a more localized flow region effecting a smaller grid and accompanying Peclet number. (Geiger-PTT)
W86-02034

RELATIONSHIP OF LABORATORY AND FIELD DETERMINED HYDRAULIC CONDUCTIVITY IN COMPACTED CLAY SOILS,

Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
A. S. Rogowski, and E. B. Richie.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 520-533, 2 fig, 25 ref.

Descriptors: *Liners, *Clays, *Permeability coefficient, *Field tests, *Design criteria, *Soil mechanics, Fluid mechanics, Membranes, Soil types, Models, Infiltration, Infiltrometers, Hydrologic properties, Thermodynamics, Soil properties.

When soil is to be used as a liner material, accurate soil properties should be obtained by simple, rapid, and reliable methods across a grid or transect sampling area. Field measurements of soil hydrological properties are often time consuming and are being replaced by models of water retention (Brooks and Corey) and the Green and Ampt infiltration equation. The high variability of scale models may be bypassed by measuring hydrological properties at a larger scale. Another attractive approach for evaluating a potential performance of clay liners is the use of scaling theory based on the concepts of similar media. Scaling factors can be obtained from readily available infiltration parameters. In swelling systems, the effect of gravity on flow will be less or nonexistent, and vertical moisture profiles are likely to vary depending on clay thickness and location with respect to the water table. Fluid mechanics and thermodynamics have been used to predict the behavior of swelling soils. Soil structure, aggregate stability, and dispersion may also influence hydraulic conductivity. Hydraulic conductivity is generally evaluated at high gradients to shorten time needed to obtain results. The ring infiltrometer test for infiltration and measurements of macroporosity by the clothier and White infiltrometer are described along with design criteria for determining the hydrologic behavior of clay liners. (Geiger-PTT)
W86-02119

LOCATING THE GROUNDWATER POLLUTION SOURCES USING COMPUTER MODELS,

Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02121

SIMULATED EFFECTS OF AN ARTIFICIAL-RECHARGE EXPERIMENT NEAR PROCTOR, LOGAN COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02344

QUALITY OF GROUND WATER IN THE PRINCIPAL AQUIFERS OF NORTHEASTERN-NORTH CENTRAL WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02345

PRELIMINARY ANALYSIS OF GEOHYDROLOGIC DATA FROM TEST WELLS DRILLED NEAR CHESTER, ON KENT ISLAND, QUEEN ANNES COUNTY, MARYLAND,

Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 5A.
W86-02349

WATER RESOURCES OF THE RATTLESNAKE BUTTE AREA, A SITE OF POTENTIAL LIGNITE MINING IN WEST-CENTRAL, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
W. F. Horak.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4228, 1983. 53 p, 23 fig, 3 tab, 23 ref.

Descriptors: *Aquifers, *Groundwater, *Surface water, *Water chemistry, *Lignite, *Strip mines, Observation wells, Test holes, Belfield, Dickinson, South Heart, *North Dakota.

The D and E lignite beds, the two mineable beds in the lower Sentinel Butte Member (Fort Union Formation), underlies the entire Rattlesnake Butt study area, North Dakota but are unsaturated over much of their area of occurrence. Ground-water flow in both lignite aquifers is largely controlled by topography. Interconnected sand beds form aquifers between the E and D beds (E-D aquifer) and below the D bed (D-HT aquifer). Both aquifers underlie the central part of the study area and consist of fine silty sand. Depth to the aquifers is as much as 320 feet. Aquifers also occur in strata of Late Cretaceous and early Tertiary age. Aquifers in the Fox Hills Sandstone (Cretaceous) and lower Tongue River Member (Tertiary) lie at depths of about 1,700 and 750 feet, respectively. All aquifers yield a sodium bicarbonate or sodium sulfate type water. Mean dissolved-solids concentrations in the four shallowest aquifers ranged from 1,290 to 1,970 milligrams per litter. North Creek and an unnamed tributary of Green River drain most of the study area. North Creek, the major drain, ceases to flow during several months of most years, while the Green River tributary, with a smaller basin area, has sustained base flows of 0.15 to 0.25 cubic foot per second. Mining-induced impacts on the shallow ground-water flow system would be very localized because of the already low water levels and the segmented nature of the flow system in the lignite aquifers. (USGS)
W86-02350

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH, WITH RESULTS OF DIGITAL-COMPUTER MODELING,

Geological Survey, Salt Lake City, UT. Water Resources Div.
W. F. Holmes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Issued as Utah Department of Natural Resources Technical Publication 79, and USGS Open-File Report 83-0432, 1984. 59 p. 20 fig, 2 tab, 36 ref.

Descriptors: Water resources, *Utah, Great Basin, *Hydrology, Recharge, Storage, Evapotranspiration, *Water quality, *Model studies, *Sevier Desert, *Finite-difference models, Model predictions.

Changes in ground-water withdrawals, water levels, and quality of water occurred in the artesian aquifers of the Sevier Desert, Utah during 1963-81. Ground-water withdrawals increased from an average of 9,500 acre-feet (11.7 cubic hectometers) per year between 1951 and 1963 to an average of 27,500 acre-feet (33.9 cubic hectometers) per year between 1964 and 1981. Most of the increased withdrawal was from the deep artesian aquifer. Water levels declined as much as 19 feet (5.8 meters) in the deep artesian aquifer and as much as 13 feet (4.0 meters) in the shallow artesian aquifer

between 1963 and 1981. The declines probably are due to increased ground-water withdrawals for irrigation and municipal use. Quality of water in parts of the shallow artesian aquifer is deteriorating. The deterioration probably is the result of recharge of poor quality from the overlying water-table aquifer. A digital-computer model was constructed to predict water-level changes resulting from changes in recharge and discharge for 20 years (1981-2000) at one-half, one, and two times the 1977-79 average rate. The model computer water-level declines of more than 80 feet (24 meters) in the deep artesian aquifer with withdrawals twice the 1977-79 average, declines of more than 40 feet (12 meters) if withdrawals were equal to the 1977-79 average, and declines of more than 15 feet (4.6 meters) if withdrawals were one-half the 1977-79 average. Computer water-level declines after 20 years in the shallow artesian aquifer were more than 50 feet (15 meters) at two times the 1977-79 average rate, more than 15 feet (4.6 meters) at the 1977-79 average, and less than 4 feet (1.2 meters) at one-half the 1977-79 average. The model also was used to predict the effects of approximate changes in ground-water withdrawals related to the Intermountain Power Project. Water-level declines in the deep artesian aquifer of more than 15 feet (4.6 meters), and only small changes in water levels in the shallow artesian aquifer after 20 years. These changes are in addition to changes computed for 20 years of withdrawals at the 1977-79 rate. (USGS)
W86-02351

EVALUATION OF THE GROUND-WATER RESOURCES OF COASTAL GEORGIA: PRELIMINARY REPORT ON THE DATA AVAILABLE AS OF JULY 1983,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02352

PRELIMINARY STUDY OF THE AQUIFERS OF THE LOWER MESILLA VALLEY IN TEXAS AND NEW MEXICO BY MODEL SIMULATION,

Geological Survey, Austin, TX. Water Resources Div.
J. S. Gates, D. E. White, and E. R. Leggat.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4317, 1984. 21 p, 6 fig, 9 ref.

Descriptors: *Groundwater, Groundwater basins, Groundwater movement, Model studies, Hydrologic models, Transmissivity, Specific yield, Storage, Well spacing, Aquifers, Aquifer characteristics, *Texas, El Paso, Juarez, Rio Grande, Groundwater modeling.

The aquifers in the lower Mesilla Valley of Texas and New Mexico provide water for irrigation, industrial use, and municipal supply. The shallow aquifer principally is used for irrigation. The medium-depth aquifer and deep aquifer are used by the city of El Paso for municipal supply, about 120,000 acre-feet per year in 1975. The potential use of the medium-depth and deep aquifers for irrigation, together with a planned increase in pumping by the city, is causing concern about the impact of this development. A three-dimensional digital model of the aquifers was developed to evaluate the responses of water levels to various schemes of development, with particular emphasis on the medium-depth and deep aquifers in and near the Canutillo well field. The model simulations indicate that if pumpage increases to 10,000 acre-feet per year from the medium-depth aquifer and to 20,000 acre-feet per year from the deep aquifer, and elsewhere is constant, then additional lowering of water levels would be as much as 24 feet in the medium-depth aquifer and as much as 52 feet in the deep aquifer. The water levels would decline sharply during the first few months, after which the levels would become nearly stable because the leakage between the aquifers probably is enough to balance the increased pumpage. The model also indicated that lining of the channel of the Rio Grande would result in an additional lowering of water levels by 10 feet in the medium-depth aquifer and 8 feet in the deep aquifer. (USGS)
W86-02353

ILLINOIS GROUND-WATER OBSERVATION NETWORK - A PRELIMINARY PLANNING DOCUMENT,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02355

APPRAISAL OF THE SURFICIAL AQUIFERS IN THE POMME DE TERRE AND CHIPPEWA RIVER VALLEYS, WESTERN MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
W. G. Soukup, D. C. Gillies, and C. F. Myette.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4086, 1984. 63 p, 26 fig, 15 tab, 37 ref.

Descriptors: *Outwash, *Aquifers, *Irrigation wells, *Streamflow depletion, Model studies, *Surface-groundwater relationships, *Minnesota, *Pomme de Terre River, *Chippewa River, Analytical model, Finite-difference models, Transient calibration.

The surficial outwash aquifer along the Pomme de Terre and Chippewa Rivers, Minnesota is as thick as 100 feet and has a maximum transmissivity of 35,000 feet squared per day. An analytical model of a 50-mile reach of the Pomme de Terre River valley indicates that the 43 existing irrigation wells pumping at maximum potential yields could reduce streamflow 77 cubic feet per second which exceeds low base flow of the river. Results from a finite-difference model of the Appleton area indicate that pumping lowered ground-water levels as much as 3 feet from 1973-80 and reduced streamflow 14 cubic feet per second. Simulation of increased irrigation pumping and decreased areal recharge during a three-year drought indicates that water levels may decline 9 feet and streamflow may be reduced 41 cubic feet per second. When results of the analytical and finite-difference models are combined, computed streamflow reductions exceed available base flow by as much as 60 cubic feet per second. Results from a finite-difference model of the Benson area indicate that at maximum hypothetical development, drought conditions and increased irrigation pumping may lower water levels 12 feet and reduce flow in the Chippewa River 30 cubic feet per second, which is less than low base flow. (USGS)
W86-02357

RECORDS OF SELECTED WELLS, ST. MARYS AND CALVERT COUNTIES, MARYLAND,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02359

MASS WATER-LEVEL MEASUREMENTS OF FALL 1984 IN THE CENTRAL PLATTE RIVER BASIN, NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02360

GROUND-WATER CONDITIONS AND WELL YIELDS IN FRACTURED ROCKS, SOUTHWESTERN NEVADA COUNTY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
R. W. Page, P. W. Anttila, K. L. Johnson, and M. J. Pierce.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4262, 1984. 38 p, 12 fig, 11 tab, 14 ref.

Descriptors: *Groundwater, *Well yield, Fractured rocks, Groundwater use, Saturated fracture zones, Recharge, Lineations, Groundwater discharge, Grass Valley, Nevada County, *California.

This report describes the availability of ground water in the southwestern part of Nevada County, and suggests general guidelines for selecting sites for future ground-water development in the study area. Ground water in this area occurs chiefly in fractures in hard pre-Tertiary metavolcanic and plutonic rocks generally above a depth of 215 feet. Some ground water is found at the contact between alluvium or decomposed granite and the underlying hard rock; little is found in alluvium or colluvium. Mean yield is less than 18 gallons per minute. (USGS)
W86-02364

CHEMICAL AND ISOTOPIC CHARACTERISTICS OF BRINES FROM THREE OIL- AND GAS-PRODUCING FORMATIONS IN EASTERN OHIO, WITH APPLICATIONS TO THE GEOCHEMICAL TRACING OF BRINE SOURCES,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02365

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE OF PROVINCE, TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02366

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02367

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02368

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02369

HYDROGEOLOGY OF A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
J. B. Foster, J. R. Erickson, and R. W. Healy.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4125, 1984, 83 p, 48 fig, 7 tab, 23 ref.

Descriptors: *Groundwater, *Glacial soils, *Radioactive wastes, *Tritium migration, Geology, Hydrology, Hydraulic conductivity, Groundwater flow model, Path of pollutants, *Illinois, Waste disposal sites, US Ecology Company, Inc., Sheffield facility.

The Sheffield low-level radioactive-waste facility is located on 20 acres of rolling terrain 3 miles southwest of Sheffield, Illinois. The shallow hydrogeologic system is composed of glacial sediments. Pennsylvania shale and mudstone bedrock isolate the regional aquifers below from the hydrogeologic system in the overlying glacial deposits. Pebbly sand underlies 67 percent of the site. Two ground-water flow paths were identified. The primary path conveys ground water from the site to the east through the pebbly-sand unit; a secondary path conveys ground water to the south and east

through less permeable material. The pebbly-sand unit provides an underdrain that eliminates the risk of water rising into the trenches. Digital computer model results indicate that the pebbly-sand unit controls ground-water movement. Tritium found migrating in ground water in the southeast corner of the site travels approximately 25 feet per year. A group of water samples from wells which contained the highest tritium concentrations had specific conductivities, alkalinities, hardness, and chloride, sulfate, calcium, and magnesium contents higher than normal for local shallow ground water. (USGS)
W86-02371

GROUND-WATER QUALITY DATA FOR THE ATLANTIC COASTAL PLAIN: NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, AND NORTH CAROLINA,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02374

GROUND-WATER DATA FOR GEORGIA, 1984,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02376

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02377

HYDROLOGY OF AREA 60, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NEW MEXICO, COLORADO, UTAH, AND ARIZONA,

Geological Survey, Albuquerque, NM. Water Resources Div.
F. E. Roybal.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-203, 1983. 80 p, 47 fig, 9 tab, 54 ref.

Descriptors: Coal mining, Surface water, Groundwater, *Water quality, *Geohydrology, Land use, Observation wells, Water level, Streamflow variability, Erosion, Sedimentation, *Water pollution sources, *New Mexico, *Colorado, *Utah, *Arizona, *Delores River basin, *San Juan River basin.

An expansion of coal-mining activity is planned for Coal Area 60, which is one of 20 hydrologic reporting areas in the Northern Great Plains and Rocky Mountain Coal Provinces. Coal Area 60 includes approximately 20,000 square miles and is located at the southern end of the Rocky Mountain Coal Province in northwestern New Mexico, southwestern Colorado, southeastern Utah, and northeastern Arizona. Area 60 includes parts of the Dolores and San Juan River basins. Water-quality characteristics are based on data from 67 surface-water stations and 49 ground-water stations. Dissolved-solids concentrations in perennial rivers such as the San Juan River commonly are less than 500 milligrams per liter. Dissolved-solids concentrations of 2,000 milligrams per liter or more are present in the flows of ephemeral channels such as the Chaco River. Calcium and bicarbonate ions are the predominant ions in headwater flows, whereas sodium and sulfate ions become increasingly more dominant in the downstream direction. Concentrations of dissolved iron, manganese, and other trace elements in surface water generally are less than the limits set in drinking-water and mining regulations; however, the total recoverable concentrations from water-sediment mixtures may exceed these limits. Suspended sediment concentrations exceeding 10,000 milligrams per liter are present in the flow of arroyos that drain areas with sparse vegetation. The chemical-quality characteristics of ground water are similar to those of surface water except that the dissolved-solids concentration in ground water from all formations, especially shale deposits, may exceed 3,000 milligrams per liter. Sulfate concentrations are small in the ground water associated with coal deposits. Large concentrations of fluoride are present in ground water from all formations; large concentrations of lead, selenium and nitrate are associated with certain formations. Large alkalinity concentrations are found in the surface waters and ground waters of Area 60. (USGS)
W86-02382

GEOLOGY OF THE SURFICIAL AQUIFER SYSTEM, BROWARD COUNTY, FLORIDA,

Geological Survey, Miami, FL. Water Resources Div.
C. R. Causaras.
Available from OFSS, USGS, Box 25425. Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4068. 1985. 2 pl, 9 fig, 9 ref.

Descriptors: *Geologic formations, *Cross sections, *Hydrology, Carbonate aquifers, Unconfined aquifer, *Forida, Broward County, *Biscayne aquifer.

The geologic framework of the surficial aquifer system, of which the Biscayne aquifer is the major component in Broward County, Florida, is presented in eight geologic cross sections. The cross sections are based on detailed lithologic logs of 27 test wells that were drilled, in the summer of 1981, through the sediments overlying the relatively impermeable units of the Hawthorn Formation, of Miocene age. The cross sections show the aquifer system as a wedge-shaped sequence of Cenozoic sediments. The aquifer thickness gradually decreases from more than 400 feet along the coast to about 160 feet in the west and southwest parts of Broward County. The sediments that comprise the aquifer system range in age from Pliocene to Pleistocene and are assigned to the following stratigraphic units from bottom to top: Tamiami Formation, Caloosahatchee Marl, Fort Thompson Formation, Key Largo Limestone, Anastasia Formation, Miami Oolite, and Pamlico Sand. (USGS)
W86-02383

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02384

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02385

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02386

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02387

DELINEATION AND DESCRIPTION OF A ZONE OF HIGHER SECONDARY PERMEABILITY IN THE SURFICIAL AQUIFER OF EASTERN PALM BEACH COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
L. J. Swayze, and W. L. Miller.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4249, 1984. 39 p, 22 fig, 5 tab, 30 ref.

Descriptors: *Groundwater, Water quality, Geology, *Florida, *Hydrogeology, Aquifers, *Permeability, Saline water intrusion, Palm Beach County, Aquifer characteristics, *Secondary permeability.

The surficial aquifer is the primary source of freshwater for the heavily developed coastal area in eastern Palm Beach County, Florida. Well fields are generally located in a discontinuous zone of higher secondary permeability, the northernmost extension of the Biscayne aquifer in the surficial aquifer, that extends from the Juno Beach area south to Broward County and varies in width from about 4 to 15 miles. The zone was formed by varying dissolution of aquifer limestone materials during Pleistocene age changes in sea level, and ranges in depth from about sea level to 220 feet below sea level. Because of proximity to the Atlantic Ocean and saltwater estuaries, the aquifer is susceptible to saltwater intrusion. Ground water to the west of the zone of higher secondary permeability is of poor quality. The ground water is calcium bicarbonate dominant. Dissolved solids, calcium carbonate hardness, and chloride are greatest along the saltwater intruded coastline and in the western part of the study area where diluted residual seawater exists. Total organic carbon increases inland due to infiltration of rainwater through thicker layers of organic soils. Ground-water levels in the surficial aquifer in eastern Palm Beach County are strongly influenced by controlled levels in canals. In March 1981, after 12 months of below average rainfall, ground-water levels ranged from about 2 feet above sea level along the coast to nearly 21 feet above sea level 15 miles inland in the northwest section of the study area. (USGS)
W86-02393

ALDICARB-PESTICIDE CONTAMINATION OF GROUND WATER IN EASTERN SUFFOLK COUNTY, LONG ISLAND, NEW YORK,

Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02394

GEOHYDROLOGIC RECONNAISSANCE OF THE AVOCA LIGNITE DEPOSIT AREA NEAR WILLISTON, NORTHWESTERN NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
W. F. Horak, and O. A. Crosby.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4024, 1985. 22 p, 6 fig, 2 tab, 18 ref.

Descriptors: Aquifers, Groundwater, Surface water, *Lignite, *Strip mines, Williston, *North Dakota, Williams County.

The Avoca deposit in the Sentinel Butte member of Fort Union Formation consists of four potentially strippable lignite beds. Average bed thicknesses, in descending order, are 5, 5, 9, and 8 feet. In the area between Stony Creek and Crazy Man Coulee, the lignite beds are unsaturated, and between Stony Creek and Little Muddy River, only the two lowest beds are saturated. Aquifers in sandstone beds in the Fox Hills Sandstone and the Hell Creek Formation probably would yield as much as 50 gallons per minute of sodium bicarbonate type water. However, the aquifers are from 1,100 to 1,800 feet below land surface. Individual sand beds in the Tongue River and Sentinel Butte Members of the Fort Union Formation are the shallowest aquifers below the minable lignite beds. Properly constructed wells completed in these sand beds could yield as much as 40 gallons per minute. The water generally is a sodium bicarbonate type with dissolved-solids concentrations ranging from about 500 to 4,200 milligrams per liter. (USGS)
W86-02398

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE NORTHERN GREAT PLAINS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING--GEOCHEMICAL EVOLUTION OF GROUND-WATER COMPOSITION IN TWO CONFINED AQUIFER SYSTEMS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02400

MATHEMATICAL MODEL OF THE TESUQUE AQUIFER SYSTEM NEAR POJOAQUE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
G. A. Hearne.
Available from Distribution Br., USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2205, 1985. 75 p, 81 fig, 17 tab, 55 ref.

Descriptors: *Mathematical models, *Groundwater movement, *New Mexico, Water levels, Withdrawal, Irrigation, Water use, Model studies, Simulation analysis.

A three-dimensional digital model of ground-water flow was constructed to represent the dipping anisotropic beds of the Tesuque aquifer system underlying the Pojoaque River basin and vicinity, New Mexico. Simulations of steady-state conditions and historical ground-water withdrawals were consistent with observed data. The model was used to simulate the response of the aquifer system to an irrigation-development plan in the Pojoaque River basin. Storage is the main source of water; 34.05 cubic feet per second (86 percent of the withdrawal rate) was simulated to be withdrawn from storage after 50 years of withdrawals for irrigation development. The maximum simulated water-level decline was 334 feet, and the net simulated streamflow capture from the Rio Grande and the Santa Cruz, Pojoaque, and Santa Fe Rivers was 5.63 cubic feet per second (14 percent of the withdrawal rate). The sensitivity of the model was tested by varying aquifer characteristics to the limits of the plausible range. Change in hydraulic head in the Pojoaque River basin is most sensitive to hydraulic conductivity. In all simulations, after 50 years of withdrawals, the maximum simulated decline in hydraulic head ranged between 210 and 474 feet, storage in the aquifer system was the source of 80 to 90 percent of the water withdrawn from wells, and streamflow capture from the Rio Grande and its tributaries plus irrigation diversions from the tributaries of the Pojoaque River simulated a decrease in the flow of the Rio Grande of between 17.13 and 21.11 cubic feet per second. (USGS)
W86-02402

WATER RESOURCES OF THE COTTONWOOD WASH WATERSHED, UTE MOUNTAIN, UTE INDIAN RESERVATION, SOUTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02404

SUMMARY OF RESULTS OF AN INVESTIGATION TO DEFINE THE GEOHYDROLOGY AND SIMULATE THE EFFECTS OF LARGE GROUNDWATER WITHDRAWALS ON THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN NORTHWESTERN MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02405

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02406

EVALUATION OF MAJOR DIKE-IMPOUNDED GROUND-WATER RESERVOIRS, ISLAND OF OAHU, WITH A SECTION ON FLOW HYDRAULICS IN DIKE TUNNELS IN HAWAII,

Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02407

PROGRESS REPORT ON BLACK MESA MONITORING PROGRAM-1984,

Geological Survey, Flagstaff, AZ. Water Resources Div.
G. W. Hill.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-483, 1985. 24 p, 4 fig, 9 tab, 6 ref.

Descriptors: *Groundwater, *Water level, Water quality, *Aquifers, *Arizona, Black Mesa, *Navajo Indian Reservation, *Hopi Indian Reservation, Monitoring.

The N aquifer is an important source of water in the 5,400 square-mile Black Mesa area on the Navajo and Hopi Indian Reservations. The project is designed to monitor long-term effects on the ground-water resources of the mesa as a result of withdrawals from the aquifer by a strip-mining operation. Withdrawals from the N aquifer by the mine have increased from 95 acre-ft in 1968 to more than 4,000 acre-ft in 1984. Water levels in the confined area of the aquifer have declined as much as 75 feet in some municipal and observation wells within about a 15-mile radius of the mine well field. Part of the drawdown in municipal wells is due to local pumpage. Water levels have not declined in wells tapping the unconfined area of the aquifer. Chemical analysis indicate no significant changes in the quality of water from wells that tap the N aquifer or from springs that discharge from several stratigraphic units, including the N aquifer, since pumping began at the mine. (USGS)
W86-02408

HYDROLOGY OF YUCCA MOUNTAIN AND VICINITY, NEVADA-CALIFORNIA--INVESTIGATIVE RESULTS THROUGH MID-1983,

Geological Survey, Lakewood, CO. Water Resources Div.
R. K. Waddell, J. H. Robison, and R. K. Blankennagel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4267, 1984. 72 p, 13 fig, 10 tab, 68 ref.

Descriptors: Groundwater, Surface water, *Radioactive waste disposal, *Hydrogeology, *Groundwater movement, Path of pollutants, *Nevada, *California, Nevada test site.

Yucca Mountain, Nevada, is one of several sites under consideration for construction of the first repository for high-level nuclear waste. The climate is arid; few perennial streams are present in the region. Flash floods occasionally occur. The site is underlain by at least 1,800 meters of volcanic tuffs of Tertiary age; limestones and dolomites of Paleozoic age underlie much of the surrounding region, and, together with alluvial deposits, comprise the major aquifers. Yucca Mountain is in the Alkali Flat-Furnace Creek Ranch ground-water subbasin, which is part of the Death Valley ground-water basin. Discharge occurs at Alkali Flat almost entirely by evapotranspiration, and at Furnace Creek Ranch from small springs and seeps. Beneath Yucca Mountain, depth to water ranges from about 460 to 700 meters; the rock under consideration for construction of the repository is in the unsaturated zone. Rate of recharge at Yucca Mountain is small, perhaps much less than 5 millimeters per year. Within the saturated zone, water movement is principally along fractures. The hydraulic gradient is small east (downgradient) of Yucca Mountain, and increases to the north and west. Lack of effective-porosity data presently precludes accurate calculation of flow velocity and travel times. (USGS)
W86-02413

GEOLOGY, HYDROLOGY, AND WATER QUALITY OF THE CAMBRIAN AND ORDOVICIAN SYSTEMS IN NORTHERN ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
A. P. Visocky, M. G. Sherrill, and K. Cartwright.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Illinois State Water Survey, Illinois State Geological Survey, Cooperative Groundwater Report 10, 1985. 136 p, 45 fig, 6 tab, 123 ref.

Descriptors: *Geologic formations, *Groundwater, *Aquifers, *Confining beds, *Aquifer systems, Bedrock, Pumping, Drawdown, Water Quality, Hydrology, Geology, *Hydrogeology, Cambrian system, Ordovician system, *Illinois, Confined area, Unconfined area.

Cambrian and Ordovician strata provide much of the groundwater supply for approximately 250 municipalities and 150 industries in the northern half of Illinois. The Cambrian and Ordovician aquifers average approximately 1,000 feet in thickness, and are hydraulically interconnected and behave as a single aquifer. Recharge occurs principally by vertical percolation of precipitation in areas where the aquifers are not confined. Additional recharge in heavily pumped areas occurs through leakage across the overlying Maquoketa Confining Unit. The practical sustained yield of the Cambrian and Ordovician aquifers is estimated to be 65 million gallons per day in northeastern Illinois. Pumpage has exceeded this amount since about 1958. The largest withdrawals occur in Cook, DuPage, Kane and Will Counties. Withdrawals have caused water levels to decline as much as 900 feet in parts of these counties. In north-central and northwestern Illinois, development has not exceeded the pratical sustained yield. Groundwater in the recharge area of the Cambrian and Ordovician aquifers is chemically homogeneous and low in dissolved solids. However, significant vertical and areal changes in the chemical character of groundwater occur in the confined area. As water moves away from the recharge area to the east and south, it increases in dissolved solids. (USGS)
W86-02414

2G. Water In Soils

PREDICTING LEACHATE GENERATION IN LANDFILLS: A NEW METHOD,

Anderson (James C.) Associates, Camden, NJ.
For primary bibliographic entry see Field 5E.
W86-02122

FIELD VARIABILITY OF SOIL PHYSICAL PROPERTIES,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
A. J. Peck.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 189-221, 7 fig, 1 tab, 90 ref.

Descriptors: *Soil water, *Soil physical properties, *Variability, *Irrigation, *Solute transport, Spatial analysis, Scaling theory, Steady flow, Nonsteady flow, Sampling, Correlation analysis, Mathematical studies, Kriging, Flow, Leaching, Infiltration, Soil porosity, Drainage, Wetting.

Quantitative studies of soil variability and its impact on water and solute transport in fields are in a state of rapid development. However, several implications are apparent. A very large number of samples are needed to reasonably estimate the mean of properties with high spatial variability, such as water and solute drainage rate. Present methods for spatial analysis, which provides a means for characterizing soil variability are limited. A major problem of methods for computing the spatial scale of soil variation is the dependence of the correlogram on the length of a transect through its effect on the variance of sample data. It

is preferable to use the variogram to quantify scales of soil variation. The scaling of soil water properties provides a single parameter for describing soil variations to nonuniform soil imply that evapotranspiration and drainage are almost uniform in areas which do not lose or gain water by surface runoff. A definition of scaling factors through infiltration and drainage experiments is easier and as effective as working from soil water retention and conductivity relationships. Soil variability is a major factor contributing to nonuniform leaching of salts from fields. When the probability density function of solute transport properties has a large variance, a relatively large spatial variation in water application rates appears to have little influence on field-averaged solute concentrations during leaching. At present, an equivalent uniform medium cannot be defined to describe water and solute transport in nonuniform fields using the Richards equation. (Cassar-PTT)
W86-02129

2H. Lakes

SOURCE MOVEMENT AND EFFECTS OF NITROGEN AND PHOSPHORUS IN THE HEADWATERS OF HOP BROOK, MARLBOROUGH, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02343

2I. Water In Plants

ADVANCES IN IRRIGATION,
For primary bibliographic entry see Field 3F.
W86-02123

IRRIGATION SCHEDULING BASED ON A DYNAMIC CROP RESPONSE MODEL,
Kansas State Univ., Manhattan. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 3F.
W86-02131

MODEL OF ROOT GROWTH AND WATER UPTAKE ACCOUNTING FOR PHOTOSYNTHESIS, RESPIRATION, TRANSPIRATION, AND SOIL HYDRAULICS,
Auburn Univ., AL. Dept. of Agonomy and Soils.
M. G. Huck, and D. Hillel.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 273-333, 17 fig, 2 tab, 37 ref, 3 append.

Descriptors: *Soil-water-plant relationships, *Irrigation, Model studies, *Root development, Evapotranspiration, Photosynthesis.

A model describing the growth and function of higher herbaceous plants considers several independent processes governed by a set of quantitative relationships involving the transport and transformations of water, carbon, and energy in the soil-plant-atmosphere continuum. This model, a simplification of reality, does not explicitly account for nutrient uptake, soil aeration, soil temperature, soil mechanical resistance to root penetration, or plant physiological processes (photosynthesis, respiration, stomatal closure, translocation, and allocation of assimilates). However, the model in its present state of development can predict plant responses to various sets of circumstances for comparison with observations. Possible uses for the model include root growth and distribution under different soil and climate conditions; assessment of the effects of irrigation strategies on crop response, evaporation, and drainage; and study of the role of genetic or adaptive factors involved in drought tolerance. (Cassar-PTT)
W86-02132

TECHNIQUES FOR ESTIMATING IRRIGATION WATER REQUIREMENTS,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
R. D. Burman, R. H. Cuenca, and A. Weiss.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 335-394, 13 fig, 16 tab, 56 ref.

Descriptors: *Evapotranspiration, *Irrigation, *Soil-water-plant relationships, Computers, Penman equation, Crop coefficients, Root zone, Effective precipitation, Climatic data.

Estimation of irrigation water requirements requires determination of evapotranspiration and other factors. Methods for estimating evapotranspiration are described. These include the grass-versus alfalfa-based reference crop method; the Penman method; non-Penman methods such as Priestly-Taylor, FAO-24, Jensen-Haise, Blaney-Criddle, U.S. Soil Conservation Service TR-21, and Boorenbos-Pruitt. Methods are also given for estimating other factors: crop coefficients, rooting depth, and effective rainfall. Methods for computing evapotranspiration must be calibrated for different climates. The suitability of 16 methods are compared, using lysimeters at 10 locations worldwide. No one method works well in all climates. Commonly, the methods under- or overpredicted evapotranspiration on the order of 100% for climates unlike those in which they had been developed. Data required for four FAO methods (Blaney-Criddle, radiation, Penman, and pan evaporation) are given. Use of microprocessors and data collection instruments improve the accuracy and speed of developing irrigation water requirements. A sample problem is calculated, applying the Penman equation to estimate reference crop evapotranspiration. (Cassar-PTT)
W86-02133

2J. Erosion and Sedimentation

SEDIMENT YIELDS IN EASTERN MONTANA: SUMMARY OF DATA AND PROPOSED TECHNIQUES FOR ESTIMATING SEDIMENT YIELDS FROM SMALL, UNGAGED WATERSHEDS,
Geological Survey, Helena, MT. Water Resources Div.
J. H. Lambing.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4200, 1984. 45 p, 3 fig, 9 tab, 35 ref.

Descriptors: *Sediment yield, *Basin characteristics, *Multiple regression, Erosion, Ungaged watersheds, Streamflow, Sediment transport, *Eastern Montana, Fort Union coal region, Power River coal region.

Sediment-yield data for 121 sites in eastern Montana have been compiled from results of studies conducted by various Federal, State, and private agencies. Methods used to determine mean annual sediment yields included reservoir sedimentation surveys, suspended-sediment sampling in streams, and estimates of gross erosion and indirect estimation based on physical characteristics of the basin. Multiple-regression equations were developed and evaluated for their adequacy in estimating mean annual sediment yields from small, ungaged watersheds in eastern Montana. Sediment yields determined from reservoir surveys were used as the dependent variable because they were considered the most representative of long-term yields. Independent variables consisted of basin characteristics which could be measured from maps or obtained from published sources. Consequently, equations developed in this study do not require onsite data. Evaluation of equations indicated that the best prediction capability was obtained when reservoir basins were segregated into classes of similar vegetation/soil complex. The predictive capability of regression equations developed for each of three classes of vegetation/soil complex, as indicated by the coefficient of determination (R2), ranged from 0.59 to 0.96. Corresponding standard errors ranged from 95 to 20 percent. The equations are applicable for small drainage basins of 2 square miles or less within the study area. (USGS)
W86-01922

ANNUAL SUSPENDED-SEDIMENT LOADS IN THE GREEN RIVER AT GREEN RIVER, UTAH, 1930-82,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4169, 1984. 17 p, 7 fig, 1 tab, 13 ref.

Descriptors: Sedimentation, Sediment transport, *Sediment discharge, *Sediment load, Sediment, *Sedimentation rates, *Sediment yield, Sediments, *Colorado River Basin, Green River Basin, *Utah.

The Green River above gaging station 093150000 at Green River, Utah, drains about 44,850 square miles in Utah, Colorado, and Wyoming. The average annual precipitation near the station was 6.11 inches. Rocks ranging in age from Precambrian to Holocene are exposed in the Green River drainage basin above Green River, Utah. Shale, siltstone, and mudstone of Tertiary age probably are the most easily eroded rocks in the basin, and they contribute a large part of the sediment load in the Green River. During 1930-82, the U.S. Geological Survey collected records of fluvial sediment at station 093150000. Based on these records the mean annual suspended-sediment load was about 15,630,000 tons, ranging from 1,780,000 tons during 1934 to 43,400,000 tons during 1937. The minimum daily load of 54 tons was on September 27, 1956, and the maximum daily load of 2,230,000 tons was on July 11, 1936. Analysis of the suspended-sediment records collected from 1930-82 at station 093150000 indicated that the accuracy of the records is fair prior to 1945 and good for the remaining period of record. The records after 1945 reflect the use of improved sampling equipment. (USGS)
W86-01935

ESTUARY AS A SEDIMENT TRAP: ALTERNATE APPROACHES TO ESTIMATING ITS FILTERING EFFICIENCY,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W86-02076

RECENT SEDIMENTATION RATES IN CHESAPEAKE BAY,
Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2L.
W86-02077

ROLE OF FLOCCULATION IN THE FILTERING OF PARTICULATE MATTER IN ESTUARIES,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2L.
W86-02078

ERODING SOILS: THE OFF-FARM IMPACTS,
Conservation Foundation, Washington, DC.
For primary bibliographic entry see Field 4D.
W86-02247

PROGRESS REPORT: PERFORMANCE OF THE VIBRATING U-TUBE FLUID DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION,
Geological Survey, Minneapolis, MN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-02348

DISTRIBUTION AND TRANSPORT OF TRACE SUBSTANCES IN THE SCHUYLKILL RIVER BASIN FROM BERNE TO PHILADELPHIA, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02410

HYDRAULIC AND SEDIMENT CHARACTERISTICS AT THE NORTH CHANNEL BRIDGE, JAMAICA BAY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
W. W. Staubitz, and S. W. Wolcott.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4085, 1985. 43 p, 6 fig, 11 tab, 23 ref.

Descriptors: Hydraulics, Tides, *Tidal currents, *Channel scour, Bottom sediments, Suspended sediments, Water quality, *New York, Jamaica Bay, North Channel Bridge, North Channel, Data collections.

Data were collected during the spring of 1984 in the vicinity of North Channel Bridge in Jamaica Bay, New York to define the hydraulic regime and the physical characteristics and chemical quality of bottom sediments. The data were used in a semi-quantitative analysis to predict the effects of bridge replacement and the attendant resuspension of bottom sediments, on the hydraulics and quality of water and bottom sediments. The bay-bottom configuration at the bridge site was defined, and continuous tidal stage and tidal velocity data were collected for about a month. In addition, eight bottom-sediment samples were collected near the bridge and analyzed. Results of the hydraulic analysis show that the proposed bridge should not have any measurable effect on the net water transport at the bridge cross section. The sediment data indicate that bottom sediments are relatively unpolluted in the vicinity of the bridge. Seventy-five percent of the resuspended bottom sediments will probably settle within 186 m of the bridge during an average ebb tide. Metals and nutrients released from the sediments to the water column are expected to be diluted far below detection limits. The extra oxygen demand exerted by the resuspended bottom sediments is also expected to be far less than ambient biochemical oxygen demand of the water column. (USGS)
W86-02412

APPROACH FOR APPRAISING THE ACCURACY OF SUSPENDED-SEDIMENT DATA,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02415

2K. Chemical Processes

AVAILABILITY AND CHEMISTRY OF GROUND WATER ON THE BRUNEAU PLATEAU, SOUTH-CENTRAL IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01963

CRITICAL COMMENT ON THE INTERNATIONAL ATOMIC ENERGY AGENCY REPORT ON THE ADVISORY GROUP MEETING ON STABLE ISOTOPE REFERENCE SAMPLES FOR GEOCHEMICAL AND HYDROLOGICAL INVESTIGATIONS, VIENNA, AUSTRIA, SEPTEMBER 19-21, 1983, BY R. GONFIANTINI,

Geological Survey, Reston, VA. Water Resources Div.
T. B. Coplen, I. Friedman, and J. R. O'Neil.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4136, 1984. 6 p, 1 fig, 2 ref.

Descriptors: Geochemistry, Isotopes, Water quality standards, Oxygen isotopes.

According to U.S. Geological Survey records, a report prepared by R. Gonfiantini summarizing the findings and recommendations of the 1983 Advisory Group Meeting on Stable Isotope Reference Samples for Geochemical and Hydrologic Investigations held in Vienna does not accurately represent the consultants' consensus on three important points. The consultants (1) recommended no value for the C02-H20 oxygen isotope fractionation factor, not the cited value of 1.04115, (2) adopted a value of 1.0309 rather than 1.03086 to relate the PDB and SMOW scales, and (3) adopted a firm 180 value of -2.20% for NBS-19 on the PDB scale rather than agreeing that this would be a tentative value subject to modification when more measurements in selected laboratories are available. (USGS)
W86-01966

HYDROGEOLOGIC RECONNAISSANCE OF STRATIFIED-DRIFT AQUIFERS NEAR SIMSBURY, CONNECTICUT: AVAILABLE DATA AND FUTURE NEEDS,

Geological Survey, Hartford, CT. Water Resources Div.
J. W. Bingham.
Available from OFSS, USGS Box 24525 Lakewood, CO 80225. USGS Water-Resources Information Report 83-4145, 1984. 31 p, 4 fig, 24 ref.

Descriptors: *Glacial aquifers, *Ground-water availability, Ground-water potential, *Aquifer characteristics, Water-resources development, *Connecticut, *Town of Simsbury, Stratified-drift aquifers, Hartford County, Saturated thickness.

Hydrogeologic data from several sources were used to prepare maps showing the extent, saturated thickness, and composition of stratified-drift deposits near Simsbury, Connecticut. This synthesis of available data is intended to guide future ground-water studies by identifying favorable areas for development and additional information useful for resources planning and management. Deposits suitable for ground-water development underlie part of Stratton Brook valley and an area between the Farmington River and the community of Hoskins. Other potentially favorable areas occur east of the Farmington River near Avon, in the upper part of Stratton Brook valley and Bissel Brook valley. Extensive, thick deposits of silt, clay, and sand unsuitable for ground-water development underlie most of the Farmington River valley. In several areas of the town, subsurface data is sparse and the water-yielding characteristics of the stratified drift are unknown. (USGS)
W86-01967

RESEARCH PROGRAM FOR ATMOSPHERIC CHEMISTRY, RADIATION AND DYNAMICS,

Atmospheric and Environmental Research, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5B.
W86-01996

FATES OF URANIUM AND THORIUM DECAY SERIES, NUCLIDES IN THE ESTUARINE ENVIRONMENT,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W86-02079

WATER ANALYSIS, VOLUME 1: INORGANIC SPECIES, PART 1,

For primary bibliographic entry see Field 5A.
W86-02257

ORIGIN AND NATURE OF SELECTED INORGANIC CONSTITUENTS IN NATURAL WATERS,

University of Southern California, Los Angeles. Environmental Engineering Program.
B. A. Eichenberger, and K. Y. Chen.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. p 1-54, 1 tab, 255 ref.

Descriptors: *Water analysis, *Trace elements, *Trace metals, *Inorganic compounds, *Chemical reactions, Reviews, Metals, Hydrogen ion concentration, Conductance, Dissolved solids, Water quality, Drinking water, Natural waters, Metal complexes, Hydrolysis.

Inorganic species enter natural waters from a variety of sources such as the weathering of rocks and soils, atmospheric fallout, and anthropogenic inputs. The possible interactions occurring between metallic species and other solution species are described, followed by a discussion of individual metals. These interactions include: hydrolysis reactions, complexation with inorganic ligand, complexation with organic ligands, and conductance and pH effects. The pH and conductivity of the water system can control solubilization or agglomeration and therefore subsequent sedimentation of the metal species. A discussion of the possible hydrolysis products, complex species, and toxicity for 15 metals and three nonmetals in natural-water systems is given. Twelve of the metals under consideration are incorporated in the EPA Primary and Secondary Drinking Water Regulations (As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Se, Ag, and Zn). Sb, Be, and Ni, which have also shown toxic properties, are included in the discussion. B, F, and cyanides are the three nonmetals considered. (Geiger-PTT)
W86-02258

REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,

Maryland Geological Survey, Baltimore.
O. P. Bricker.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. p 55-83, 11 fig, 2 tab, 101 ref.

Descriptors: *Oxidation-reduction potential, *Chemical reactions, *Water anlaysis, *Trace, elements, *Natural waters, Oxidation, Trace metals, Dissolved solids, Hydrogen ion concentration, Conductance, Potentiometers, Electrodes.

Oxidation and reduction (redox) reactions play an important role in determining the behavior of many elements in the environment. The theoretical framework of redox reactions is given. The redox potential is usually measured electrometrically with an electrode pair consisting of an inert metal electrode coupled with a reference electrode. The electrometers usually employed are the direct reading meter and the null balance meter. The electrodes of the electrometer must be made of a material that is inert to chemical reaction in the system being measured, but electroactive to both the reduced and oxidized species involved. The nobel metals, boron carbide, and graphite are commonly used in electrodes. The hydrogen electrode is the ultimate reference standard of redox potential measurements. The calomel electrode and the silver-silver chloride electrode are also described. The operation of reference electrodes depends upon liquid junction effects. The redox potential is a variable of major importance in characterizing systems containing elements that exhibit more than one oxidation state. When the appropriate thermodynamic data are available, the equilibrium configuration of a redox system may be easily modeled for a given set of conditions. Perhaps the most reliable method currently available for evaluating the redox state of a system is quantitative analysis of the oxidized and reduced species of a component of the system. (Geiger-PTT)
W86-02259

ALKALINITY AND ACIDITY,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. R. Kramer.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. p 85-135, 7 fig, 5 tab, 20 ref.

Descriptors: *Alkalinity, *Acidity, *Water analysis, *Natural waters, *Chemistry properties, Trace elements, Hydrogen ion concentration, Physiochemical properties, Colloids, Chemical analysis, Chemical reactions.

Alkalinity is a routinely measured parameter for natural waters and wastewaters, whereas acidity is less commonly measured but is involved in analysis of low-pH solutions such as rainfall. Alkalinity and acidity are conservative terms that change only with the volume of the sample. Parameters that are

significant in alkalinity and acidity determinations consist of nutrients, trace metals, organic acids, gases, solids, and colloids. There is often a good relationship between specific conductance and the alkalinity for natural waters when calcium and bicarbonate ions make up the major portion of ions. The monoprotic, diprotic, and carbonate systems are considered along with Gran and modified Gran analysis of titration data, and analysis of mixed ligand systems. Some details of anlaysis of acidity and alkalinity are considered. Methods involving modified Gran analysis are encouraged although fixed-endpoint methods are briefly discussed, but particular attention is given to the use and determination of H-ion concentration rather than activity. The inability to obtain a linear function in a modified Gran analysis is often due to wrong assumptions regarding electrode response and also to the reliance on pH buffer solutions. (Geiger-PTT)
W86-02260

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1B.
W86-02261

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,

Hach Co., Loveland, CO.
R. D. Vanous, P. E. Larson, and C. C. Hach.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. 1982, p 163-234, 37 fig, 6 tab, 15 ref.

Descriptors: *Turbidity, *Dissolved solids, *Suspended solids, *Physical properties, *Water analysis, Chemical properties, Wastewater analysis, Water quality, Natural waters, Nephelometers, Opacity, Light penetration.

Any natural water sample that the analyst comes in contact with will invariably contain residue. The importance of monitoring residue was not fully realized and its applications were not widespread until the late 19th century. The nonspecific analytical techniques of residue analysis and turbidimetry are based largely on the physical parameter of size, with little or no significance attached to their chemical nature. The principles of light scattering that are fundamental to turbidity measurements are described, with special emphasis on Raleigh scattering and Mie scattering. The effects of sample and instrument parameters on turbidity measurement are examined. Early turbidimetric methods utilized the visual devices of Jackson, Hellige, Duboscq, and Parr. Modern nephelometric instruments rely on detectors such as the photomultiplier tube, vacuum photodiode, the silicon photodiode, and the CdS photoconductor. Responses of commercially available nephelometers that affect the outcome of turbidity measurements are compared. Process instruments used to continually monitor turbidity are described. A comparison of various specifications of nephelometric instruments is given. The calibration and standardization of nephelometric instruments are considered along with the potential of future nephelometric developments. The procedures used for the determination of residue (suspended and dissolved solids) are reviewed. (Geiger-PTT)
W86-02262

SALINITY SOURCES AND PROBLEMS OF THE DANUBE RIVER BASIN,

North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W86-02273

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI,

Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 5B.
W86-02274

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,

Montana Univ., Missoula. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W86-02277

GRAND VALLEY SALT PICK-UP CALCULATIONS,

Bureau of Reclamation, Grand Junction, CO.
For primary bibliographic entry see Field 5B.
W86-02278

CHEMICAL REACTIONS INFLUENCING SALINITY INCREASE OF SOIL AND GROUNDWATERS IN THE GREAT BASIN, WESTERN UNITED STATES,

Nevada Univ. System, Reno. Desert Research Inst.
B. Bohm, and R. L. Jacobson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 525-535, 4 fig, 20 ref.

Descriptors: *Groundwater, *Salinity, *Water pollution sources, Calcium, Magnesium, Sodium, Potassium, Silica, Chloride, Alkalinity.

Groundwater chemistry in the semi-arid western Great Basin is mostly controlled by common processes of rock dissolution and formation of secondary minerals. The major cations and silica are provided from dissolution of silicate minerals. Levels of Ca, Mg, SO4 and alkalinity are mostly controlled by incongruent silicate reactions. Chloride is derived from traces in rocks and only minimally from cyclic salts. It increases gradually along a flow path and due to the high solubility of its salts, its levels are not restricted. The acidity required for the advance of rock dissolution is probably mostly provided by CO2 derived from geothermal processes, and to a lesser degree from biological activity in soils and perhaps locally from the oxidation of sulfide minerals. (Author)
W86-02311

QUALITY OF GROUND WATER IN THE PRINCIPAL AQUIFERS OF NORTHEASTERN-NORTH CENTRAL WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
J. C. Ebbert.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4102, 1984. 112 p, 24 fig, 37 tab, 20 ref.

Descriptors: *Water quality, *Groundwater, Water quality standards, *Washington.

In 1979 the quality of ground water in major aquifers in northeastern-north central Washington State was assessed in terms of inorganic-chemical, trace-metal, and fecal-coliform concentrations. For the Spokane Valley aquifer some organic-chemical data were also included. Results of this assessment indicate that the ground water in the region is generally suitable for most uses. (USGS)
W86-02345

ANALYSIS OF GROUND-WATER-QUALITY DATA IN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02361

CHEMICAL AND ISOTOPIC CHARACTERISTICS OF BRINES FROM THREE OIL- AND GAS-PRODUCING FORMATIONS IN EASTERN OHIO, WITH APPLICATIONS TO THE GEOCHEMICAL TRACING OF BRINE SOURCES,

Geological Survey, Columbus, OH. Water Resources Div.
K. J. Breen, C. G. Angelo, R. W. Masters, and A. C. Sedam.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4314, 1985. 58 p, 14 fig, 11 tab, 25 ref.

Descriptors: *Brines, *Chemical properties, Oil wells, Isotope studies, *Geochemistry, Alkali metals, Alkaline earth metals, Ions, Berea Sandstone, Clinton sandstone, Albion Knox Dolomite, Rose Run sandstone, *Ohio.

Chemical and isotopic characteristics of selected inorganic constituents are reported for brines from the Berea Sandstone of Mississippian age, the Clinton sandstone, Albion Sandstone of Silurian age, and the Rose Run formation of Cambrian and Ordovician age in 24 counties in eastern Ohio. Ionic concentrations of dissolved constituents in brines from these formations generally fall in the following ranges (in millimoles per kilogram of brine): Na, Cl $> 1{,}000$; $100 <$ Ca, Mg $< 1{,}000$; $1 <$ K, Br, Sr, Li, Fe, SO4 < 100; Mn, Zn, Al, I, HCO3, SiO2 < 1. Mean ionic concentrations of Ca, Mg, Na, Cl, K, SO4 and Br, and mean values of density and dissolved solids are significantly different at the 95-percent confidence level in each formation. Only potassium has a unique concentration range in each formation. Selected concentration ratios are identified as potential indicators for geochemical tracing of brines having some history of dilution. The k:Na ratios work best for identifying the source formation of an unidentified brine. Isotopic characteristics of hydrogen and oxygen indicate a meteoric origin for the water matrix of the brines. Sulfur isotopes may have utility for differentiating brines from oxidizing ground water. (USGS)
W86-02365

GROUND-WATER QUALITY DATA FOR THE ATLANTIC COASTAL PLAIN: NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, AND NORTH CAROLINA,

Geological Survey, Trenton, NJ. Water Resources Div.
L. L. Knobel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-154, 1985. 84 p, 1 fig, 10 tab, 8 ref, 1 pl.

Descriptors: *Coastal aquifers, Coastal plains, *Data collections, Groundwater, Statistics, *Water quality, *Groundwater data, *Atlantic Coastal Plain, Delaware, Maryland, New Jersey, North Carolina, Virginia.

This report is a compilation of chemical analyses of ground-water samples in the Atlantic Coastal Plain from North Carolina through New Jersey. It contains records of 3,616 chemical analyses of ground water selected from more than 15,000 analyses in WATSTORE. These analyses serve as the data base for interpreting the geochemistry of the northern Atlantic Coastal Plain aquifer system. Reported chemical data include common anions and cations, selected trace metals, and selected physical characteristics. (USGS)
W86-02374

VOLATILE TRACE-ELEMENT CONCENTRATIONS IN SNOWMELT CONTRIBUTIONS TO STREAMS MONITORED BY HYDROLOGIC BENCH MARK NETWORK STATIONS IN THE CONTERMINOUS UNITED STATES WHERE AVERAGE ANNUAL SNOWFALL EXCEEDS 12 INCHES,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02397

GEOHYDROLOGIC RECONNAISSANCE OF THE AVOCA LIGNITE DEPOSIT AREA NEAR WILLISTON, NORTHWESTERN NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02398

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE NORTHERN GREAT PLAINS IN PARTS

OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING--GEOCHEMICAL EVOLUTION OF GROUND-WATER COMPOSITION IN TWO CONFINED AQUIFER SYSTEMS,

Geological Survey, Lakewood, CO. Water Resources Div.
T. Henderson.
Available from Distribution Br, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1402-C, 1984. 84 p, 53 fig, 32 tab, 122 ref.

Descriptors: *Groundwater, *Geochemistry, Mass transfer, Isotope studies, *Wyoming, *Montana, Major chemical elements, Minor chemical elements, *Kootenai Formation, *Fox Hills Sandstone, *Lance Formation.

The Kootenai Formation in the Judith Basin, Montana, and the Lance Formation and Fox Hills Sandstone in the Powder River Basin, Wyoming, constitute two important sandstone aquifer systems in the Northern Great Plains region. Calculation of the saturation states of aquifer minerals suggests several carbonate, silicate, and aluminosilicate phases, which could control ground-water chemistry. Mass transfer modeling indicates that the observed behavior of major and minor dissolved species in both systems can satisfactorily be explained by equilibration with calcite and dolomite. Specific processes controlling the geochemistry of these systems are probably the incongruent dissolution of dolomite to form calcite driven by the dissolution of CO2. Plausible CO2 sources include organic carbon oxidation and lignite coalification. Aluminosilicates influence major element chemistry primarily as substrates for cation exchange. Measured variations in dissolved carbonate isotopic composition compare favorably with carbon isotopic evolution, calculated by assuming de-dolomitization. Ground-water flow rates, calculated by adjusting measured carbon-14 activities for carbonate mass transfer, are comparable to values calculated from hydrologic aquifer tests and potentiometric data. These carbon-14 flow rates average 1.6 meters per year for the Second Cat Creek aquifer of the Kootenai Formation, and 1.3 meters per year for the Lance-Fox Hills aquifer. (USGS)
W86-02400

2L. Estuaries

APPEARANCE AND WATER QUALITY OF TURBIDITY PLUMES PRODUCED BY DREDGING IN TAMPA BAY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 6G.
W86-01929

METHODS FOR THE COLLECTION OF GEOCHEMICAL DATA FROM THE SEDIMENTS OF THE TIDAL POTOMAC RIVER AND ESTUARY, INCLUDING DATA FOR 1978-1980 AS AN APPENDIX,

Geological Survey, Reston, VA. Water Resources Div.
S. D. Goodwin, B I. Schultz, D. L. Parkhurst, N. S. Simon, and E. Callender.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-074, 1984. 129 p, 4 fig, 4 tab, 42 ref.

Descriptors: Rivers, *Estuaries, Sediments, Pore water, Alkalinity, Sulfide, Sulfate, Phosphate, Carbon, Ammonium, Silica, Iron, Manganese, Chloride, Sodium, Potassium, Calcium, Magnesium, Porosity, Nitrogen, Phosphorus, Cores, Tidal Potomac River, *Potomac Estuary, Sediment sampling, Core processing, *Geochemical data, *Water quality, pH, Eh.

The chemical composition of bottom sediments and their associated pore waters from the tidal Potomac River and Estuary was studied from May 1978 through June 1980. Pore waters were routinely analyzed for pH, Eh, alkalinity, and concentrations of sulfide, sulfate, phosphate, carbon, ammonium, silica, iron, manganese, chloride, sodium, potassium, calcium, and magnesium. Porosity, weight loss on ignition, and carbon, nitrogen, and phosphorus contents were determined for the solid sediments. The range of salinity and chemical composition encountered in the estuary frequently necessitated modifications of standard methods of analysis. Therefore, the methods used, their modifications, and their limitations are presented in some detail. The appendix lists the data obtained from six sampling periods. (USGS)
W86-01930

ESTUARY AS A FILTER,

Proceedings of the Seventh Biennial International Estuarine Research Conference, Virginia Beach, Virginia, October 23-26, 1983. Academic Press, Orlando, FL. 1984. Edited by Victor S. Kennedy. 511 p.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Fate of pollutants, Sediments, Sedimentation, Water circulation, Management, Aquatic life.

Estuaries and coastal areas act as filters between rivers and oceans by trapping significant quantities of sediments and associated pollutants. This filter aspect is emphasized in a collection of papers concerning physical processes, geological processes, chemical-geochemical processes, biological processes, and management implications. The physical shape, mixing, circulation, characteristics, and stage of evolution of the estuary strongly influence its filtering capacity. The Chesapeake Bay and fjords such as Puget Sound are particularly effective filters for particulate matter. Chemical and geochemical processes are illustrated in case studies of nutrients and other substances in northern San Francisco Bay and in the Delaware Estuary. Biological processes involving surface foam, phytoplankton, aquatic plants, and bacteria are shown to affect nutrient and sediment transport in several estuaries. Management strategies are given for reduced freshwater inflow, sedimentation in the Mississippi Delta, pollution in the Chesapeake Bay, and the rehabilitation of water quality in the Thames Estuary. (Cassar-PTT)
W86-02070

ESTUARY AS A FILTER: AN INTRODUCTION,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. R. Schubel, and V. S. Kennedy.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 1-11, 10 ref.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Sedimentation, Suspended sediments, Sediments, Water circulation, Mixing, Rivers, Saline water, Tidal effects, Wind waves, Dissolved solids, Turbidity, Colloids, Nutrients, Organic carbon, Productivity, Aquatic life, *Fate of pollutants, Geochemistry, Management, Sediment transport.

The filter action of estuaries modifies the suspended matter and chemical regime as well as physical inputs such as currents, wind, and tides. This action has both negative effects (dissolved oxygen depletion) and positive effects (rapid recycling of nutrients and organic matter). Estuary circulation ranges from the river-dominated, highly stratified type to the thoroughly mixed, sectionally homogeneous type. The most effective filtration, where productivity is highest, occurs near the upstream limit of sea salt penetration and near the estuary mouth. The turbidity maxima are usually in the null zone, where the upstream flow of the lower layer dissipates. Geochemical removal of dissolved and colloidal material is affected by mixing, gravitational circulation, and alternate deposition and resuspension of bottom sediment by tidal scour and wind waves. Biological and biochemical filtration is a result of filter-feeding activity and biological fixation of dissolved materials into particulate form. Submerged macrophytes remove both dissolved and suspended particulates from the water. An understanding of the filtering capacities of estuaries should be incorporated into management programs. (Cassar-PTT)
W86-02071

TURBULENCE AND MIXING IN ESTUARIES,

Liverpool Univ. (England). Dept. of Oceanography.
K. F. Bowden.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 15-26, 2 fig, 19 ref.

Descriptors: *Estuaries, *Water circulation, *Mixing, *Turbulence, Currents, Water currents, Filtration, Currents, Model studies, Advection, Diffusion, Dispersion, Tidal effects, Turbidity, Rivers, Sediment transport, Saline water.

Mixing and dispersion in an estuary result from a combination of advective and diffusive processes and are closely related to patterns of circulation. The intensity and scale of turbulence depend largely on the stability of the density distribution and so affect directly the vertical fluxes of momentum and matter. Indirectly, the state of turbulence also influences the longitudinal and transverse mixing. In setting up models to predict changes in estuarine conditions arising from natural external causes or human intervention, most attention in the past has been given to longitudinal fluxes across planes perpendicular to the axis of an estuary. The apparent simplicity of one-dimensional treatments, often used for this purpose, conceals the importance of contributions from physical processes in the vertical and transverse directions. It is likely that two- and three-dimensional models will be more widely used in the future, but their successful employment calls for a better understanding of the physical processes which are to be simulated. (Author)
W86-02072

VERTICAL VARIATIONS IN RESIDUAL CURRENT RESPONSE TO METEOROLOGICAL FORCING IN THE MID-CHESAPEAKE BAY,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. W. Pritchard, and M. E. C. Vieira.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 27-65, 13 fig, 4 tab, 11 ref. 0CN8208363A01.

Descriptors: *Estuaries, *Filtration, *Water currents, *Wind pressure, Chesapeake Bay, Model studies, Currents, Tidal effects, Rivers, Atmospheric pressure.

Records of the nontidal current velocity obtained from current meters deployed for 20 days in two cross sections in Chesapeake Bay were used with an interpolation scheme to produce a vertical profile of the laterally-averaged longitudinal velocity component of one meter depth intervals at each section, at 3-hour intervals over the 15-day truncated record. Various statistical procedures were used to relate variations in the residual current, at each depth, to wind variations. Surface layers down to about 8 m responded directly to wind with little time lag. A slope of the water surface was also set up by the wind, with a consequent barotropic pressure force directly opposite to the wind. The current near the bottom responded first to this pressure force, flowing opposite to the wind with a phase lag of about 8 hours. This counter response proceeded up the water column, such that in the intermediate layers just below the pycnocline the negative response to the wind had a phase lag of about 20 hours. A diagnostic analytical model, based upon a Fourier transform of the linearized equations of motion, was exercised for a four-layered simulation of the vertical response of the currents to inputs of the observed fluctuations in wind and surface slope. The major features of the time variations in the residual currents in the four layers were reproduced by the model. (Author)
W86-02073

TRANSPORT VARIABILITY IN A FJORD,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
G. A. Cannon, D. E. Bretschneider, and J. R. Holbrook.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 67-78, 5 fig, 5 ref.

Descriptors: *Estuaries, *Filtration, *Fjords, *Water circulation, *Fate of pollutants, Bottom water, Mixing, Tidal effects, Dissolved solids, Suspended sediments, Particulate matter, Water circulation, *Puget Sound, *Washington, Saline water, Sediments, Rivers.

Bottom water in fjord-like Puget Sound is renewed several times a year, usually at the largest flood tides through Admiralty Inlet and at the smallest neap tides. The controlling mechanism appears to be tidal and mixing processes at the entrance sill. Although the average bottom water replacement time is about two weeks, complete renewal does not occur every two weeks. The inflowing bottom water entrains some of the seaward flowing upper water at the landward side of the sill. This acts as a filter to prevent some dissolved and particulate matter with their associated contaminants from leaving the system. (Cassar-PTT)
W86-02074

ESTUARY AS A FILTER FOR FINE-GRAINED SUSPENDED SEDIMENT,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. R. Schubel, and H. H. Carter.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 81-105, 3 fig, 2 tab, 53 ref.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Sedimentation, Suspended sediments, Sediments, Mixing, Tidal effects, Currents, Water currents, Sediment transport, Model studies, Saline water, Fate of pollutants, Stratification, Chesapeake Bay, Rivers, Turbidity, Potomac River, Wind effects.

Estuaries function as filters for the signals they receive from the land and the sea. The nontidal residual circulation, tidal mixing, and estuarine geometry determine the efficiency of this filter for suspended sediment. Tidal currents provide energy for mixing saltwater from the ocean with freshwater from the river. The resulting salinity distribution drives that part of the nontidal circulation caused by density differences, which in turn influences the salinity patterns and resulting density gradients. This feedback between salinity redistribution and gravitational circulation places a constraint (filter) on the range of variations in flow and salt concentration in the estuary. The nontidal circulation also controls the distribution and transportation of suspended sediment, and the deposition of fine particles with the estuary. The distributions of salt and fine suspended matter control the behavior of many nonconservative constituents such as nutrients, radionuclides and some metals, their modes of occurrence and transport, and their reservoirs of accumulation. The result of these processes is that the estuary modifies significantly the strength and the form of the signals it receives from land and sea. Alteration of an estuary's gravitational circulation pattern by changing its freshwater input or its geometry modifies its filtering efficiency. In general, as an estuary changes from being highly stratified toward being well-mixed, its filtering efficiency for land-derived constituents first increases to a maximum (in the partially-mixed region) and then decreases. A simple kinematic model is used to demonstrate the relationship between estuarine type and filtering efficiency for Chesapeake Bay. (Author)
W86-02075

ESTUARY AS A SEDIMENT TRAP: ALTERNATE APPROACHES TO ESTIMATING ITS FILTERING EFFICIENCY,

Delaware Univ., Newark. Coll. of Marine Studies.
R. B. Biggs, and B. A. Howell.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 107-129, 2 fig, 4 tab, 61 ref. X-003256-01.

Descriptors: *Estuaries, *Filtration, *Sedimentation, *Particulate matter, Capacity/inflow ratio, Model studies, Aquatic life, Zooplankton, Oysters, Shellfish, Suspended sediments, Sediments, Delaware Bay, Bathymetry, Sediment cores, Sediment transport, Rivers, Saline water.

The sediment trapping efficiency of estuaries for particulate matter was reviewed using several methods of estimating trapping efficiency: box models, historical changes in bathymetric data, geochronological data, and the capacity-inflow ratio (C/I). Most open water estuaries (those which have not yet evolved into deltaic systems) showed 90-100% sediment trapping efficiency. The C/I was computed for several estuaries using the mean low water volume to minimize tidal variations and the precipitation times watershed area instead of actual inflow. An exponential curve was devised to use the C/I to predict the percent sediment trapped. A >99% sediment trapping efficiency was equivalent to a C/I of about 2, about 75% t 0.05 C/I, and 30% to 0.006 C/I. A conceptual model was developed to show the source and intensity of areal depositional processes. Biologically mediated sedimentation was shown to be a major factor in sedimentation. For example, the zooplankton, oysters, and mussels in Delaware Bay fix about 400 billion kg/year of sediment. This is 200 times the annual sediment input from the rivers (1.4 billion kg/year). (Cassar-PTT)
W86-02076

RECENT SEDIMENTATION RATES IN CHESAPEAKE BAY,

Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
C. B. Officer, D. R. Lynch, G. H. Setiock, and G. R. Helz.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p.131-157, 4 fig, 2 tab, 27 ref.

Descriptors: *Estuaries, *Sediment transport, *Filtration, *Sedimentation rates, *Chesapeake Bay, Tracer studies, Susquehanna River, Rivers, Saline water.

Nonlinear parameter estimation techniques were applied to obtain optimum values and confidence intervals for mass sedimentation rates in Chesapeake Bay from Pb210, Cs137 and Pu239, 240 geochemical tracer profiles. The results show high sedimentation rates of around 0.3-1.2 g/sq cm/year for the upper bay, modest sedimentation rates of 0.1-0.3 g/sq cm/yr for the middle bay, and modest to high sedimentation rates of 0.1-0.8 g/sq cm/yr for the lower bay. The principal source for the upper bay is the Susquehanna River discharge and that for the lower bay is the ocean and lower bay environment. In terms of total sediment budget the results are in agreement with published eivdence that episodic sedimentation events are an important feature of the bay system. (Author)
W86-02077

ROLE OF FLOCCULATION IN THE FILTERING OF PARTICULATE MATTER IN ESTUARIES,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
K. Kranck.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 159-175, 6 fig, 44 ref.

Descriptors: *Estuaries, *Filtration, *Particulate matter, *Flocculation, *Sedimentation, Suspended sediments, Sediments, Rivers, Saline water, Particle size, Sediment transport, Settling velocity, Organic matter.

The structuring of suspended particulate matter in estuaries into flocculated settling entities is described and discussed. A hierarchy of three particle distribution types is described: in situ distributions contain abundant large low density fragile aggregates (macro-flocs) with high settling rates, the formation of which is promoted by low turbulence and high particulate concentrations. During periods of high currents in nature and during shipboard and laboratory sample handling, these macro-flocs break up into more stable distributions of smaller flocs which are the basic building blocks of the larger units. Laboratory oxidation of organic matter and disaggregation of aggregates allow the size analysis of individual single mineral grain distributions for purposes of direct comparison between bottom and suspended sediment spectra. The constituent grain-size distribution of the inorganic component of a floc replicates the grain size of the suspension as a whole. The diverse grain size and chemical nature of the organic matter makes its flocculation kinetics more complicated. Past laboratory experiments have indicated the existence of organic-inorganic proportions optimum for flocculation. This is substantiated by ash-loss data from three estuaries with different relative inputs of organic and inorganic matter. The particulate matter in each was dominated by similar organic-inorganic proportions (65%-75% organic matter by volume) indicating that the component in excess of this value had been preferentially exported from the estuary. Settling of suspended sediment as macro-flocs and near bottom break-up and resuspension of floc fragments control the very dynamic equilibrium between particle trapping and particle flushing in estuaries. (Author)
W86-02078

FATES OF URANIUM AND THORIUM DECAY SERIES, NUCLIDES IN THE ESTUARINE ENVIRONMENT,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
J. K. Cochran.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 179-220, 10 fig, 1 tab, 66 ref. OCE76-02-39.

Descriptors: *Estuaries, *Filtration, *Radioisotopes, *Tracer studies, Sedimentation, Uranium radioisotopes, Thorium radioisotopes, Radium radioisotopes, Lead radioisotopes, Polonium radioisotopes, Sediments, Suspended sediments, Mixing, Organic matter, Saline water, Bottom sediments, Sediments, Rivers, Radon, Aquatic life, Benthic fauna.

Naturally occurring radionuclides of the uranium and thorium decay series are useful in studying estuarine geochemical processes ranging from the removal of reactive nuclides from the water column to the mobilization and transport of chemical species in the sediment column. Although uranium isotopes generally show conservative behavior during estuarine mixing, removal from solution can occur at low salinities or in estuaries high in dissolved organic matter. Uranium in estuarine sediments also displays a diagenetic chemistry linked to oxidation-reduction. In contrast to uranium, radium isotopes are released during estuarine mixing. Mechanisms of release include desorption from suspended sediments and the mobilization of radium from bottom sediments. The latter is demonstrated by measurements of Ra226 and Ra228 in sediment pore waters. The thorium isotopes, Th234 and Th228, produced by decay of soluble parents U238 and Ra228, are good analogs for chemical species which interact strongly with particles in the estuary. Both have been used to estimate removal times of thorium from solution to particles. The distribution of Th234 and Th228 in sediments is governed primarily by particle mixing by the benthic fauna, and both isotopes serve as chronometers to determine mixing rates. Pb210 and its daughter Po210 also serve as tracers of reactive nuclides. Both are removed rapidly to bottom sediments. Although Pb210 is a longer lived tracer than Th234 or Th228, its depth distribution in estuarine sediments is also affected by bioturbation. Successful reconstruction of sediment chronology in the estuary thus requires the application of several tracers with different half-lives and independent information on the sediment budget of the area. (Author)
W86-02079

RESPONSE OF NORTHERN SAN FRANCISCO BAY TO RIVERINE INPUTS OF DISSOLVED INORGANIC CARBON, SILICON, NITROGEN AND PHSOPHORUS,

Geological Survey, Menlo Park, CA.
L. E. Schemel, D. D. Harmon, S. W. Hager, and D. H. Perterson.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 221-240, 6 fig, 1 tab, 29 ref.

Descriptors: *Estuaries, *Filtration, *Nutrients, Dissolved solids, Silicon, Nitrogen, Phosphorus, San Francisco Bay, Sacramento River, San Joquin

River, San Pablo Bay, Suisun Bay, Rivers, Solute transport, Seasonal variation, Water quality, Saline water, Biological filters, Phytoplankton.

Estuarine processes can be effective in modifying (filtering) distributions of dissolved inorganic forms of carbon, silicon, nitrogen, and phosphorus in northern San Francisco Bay. During winter, high inflow from the Sacramento-San Joaquin river system supplied these nutrients to the estuary at rates that exceeded potential rates of estuary supply and removal processes. During spring and summer, when inflow rates were lower, the estuary was an effective filter of the river inflow signal because rates of estuarine processes were high relative to river and other supply rates. At lower inflow rates, the river apparently influenced estuarine hydrodynamic feeatures that controlled rates of phytoplankton nutrient removal. Largest biological removal effects were localized in Sen Pablo Bay during spring and Suisun Bay during summer, and they were generally more pronounced in shallow water areas of the bays. In San Pablo Bay, effects of biological removal appeared soon after river inflow decreased from high winter rates, but persisted for only a short time. During the following summer months dissolved nitrogen and dissolved phosphorus distributions in San Pablo Bay indicated that estuarine sources contributed to higher concentrations of these nutrients. (Author)
W86-02080

ESTUARINE INTERACTION OF NUTRIENTS, ORGANICS, AND METALS: A CASE STUDY IN THE DELAWARE ESTUARY,

Delaware Univ., Lewes. Coll. of Marine Studies.
J. H. Sharp, J. R. Pennock, T. M. Church, J. M. Tramontano, and L. A. Cifuentes.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. P 241-258, 10 fig, 23 ref. NA80AA-D-00106.

Descriptors: *Estuaries, *Fate of pollutants, *Filtrations, *Nutrients, Phytoplankton, Metals, Heavy metals, Delaware Estuary, Geochemistry, Nutrients, Organic matter, Phosphates, Humic acids, Particulate matter, Dissolved solids, Rivers, Saline water, Iron, Phosphates, Ammonium compounds, Urea, Silicates, Nickel, Copper.

The geochemical and the biochemical processes which alter concentrations of soluble nutrients, organic matter, and trace metals were studied in the Delaware Estuary using property-salinity plots. Geochemical filtration occurred primarily in the low salinity upper estuary, where particulate concentrations were highest because of flocculation and resuspension of bottom sediments. Biochemical filtration occurred primarily in the low salinity upper property-salinity plots. Geochemical filtration occurred primarily in the low salinity upper estuary, where particulate concentrations were highest because of flocculation and resuspension of bottom sediments. Biochemical filtration occurred predominantly in the lower estuary, where biological productivity was highest. Geochemical filtration was studied with organic matter, iron, and phosphate. Dissolved organic matter and humic acid concentrations decreased with increasing salinity; amino acids generally increased with increasing salinity. Iron and phosphate concentrations decreased with increasing salinity. However, the steady-state lower limit was higher for iron (30 nM) than for phosphate (1 nM). This was attributed to the phosphorus buffer effect. Geochemical removal was most apparent during winter. Biochemical filtration was studied with nutrients and trace metals. In spring concentrations of ammonium, phosphate, silicate and urea decreased to nearly zero at a salinity of about 15. Phytoplankton activity was highest in the region of 10-22 salinity. Nickel and copper showed little filtration, despite their potential for bioreactivity. Cadmium and phosphate concentrations illustrated a combined biogeochemical filter, with geochemical exchange dominant at lower salinities and biochemical activity dominant at higher salinities. (Cassar-PTT)
W86-02081

ESTUARINE TOTAL SYSTEM METABOLISM AND ORGANIC EXCHANGE CALCULATED FROM NUTRIENT RATIOS: AN EXAMPLE FROM NARRAGANSETT BAY,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
S. W. Nixon, and M. E. Q. Pilson.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 261-290, 9 fig, 2 tab, 50 ref.

Descriptors: *Estuaries, *Filtration, *Organic matter, *Nutrients, *Narragansett Bay, *Rhode Island, Nitrogen, Phosphorus, Denitrification, Sedimentation, Mixing, Phytoplankton, Productivity, Metabolism, Saline water.

The system metabolism of Narragansett Bay, Rhode Island, was calculated from the annual nutrient input, the ratio of the annual time and volume-weighted mean concentrations of dissolved inorganic nitrogen and dissolved inorganic phosphorus, the annual rate of denitrification, and data on the chemical composition of the plankton. Results showed that the system is autotrophic, with net production exceeding consumption by about 80 g C per sq m per year. The amount or organic matter exported from the bay is 70-75 g C per sq m per year, equivalent to 22-24% of the phytoplankton production. Estimated accumulation in the sediments is about 6 g C per sq m per year; estimated removal by fisheries is about 1 g C per sq m per year. (Cassar-PTT)
W86-02082

ANTHROPOGENIC NITROGEN LOADING AND ASSIMILATION CAPACITY OF THE HUDSON RIVER ESTUARINE SYSTEM, USA,

Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
T. C. Malone.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 291-311, 8 fig, 1 tab, 37 ref.

Descriptors: *Estuaries, *Fate of pollutants, *Filtration, *Nitrogen, Wastewater disposal, Hudson River Estuary, Phytoplankton, Productivity, Dissolved oxygen, Oxygen, Saline water.

The fate of sewage-derived nitrogen was studied in the Hudson River Estuary. Net export of nitrogen was negligible during March-October. During this period sewage-nitrogen accounted for 54% (March-May) to 121% (June-October) of new production. During the remainder of the year most new nitrogen was exported to adjacent coastal water with little uptake by the plume. Estimated increases in new production as a result of sewage-nitrogen loading were 77 million kg C during March-May and 94 million kg C during June-October. This was a 30% increase in phytoplankton production over the predischarge levels of 578 million kg C per year. During summer, when the phytoplankton production was highest, nitrogen was exported as plankton biomass or as fecal material. The increased phytoplankton production in response to sewage-nitrogen had little effect (about 30%) on dissolved oxygen levels because over 80% of phytoplankton production is metabolized within the plume before reaching the bottom waters. (Cassar-PTT)
W86-02083

ESTUARY EXTENDED - A RECIPIENT-SYSTEM STUDY OF ESTUARINE OUTWELLING IN GEORGIA,

Georgia Univ., Sapelo Island. Marine Inst.
C. S. Hopkinson, and F. A. Hoffman.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 313-330, 1 fig, 5 tab, 36 ref.

Descriptors: *Estuaries, *Filtration, *Marshes, *Organic carbon, Georgia, Rivers, Saline water, Organic matter, Productivity, Sedimentation, Respiration, Aquatic life, Nearshore processes, Salt marshes.

Organic carbon budgets are presented for the marsh, estuarine water bodies and the inner portion of the nearshore region of Georgia. Budgets were determined by balancing external inputs and outputs from rivers and the mid-shelf against measurements of community production, metabolism and internal organic matter storage. On the marsh, primary production exceeds sedimentation and respiration by a factor of 2.6. The aquatic system is distinctly heterotrophic, with the primary production to community respiration ratio being 0.63:1. The current best estimate is that the autotrophic marsh-estuarine system has 947 g C per sq m potentially available for export. The nearshore system requires an input of 210 g C per sq m per year in addition to primary production to sustain its high rate of community production. Allochthonous organic inputs from rivers constitute 12% of total inputs to the marsh/estuarine/nearshore interface system. Roughly 50% of carbon inputs to the interface system are unaccounted for. About 10% of net primary production of the marsh must be exported to sustain heterotrophic levels in the estuarine aquatic system and the nearshore. The nearshore region is a component of a coupled system and is strongly dependent on the adjacent marsh/estuary and river for a portion of its organic matter. As such, the nearshore can be considered as a functional extension of the estuary into the ocean. The estuary is a filter in the sense that materials received at the land-sea interface will be processed, transformed and exchanged within the marsh/estuary and the nearshore zones. (Author)
W86-02084

SURFACE FOAM CHEMISTRY AND PRODUCTIVITY IN THE DUCKABUSH RIVER ESTUARY, PUGET SOUND, WASHINGTON,

Washington Univ., Seattle. Coll. of Ocean and Fishery Sciences.
R. C. Wissmar, and C. A. Simenstad.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 331-348, 3 fig, 5 tab, 42 ref. R/F-37.

Descriptors: *Estuaries, *Filtration, *Organic matter, Foaming, Nitrogen, Chlorophyll, Adenosine triphosphate, bacteria, Sediments, Duckabush River, Hood Canal, Puget Sound, Washington, Productivity, Neritic environment, Algae, Eelgrass, Phytoplankton.

Chemical and biotic constituentsof surface foam were compared in estuarine and neritic waters of Puget Sound, Washington. The role of surface foam formation as a major filtering medium in an estuary was indicated by entrainment and concentration of constituents in foam several times higher than that of subsurface and neritic waters. Stable carbon isotopic ratios and organic solute fractions (hydrophobic and hydrophilic) indicated that organic matter in foams originated from dissolved organic carbon compounds released from seagrasses and benthic algae. Concentrations of particulate oranic carbon and nitrogen, chlorophyll a, adenosine triphosphate, and bacteria counts showed enrichment in foams due to entrained sediment particles, algae, and bacteria. Inorganic nutrient concentrations, primary production and respiration rates of estuarine foam were also severalfold greater than neritic waters. The high levels of organic and inorganic chemical constituents, and metabolic rates of the microbial community indicate that surface foams are important interfaces for cycling of nutrients, formation of detrital matter, and production of microbial forage for consumers. (Author)
W86-02085

MICROBIOLOGICAL CHANGES OCCURRING AT THE FRESHWATER-SEAWATER INTERFACE OF THE NEUSE RIVER ESTUARY, NORTH CAROLINA,

East Carolina Univ., Greenville, NC. Dept. of Biology.
R. R. Christian, D. W. Stanley, and D. A. Daniel.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 349-365, 2 fig, 3 tab, 32 ref. NA83AA-D-0012.

Descriptors: *Estuaries, *Filtration, *Bacteria, *Saline-freshwater interfaces, *Neuse River Estuary, *North Carolina, Nitrates, Phosphates, Phytoplankton, Productivity, Chlorophyll, Nitrogen.

The hypothesis that mass mortality of freshwater phytoplankton at the freshwater-saltwater interface causes rapid biogeochemical changes was

tested. Physical, chemical, and microbiological variables were studied in the Neuse River Estuary, North Carolina. Nitrate nitrogen, orthophosphate, and number of phytoplankton taxa all decreased significantly going downriver across the freshwater-seawater interface, while bacterial density and productivity rose sharply. Parameters which did not change significantly were phytoplankton density, chlorophyll a, ammonia nitrogen, and light absorption coefficient. In laboratory studies, increasing salt concentration from zero to 4 ppt produced slightly lower bacterial density and slightly higher bacterial productivity. In the same studies the following parameters were unaffected by the change from freshwater to saline water: primary productivity, chlorophyll concentration, number of phytoplankton taxa, ammonium-N uptake, and nitrate-N uptake. No evidence was found to confirm the hypothesis that salt at the interface affects the microbial community. (Cassar-PTT)
W86-02086

INFLUENCES OF SUBMERGED VASCULAR PLANTS ON ECOLOGICAL PROCESSES IN UPPER CHESAPEAKE BAY,

Maryland Univ., Cambridge. Horn Point Environmental Labs.

W. M. Kemp, W. R. Boynton, R. R. Twilley, J. C. Stevenson, and L. G. Ward.

IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. P 367394, 6 fig, 2 tab, 73 ref. R80593200.

Descriptors: *Estuaries, *Filtration, *Aquatic plants, *Sediments, Submerged plants, *Organic matter, Suspended sediments, Sediments, *Chesapeake Bay, Potamogeton perfoliatus, Ruppia maritima, Phytoplankton, Turbidity, Fish, Aquatic animals, Vegetation effects, Waterfowl, Nitrogen, Phosphorus, Nutrients, Oxygen demand, Productivity, Decomposition.

Physical, chemical and biological influences of submersed vascular plants (dominated by Potamogeton perfoliatus and Ruppia maritima) on their surrounding environment are summarized for portions of Upper Chesapeake Bay. Rates of accretion of organic matter in these ecosystems were high owing to the combined effects of vascular plant and associated algal production and the trapping of particulate organics of phytoplanktonic origin. Time-series observations of seston along transects traversing vegetated bottoms indicated significantly less turbid water over the plant beds, due both to increased deposition and to decreased resuspension of fine-grain sediments. Submersed plants provided a preferred habitat for many animal populations, and abundance of fishes (predominantly juveniles) was significantly greater in these plant beds than in adjacent unvegetated areas. Recent declines in several species of migrating waterfowl which feed directly on plant material were highly correlated with contemporaneous decreases in plant distribution. Rapid uptake of dissolved inorganic nitrogen and phosphorus was demonstrated for these communities, with subsequent incorporation into plant material via both growth and facultative increases in percent N and P composition. Upon senescence and death, submersed vascular plants contributed 33% to the organic C budget, while acting as a seasonal sink for 210% and 7% of the total sediment and nitrogen inputs, respectively, to the estuary. (Author)
W86-02087

SEAGRASS FILTER: PURIFICATION OF ESTUARINE AND COASTAL WATERS,

New Hampshire Univ., Durham. Jackson Estuarine Lab.

F. T. Short, and C. A. Short.

IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 395-413, 5 fig, 1 tab, 46 ref.

Descriptors: *Estuaries, *Filtration, *Sedimetation, *Aquatic plants, *Nutrient removal, Particulate matter, Seagrass, Vegetation effects, Silt, Clays, Organic matter, *Indian River, *Florida, Suspended sediments, Sediments, Nitrogen, Phosphates, Saline water.

Sediment removal and nutrient removal were studied in tanks planted with seagrass. Light penetration to specified depth of the tank increased more rapidly with time in seagrass tanks than in uplanted tanks. Halodule wrightii had a greater sediment trapping effect than Syringodium filiforme. Terrestrial organic silt was more readily settled than the other forms of ammonium chloride and sodium phosphate. The rate of phosphate removal was similar in seagrass and nonvegetated tanks (from 2 to 1 micromoles in three hours). Ammonium concentrations were reduced from 10 to 1 micromoles in seagrass tanks within 1.5 hours; from 10 to 6 micromoles in the control tank. Results were extrapolated to field conditions in Indian River Lagoon, Florida. Nitrogen removal in that seagrass community was calculated to be 3890 metric tons of N annually, 1860 tons of this during May-July. This nitrogen removal represents 11% of the nutrient load to the Indian River. However, excessive loading of nutrients or suspended material is detrimental to the seagrass community, promoting loss of the vegetated beds and their filtering mechanism. (Cassar-PTT)
W86-02088

BIOLOGICAL AND PHYSICAL FILTERING IN ARID-REGION ESTUARIES: SEASONALITY, EXTREME EVENTS, AND EFFECTS OF WATERSHED MODIFICATION,

San Diego State Univ., CA. Dept. of Biology.

J. B. Zedler, and C. P. Onuf.

IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 415-432, 5 fig, 2 tab, 22 ref. R/CZ-33c & R/CZ-51.

Descriptors: *Estuaries, *Filtration, *Sedimentation, Watershed, Enviromental effects, Suspended sediments, Sediments, Saline water, Semiarid lands, Tijuana Estuary, Mugu Lagoon, Colorado Lagoon, *California, Floods, Construction, Aquatic habitats, Habitats, Storms, Seasonal variation, Tidal effects, Nutrients, Channels, Marshes, Salt marshes, Invertebrates.

The filtering functions occurring in the arid region estuaries of southern California were reviewed using data from three tidally flushed systems: Tijuana Estuary, Mugu Lagoon, and Colorado Lagoon. Three hypotheses were developed. (1) The biological and physical filters differ significantly in wet and dry seasons. During the wet season plants take up nutrients, animals consume organic carbon, and sediments are deposited in channels. During the dry season no nutrients are input from the watershed. Organisms continue to filter materials from the water. The filtering function is one of nutrient uptake and recycling rather than tapping of imported particulate organic matter. (2) Extreme events such as floods substantially alter estuarine structure and fuctioning. In channels, sedimentation and salinity reduction can eliminate both plant and animal communities. In salt marshes reduced soil salinity and possibly increased nutrient levels produce increased vascular plant growth and establishment of cordgrass. (3) The combination of extreme events with hunman disturbance in the watershed has the potential for long-term consequences in the estuaries. For example, accelerated erosion from construction increases sedimentation, reducing the water depth and eliminating fish and eelgrass beds in favor of a subtidal habitat. A reservoir drawdown, prolonging the wet season, can eliminate the halophyte community. (Cassar-PTT)
W86-02089

ASSESSING AND MANAGING EFFECTS OF REDUCED FRESHWATER INFLOW TO TWO TEXAS ESTUARIES,

National Coastal Ecosystems Team, Slidell, LA.
For primary bibliographic entry see Field 6G.
W86-02090

DETERIORATION OF COASTAL ENVIRONMENTS IN THE MISSISSIPPI DELTAIC PLAIN: OPTIONS FOR MANAGEMENT,

Louisiana Universities Marine Consortium, Chauvin.
For primary bibliographic entry see Field 6G.
W86-02091

ENVIRONMENTAL CHARACTERIZATION OF CHESAPEAKE BAY AND A FRAMEWORK FOR ACTION,

Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Program.

V. K. Tippie.

IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 467-487, 7 fig, 2 tab, 4 ref.

Descriptors: *Estuaries, *Water pollution sources, *Fate of pollutants, *Filtration, Metals, Organic compounds, Water pollution control, Water quality, Management, *Chesapeake bay, Aquatic life, Shellfish, Fish, Aquatic animals, Aquatic plants, Algae, Oysters, Submerged plants, Sediments, Nutrients, Nitrogen, Phosphorus, Dissolved oxygen, Oxygen.

Data compiled and analyzed during the EPA's Chesapeake bay Program show how the filtering action responsible for the estuary's high productivity also traps pollutants. The bay's ecology has gradually changed as follows: blue-green algal blooms have increased in frequency; submerged aquatic vegetation has declined dramatically, particularly in the upper bay and western shore tributaries; freshwater-spawning fish have declined, while marine-spawning fish have increased; and oyster spat set has decreased significantly as blue crab harvests have increased. Nutrient levels are high in the upper bay and tributaries, moderate in the eastern shore area, and normal in the lower bay. The amount of water in the main part of the bay which has low or no dissolved oxygen has increased 15-fold between 1950 and 1980. High concentrations of toxic organic compounds are in bottom sediments of the main bay near industrial facilities, near river mouths, and in areas of maximum turbidity. Metal concentrations are significantly higher than background levels in many areas; the Patapsco and Elizabeth Rivers being most highly contaminated. To reverse the decline of this ecosystem, inputs of nutrients and toxic materials must be controlled. Nutrient loadings can be reduced by implementing agricultural runoff control, urban runoff control, and point source control of industrial and wastewater treatment plant discharges. Metal loadings from point and nonpoint sources are already being reduced with the aid of the metal contamination index, the toxicity index, and effluent/sediment testing procedures. (Cassar-PTT)
W86-02092

ENVIRONMENTAL IMPACT OF POLLUTION CONTROLS ON THE THAMES ESTUARY, UNITED KINGDOM,

Thames Water Authority, Reading (England).
For primary bibliographic entry see Field 5G.
W86-02093

NUTRIENT AND DETRITUS TRANSPORT IN THE APALACHICOLA RIVER, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02356

HYDRAULIC AND SEDIMENT CHARACTERISTICS AT THE NORTH CHANNEL BRIDGE, JAMAICA BAY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02412

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING BY REVERSE OSMOSIS AT YUMA DESALTING PLANT,

Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
K. M. Trompeter, and S. H. Suemoto.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 427-437, 5 fig.

Descriptors: *Saline water, *Salinity, *Desalination, Desalination plants, Desalination apparatus, Colorado River, Reverse osmosis, Legal aspects, Yuma, Arizona.

This paper presents the pretreatment and desalting systems at Yuma Desalting Plant at Yuma, Arizona. This discussion of processes includes sedimentation, partial lime softening, filtration, scale inhibitors, and reverse osmosis desalting. Other plant features are office, maintenance areas, computer control, energy recovery, and improving performance of treatment by use of Test Train. The key feature of the desalting plant is the reverse osmosis desalting equipment, with a capacity of 22.4 million-gallons-per day. The present status of constructin including anticipated start-up and completion dates, and an update of capital, operation, and maintenance costs, is also presented. (Halterman-PTT)
W86-02319

3B. Water Yield Improvement

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 JANUARY 1979 THROUGH 30 SEPTEMBER 1984: VOLUME ONE - EXECUTIVE SUMMARY,
Atmospherics, Inc., Fresno, CA..
For primary bibliographic entry see Field 2B.
W86-01984

ROOFTOP RAINWATER CATCHMENT SYSTEMS FOR DRINKING WATER SUPPLY,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 85-100, 13 fig, 9 ref.

Descriptors: *Water supply, *Drinking water, *Water conveyance, *Water storage, *Storage tanks, Potable water, Water supply development, Water tanks, Rain, Design criteria, Developing countries, Cisterns, Water demands, Computer models.

In developing countries where the fetching of water is time consuming, rooftop rainwater catchment systems (RWCS) can be a valuable asset. Rainwater catchments are a form of renewable energy technology, using solar energy, which evaporates surface water, both purifying and elevating it. Components of the RWCS are: a catchment device, a conduit system, and a storage tank. In designing such systems the components must be of adequate size and strength to provide the optimum amount of potable water at the most economical cost. A reasonable water demand will have to be selected for design considerations. The time variation of rainfall (RF) is important in designing a RWCS, because the storage tank must be designed to trap the excess rainfall for use in dry periods. Planned rationing can greatly alter the reliability of a system. The first step in designing a RWCS is to determine whether RWCS' are feasible in a given area. To correctly design a RWCS, it is necessary to take into account the variability in the particular RF pattern. Computer modeling with historical RF data is described. Another approach is to apply statistical methods to the design of RWCS systems. Several devices have been used to divert the dirt that accumulates on rooftops and is present in the first runoff of rainwater. The RWCS tank should be cleaned annually. (Geiger-PTT)
W86-02330

3C. Use Of Water Of Impaired Quality

COLORADO RIVER SALINITY - THE USER'S PERSPECTIVE,
Colorado River Board of California, Los Angeles.
For primary bibliographic entry see Field 5B.
W86-02265

IRRIGATION WITH SALINE GROUNDWATER AS A STRATEGY FOR SALINITY CONTROL IN THE SHEPPARTON REGION OF NORTHERN VICTORIA,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
R. A. Wildes.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 225-264, 2 tab, 15 ref.

Descriptors: *Salinity, *Saline water, *Water quality control, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture.

A strategy for salinity control based on private groundwater pumping and the direct, on-farm use of the water for irrigation is described. The major advantage of the on-farm approach to salinity control are that saline drainage flows to the Murray River are minimized while agricultural productivity is improved through the increased availability of irrigation water. The specific benefits include matching irrigation water salinity to suit particular crops, soils, and management methods; maximizing the productive use of groundwater, thus minimizing the amount of salt input to the Murray River; farmer-owned and operated pumps cost less than state-owned pumps; on-farm methods potentially apply to the whole area of the irrigated lands; and greater flexibility of irrigation management including the opportunity to irrigate during winter. (Halterman-PTT)
W86-02287

LIVING WITH SALINITY: AN EVALUATION OF TWO POLICY MEASURES WITHIN A REGIONAL FRAMEWORK.
Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
D. Yaron, and A Ratner.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 441-454, 1 fig, 4 tab, 15 ref.

Descriptors: *Salinity, *Saline water, Legal aspects, Jurisdiction, Water rights, Water use, Impaired water use.

Two analyses of policy measures aimed at compensating for, or reducing, salinity-induced losses in agriculture are described. The extent of income losses due to salinity depends on: the mix of crops, their sensitivity and income potential; the share of value added in gross output value; and the degree of the farm's adaptation to salinity. With regard to the latter, distinction must be made between: currently practiced crop mix and irrigation technology; crop mix adapted to salinity and currently practiced irrigation technology; and both crop mix and irrigation technology adapted to salinity. The first policy discussed is compensation for increased water salinity, which would become critical for a region when water rights are firmly practiced, and water quality deteriorates. The second policy discussed pertains to the determination of the optimal water quantity-salinity mix for a region and regional co-operation. This issue becomes important when a region can be supplied with more water, but at the cost of increased salinity. Various applications of these policies are discussed and several mathematical treatments are illustrated. (Halterman-PTT)
W86-02304

IRRIGATION AS A SOLUTION TO SALINITY PROBLEMS OF RIVER SYSTEMS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
G. R. Dutt, D. A. Pennington, and F. Turner.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 465-472, 8 tab, 8 ref.

Descriptors: *Salinity, *Saline water, *Irrigation, Irrigation engineering, Irrigation operation, Irrigation practices, Irrigation-return flow, Water use, Impaired water use.

Saline waters diverted from river systems to maintain water quality usually can be used for the production of salt tolerant crops. Irrigation by saline waters has been shown to be economically feasible in Arizona. The establishment of saline irrigation projects with their accompanying drainage systems and brine disposal facilities can economically use most waters being diverted from river systems. Field data corroborating these conclusions are provided for cotton, barley, sorghum and sugar beets. (Halterman-PTT)
W86-02305

USE OF SALINE WASTE WATER FROM ELECTRICAL POWER PLANTS FOR IRRIGATION,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
R. J. Hanks, R. F. Nielson, R. L. Cartee, and L. S. Willardson.
IN: Salinity in Watercourses and Reservoirs,, Butterworth Publishers, Boston. 1984. p 473-482, 8 fig, 1 tab, 4 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation engineering, Irrigation operation, Irrigation practices, Water use, Impaired water use.

Water is generally re-cycled in the evaporation-cooling system of power plants until the salinity of the water reaches a high level, at which time it is disposed of as waste water. The possible disposal of saline waste water from power plants by irrigation of crops is discussed, and is shown to be an economically sound disposal method. The long-term effects of salt and specific ions on the soil and crops are relatively unknown. Five years of experience at Huntington, Utah shows a stability in production for forage and grain crops but a continuing production decrease on root crops. Work will continue, and specific ion effects will be evaluated, to determine their importance for long-term management. (Halterman-PTT)
W86-02306

AQUATRAIN PIPELINE SYSTEM,
Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
M. J. Clinton, and I. E. McKeever.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 483-492, 1 fig.

Descriptors: *Salinity, *Saline water, Colorado River, Water use, Impaired water use, Salvaged water, Conveyance structures, Pipelines, Resource development, Hydraulic engineering.

The AQUATRAIN project, a proposed pipeline system to help control Colorado River salinity, and economically transport coal to markets, is discussed. The primary goals are: to collect saline water in the Colorado River basin, transport it to points of most beneficial use, and dispose of it in the most cost effective manner; and to provide an economically competitive method of moving coal and other commodities from source points to markets, using a part of the savings in commodity transport costs to pay for the salinity control function. Sources and markets, pipeline corridor selection, program status and schedule, costs, and public involvement in the AQUATRAIN Process are discussed. (Halterman-PTT)
W86-02307

SALT GRADIENT SOLAR PONDS.
Department of Energy, Washington, DC.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 493-502, 5 fig,

1 tab.

Descriptors: *Salinity, *Saline water, *Electric power production, *Solar energy, Water use, Impaired water use, Resource development, Brine disposal.

Various aspects of the possible use of impounded brackish water for a solar power generation facility are discussed. Highly brackish water which would normally flow into the Wichita River, from a variety of sources, would instead be impounded into a solar pond. The solar pond is a device for trapping and storing solar thermal energy. The proposed salt gradient solar pond achieves this by means of a salt concentration gradient, increasing from low salinity at the surface to high salinity a meter or two below the surface. Hence deeper waters are heavier than waters above them, impeding upward movement of warmed water. Thus, the principal mechanism of heat loss in ordinary ponds is impeded. In this manner, temperatures can reach the boiling point of saline water. Coupling the pond with an organic Rankine-cycle engine will produce electricity. The feasibility is discussed in detail. (Halterman-PTT)
W86-02308

REUSING SALINE DRAINAGE WATERS FOR IRRIGATION: A STRATEGY TO REDUCE SALT LOADING OF RIVERS,

Agricultural Research Service, Riverside, CA. Salinity Lab.
J. D. Rhoades.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 455-464.

Descriptors: *Salinity, *Saline water, *Irrigation, Irrigation engineering, Irrigation operation, Irrigation practices, Irrigation-return flow, Water use, Impaired water use.

Several strategies for coping with increasing levels of salinity in river systems resulting from irrigation are discussed. Emphasis is on irrigation with saline drainage water, and cycling crop types. The process works by intercepting drainage returns before they flow back into the river, and using them for irrigation. When the water is of such poor quality (high salinity) that it is no longer usable, it is pumped into evaporation ponds. Water is conserved and salt loading is minimized by this process. The efficiency of this strategy is maximized when salt sensitive crops irrigated with river water, are rotated with salt tolerant crops which are then irrigated with reused irrigation water with higher salinity. (Halterman-PTT)
W86-02318

3F. Conservation In Agriculture

ADVANCES IN IRRIGATION,

Volume 2, Academic Press, New York, 1983. Edited by Daniel Hillel. 429 p.

Descriptors: *Water conservation, *Irrigation, *Soil-water-plant relationships, *Evapotranspiration, Model studies, Agriculture, Crop yield, Water stress.

This serial publication updates developments in irrigation science and practice. Irrigation scheduling with emphasis on timing criteria is reviewed. Energy consumption by irrigation, methods for conserving energy in irrigation and energy sources for future development are described. A review of crop-water production functions reveals the complexity of the interactions underlying the productive relationship between crops and irrigation water. In Australia irrigation is limited by political and economic factors. The plant-environment model, Cupid, is used to study the complete water budget of a crop. Soil variability has profound effects on irrigation efficiency. However, present methods have many problems, including the need for a large number of samples. Models based on the response functions of crops can be used to develop irrigation schedules. The dynamic crop response model, incorporated into a dynamic programming model, obtains the optimal irrigation schedule for given economic conditions. A model describing the growth and function of plants has several possible uses. Methods for determining evapotranspiration are reviewed. Remote sensing techniques can be applied to estimating crop stress and evapotranspiration. (Cassar-PTT)
W86-02123

IRRIGATION SCHEDULING: APPLIED TIMING CRITERIA,

North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 1-30, 17 fig, 1 tab, 90 ref.

Descriptors: *Water conservation, *Irrigation efficiency, Crop yield, Economic aspects, Hydrologic budget, Soil water, Evapotranspiration, Water potentials, Air temperature, Temperture.

Irrigation scheduling concepts were reviewed with emphasis on timing criteria. Yield-evapotranspiration relationships show an upper-bound region for a given set of production inputs. Upper-bound yields can be attained with a variety of irrigation schedules. Maximum economic returns are usually obtained when yields are in the maximal seasonal yield region. Water balance methods of irrigation scheduling are usable with computer technology. High efficiencies (near maximum yield with minimal annual seasonal applied depth application) can be attained with a variety of methods for estimating evapotranspiration. Allowable root zone soil water depletion criteria are the most widely used methods for irrigation timing. Some improvement has been seen in several plant-based methods: evapotranspiration deficit, leaf water potential, foliage-air temperature difference. (Cassar-PTT)
W86-02124

ENERGY UTILIZATION AND MANAGEMENT IN IRRIGATION,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 31-59, 8 fig, 4 tab, 45 ref.

Descriptors: *Water conservation, *Irrigation efficiency, *Energy, *Fuels, Sprinkler irrigation, Surface irrigation, Pumps, Fertilizers.

An estimated 0.32 exajoules of energy was used to pump irrigation water in the U.S. in 1980. Natural gas accounts for 40.6%; electricity, 25.2% diesel, 21.7%; propane, 9.5%; and gasoline, 3%. Some methods of reducing energy use in irrigation include reduction in pumping volume (by improved irrigation efficiency or reduced net application); reduction in pumping head (by reduced-pressure sprinkler systems, replacement of sprinkler systems by surface systems, substitution of surface water for groundwater, reduction of friction in pipelines, or improved well design); improvement in pumping plant performance; less operation during peak electrical demand hours; improved fertilizer practices; and reduction in tillage. Energy saving practices are described for surface systems and for center-pivot sprinkler systems. Although sufficient conventional fuels are available, prices are expected to increase. Alcohol and wind power will be among the first renewable energy sources to become widely used, followed by biomass and solar systems. (Cassar-PTT)
W86-02125

CROP-WATER PRODUCTION FUNCTIONS,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
H. J. Vaux, and W. O. Pruitt.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 61-97, 2 fig, 1 tab, 88 ref.

Descriptors: *Water conservation, *Irrigation efficiency, *Economic aspects, Water stress, Water use, Prices, Crop yield, Soil water, Evapotranspiration.

A review of crop-water production functions revealed the complexity of the interactions which underlie the productive relationship between crop and water in irrigated agriculture. The mechanisms which govern whether water is limiting or not is well understood, but the response of plants to the timing and level of moisture stressing in less understood. Evidence indicates that the relationship between evapotranspiration and yield is linear and that the relationship between yield and applied water is curvilinear. The factors which govern the relationship between evapotranspiration and applied water are not well understood. Thus, irrigators have little incentive to save water by permitting water to limit plant moisture stress-yield relationship is unclear. The economic literature indicates that water would be used more efficiently in agriculture if it were priced according to its true scarcity value. However, risk, timing, and interstage dependence must be considered before moisture stressing is widely practiced. (Cassar-PTT)
W86-02126

IRRIGATION IN AUSTRALIA: DEVELOPMENT AND PROSPECTS,

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
R. C. Smith, W. K. Mason, W. S. Meyer, and H. D. Barrs.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 99-153, 9 fig, 11 tab, 156 ref.

Descriptors: *Water conservation, *Irrigation, *Crop yield, *Soil, Clays, Australia, Pastures, Water resources, Irrigation efficiency, Water allocation, Salinity, Saline soils, Nutrients, Root zone, Soil management, Surface irrigation.

Irrigation in Australia has been limited by political and economic factors. Most of the irrigation is used for pastures. When crops are irrigated, poor results are often obtained because of poorly permeable soil. Water is limited, highly-valuable, but low-priced. Water allocation rules make it difficult to shift the water from areas of lower productivity to areasof higher productivity. The Murray-Darling basin contains 90% of the continent's irrigated land; development here is nearly complete. The main water resource potential for irrigation expansion is in northern Australia, where crop yields are low and market opportunities scarce. Soil throughout much of the continent is unsuitable for irrigation. Heavy clays with significant levels of exchangeable sodium and magnesium lead to problems of low permeability. This soil can be managed with minimal tillage, incorporation of crop residues, better irrigation scheduling, and nutrient management. (Cassar-PTT)
W86-02127

APPLICATION OF A PLANT-ENVIRONMENT MODEL TO PROBLEMS IN IRRIGATION,

Nebraska Univ., Lincoln. Dept. of Agronomy.
J. M. Norman, and G. Campbell.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 155-188, 16 fig, 7 tab, 27 ref. NA 80AA-H-00087.

Descriptors: *Soil-water plant relationships, *Irrigation, Model studies, Evapotranspiration, Evaporation, Cupid model, Canopy, Interception, Hydrologic budget, Water loss.

The plant-environment model Cupid is useful for studying the complete water budget of a crop. Several implications were developed. About one-fourth of the evapotranspiration in Nebraska-type climate is evaporation. Interception evaporation is greatest in canopies with small leaves such as wheat or prairie grass, where it might reach 10 mm for a single event. Using air temperatures as a measure of plant temperature will introduce errors in management because air temperature differs by several degrees from those of the canopy and soil surface. For a wet soil surface and given atmospheric vapor pressure and temperature, evaporation from the soil can vary from negligible to more than 50% of the evapotranspiration. Cupid reasonably predicts the canopy water balance components; however, the interception evaporation is smaller than measurements. The model does not

consider several important factors in sufficient detail--the influence of surface residues on energy and water balances or the effects of residues, surface crusting, and surface slope in infiltration and runoff. (Cassar-PTT)
W86-02128

FIELD VARIABILITY OF SOIL PHYSICAL PROPERTIES,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 2G.
W86-02129

ECONOMIC ANALYSIS OF ON-FARM IRRIGATION USING RESPONSE FUNCTIONS OF CROPS,
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
D. Yaron, and E. Bresler.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 223-255, 4 fig, 5 tab, 37 ref, 1 append.

Descriptors: *Water conservation, *Irrigation, *Economic aspects, *Soil-water-plant relationships, Response functions, Model studies, Linear programming, Dynamic programming, Production functions, Planning, Soil water, Crop yield.

An integrated agrobiological-economic approach to irrigation is presented. Several types of models are described, starting with the least complex: the macro response or production function in an individual crop with a fixed intraseasonal distribution of water, the dated crop response functions to irrigation and soil moisture, and dynamic programming models for irrigation scheduling. Examples of irrigation scheduling include a single crop, an entire farm, and irrigation in response to water stress. The appendix describes linear programming and gives a sample situation. (Cassar-PTT)
W86-02130

IRRIGATION SCHEDULING BASED ON A DYNAMIC CROP RESPONSE MODEL,
Kansas State Univ., Manhattan. Dept. of Industrial Engineering.
K. S. Raju, E. S. Lee, A. W. Biere, and E. T. Kanemasu.
IN: Advances in Irrigation Volume 2, Academic Press, New York. 1983. p 257-271, 4 fig, 1 tab, 6 ref. A-086-KAN. 55257-5134.

Descriptors: *Water conservation, *Irrigation, *Crop yield, *Soil-water-plant relationships, Dynamic programming, Model studies, Economic aspects, Root zone.

The dynamic crop response model was incorporated into a dynamic programming model to obtain the optimal irrigation schedule for given economic conditions. The impact of irrigation costs and grain prices in an irrigation strategy for maximum net return per hectare can be seen as economic conditions vary. The model can be used to develop experimental designs to collect data for studying the dynamics of crop growth. The method can be modified to include dynamics of soil fertility. The model accounts for several environmental factors, such as soil moisture holding capacity in the root zone. The crop response model and the evapotranspiration model can be used jointly to simulate dry-land yields under various conditions and to study dry-land cropping strategies. (Cassar-PTT)
W86-02131

MODEL OF ROOT GROWTH AND WATER UPTAKE ACCOUNTING FOR PHOTOSYNTHESIS, RESPIRATION, TRANSPIRATION, AND SOIL HYDRAULICS,
Auburn Univ., AL. Dept. of Agonomy and Soils.
For primary bibliographic entry see Field 2I.
W86-02132

TECHNIQUES FOR ESTIMATING IRRIGATION WATER REQUIREMENTS,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W86-02133

EVAPOTRANSPIRATION OBTAINED FROM REMOTE SENSING METHODS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 7B.
W86-02134

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,
Utah State Univ., Logan. Coll. of Engineering.
A. B. Bishop, D. R. Franklin, and R. Narayanan.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 243-252, 2 fig, 1 tab, 3 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, *Economic aspects, Model studies, Colorado River, Water conservation, Conservation, Water costs, Costs, Water demand, Dissolved solids.

The economic feasibility of public and private water conservation measures that could be employed in response to salinity control and increased water prices are discussed. Specific issues that are addressed include the total cost to the economy of the public sector investments in water conservation and other measures which reduce salinity; the water conservation measures in private agricultural and energy sectors which are economically efficient; and the benefits and costs of various government-sponsored water-saving techniques. Model simulations indicate that public investments in measures only for the sake of water conservation are not economically efficient since the marginal value of water is less than the cost of conservation. When factors that increase salinity levels are taken into consideration, however, the value of water conserved is greater than the cost of various conservation programs, because the water saved is used for decreasing the salinity levels downstream through greater dilution. (Halterman-PTT)
W86-02286

CASE STUDY OF A SALINITY CONTROL PROGRAM, VINTA BASIN, UTAH,
Soil Conservation Service, Salt Lake City, UT.
For primary bibliographic entry see Field 5G.
W86-02289

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,
Soil Conservation Service, Denver, CO.
M. E. Hess.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 285-294, 3 tab, 7 ref.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Colorado River.

Methodologies to control salinity in the Colorado River in the vicinity of the Grand Valley include installing structural measures to reduce seepage from unlined earthen irrigation ditches; improving irrigation water management practices to reduce deep percolation from field irrigation and to enhance uniformity of irrigation applications; and implementing a monitoring and evaluation program to assess the effectiveness of salinity control measures. The structural measures (pipelines, gated pipes, ditch lining and land leveling) have reduced salt loads by an estimated 17,500 metric tons per year. Key elements of the monitoring and evaluation program include measuring surface inflow and runoff to determine water infiltration into the ground, collecting local climatological data to evaluate crop evapotranspiration requirements (to help determine deep percolation rates), and using soil moisture sensors to assess uniformity of irrigation. The use of these data for salt loading computation under improved management practices is discussed. (Halterman-PTT)
W86-02290

SALINITY CONTROL AND DRAINAGE IN NORTHERN VICTORIA (AUSTRALIA),
Victoria State Rivers and Water Supply Commission, Armadale (Australia).
K. O. Collett, and G. C. Earl.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 315-323, 1 fig.

Descriptors: *Salinity, *Saline water, *Water quality control, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agriculture, Agricultural hydrology, *Australia.

Following the irrigation-related rise of the water table and increased salinity level of the ground water, a drainage strategy was developed to prevent waterlogging and control salinity. Pumping saline groundwater and draining it into the River Murray, the initial action taken, caused reduced water quality in the River Murray. On-farm measures, such as recycling, which have been demonstrated to be a partial solution to the problem could improve the situation. Wide scale use of on-farm alternatives have not yet been put into practice. The main points concerning the current developments in salinity mitigation are: strategies based on public scale schemes may not always be able to be justified in economic terms; integrating efforts at the on-farm level with public-scale action offers possibilities for achieving salinity control and drainage objectives within economic and other constraints; and finally, there is a willingness to modify current irrigation practices in order to achieve these objectives. (Halterman-PTT)
W86-02293

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DRAINAGE BASINS IN ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02363

EVALUATION OF COMMUNITIES FOR THE APPLICATION OF LIMITED-DETAIL STUDY METHODS FOR FLOOD-INSURANCE STUDIES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6F.
W86-02373

PHASE I SUMMARY AND PHASE II PLAN FOR COMPARING REGULATED WITH UNREGULATED STREAMFLOW IN THE YAKIMA RIVER AT UNION GAP, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
C. H. Swift.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-4015, 1985. 21 p, 5 fig, 2 tab, 8 ref.

Descriptors: River flow, *Regulated flow, *Natural flow, *River regulations, Alteration of flow, Water management (applied), Diversions, Reservoir operation, Riparian rights, Treaties, *Washington, Yakima County, Kittitas County, Yakima Indian Reservation.

A preliminary investigation of the effects of reservoir storage and canal diversion on the flow of the

Yakima River at Union Gap, Washington indicates that those effects are measurable and substantial--on the average causing a reduction of roughly one-quarter from the unregulated flow. Preliminary computations of the unregulated flow of the Yakima River at Parker (near Union Gap) for the 1978 water year using the U.S. Bureau of Reclamation's SSARR model indicate, however, that the computed flow figures contain inaccuracies. Further investigation of the model indicates that the inaccuracies can be substantially reduced by data checking and by using additional discharge records to improve the estimation of local inflows. (USGS)
W85-02378

EVALUATION OF THE CREST-STAGE GAGE PROGRAM IN LOUISIANA,

Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02399

DISCHARGE RATINGS FOR CONTROL GAGES AT MISSISSIPPI RIVER LOCK AND DAM 11, DUBUQUE, IOWA,

Geological Survey, Iowa City, IA. Water Resources Div.
A. J. Heinitz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4105, 1985. 43 p, 15 fig, 7 tab, 11 ref.

Descriptors: *Discharge coefficients, *Control-gate ratings, *Iowa, Stage-discharge relations, Tainter gate, Roller gate, Current-meter measurements, Tainter-gate opening, *Mississippi River, *Lock and Dam 11.

The water level of the navigation pools on the Mississippi River are maintained by the operation of tainter and roller gates at locks and dams. Discharge ratings for the gates on Lock and Dam 11, Dubuque, Iowa, were developed from current-meter discharge measurements made in the forebays. Methodology is given to accurately compute the vertical gate openings of the tainter gates. Discharge coeffients, in equations that express discharge as a function of tailwater depth, headwater depth, and vertical height of gate opening, were determined for conditions of submerged-orifice and free-weir flow. A comparison of the rating discharges to the theoretical rating discharges is given for submerged orifice flow for the tainter and roller gates. (USGS)
W86-02401

STATISTICAL MODELS FOR ESTIMATING FLOW CHARACTERISTICS OF MICHIGAN STREAMS,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02411

4B. Groundwater Management

SALINITY CONTROL PROBLEMS ASSOCIATED WITH IRRIGATION IN SOUTH-WEST NEW SOUTH WALES, AUSTRALIA,

Water Resources Commission of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 5B.
W86-02288

SIMULATED EFFECTS OF AN ARTIFICIAL-RECHARGE EXPERIMENT NEAR PROCTOR, LOGAN COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
A. W. Burns.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4010, 1984. 17 p, 6 fig, 3 tab, 6 ref.

Descriptors: *Artificial recharge, *Surface-groundwater relationships, Logan County, *Colorado, *Simulation analysis.

An artificial-recharge experiment was conducted near Proctor, Colorado in which a computed 620 acre-feet were pumped from a well during a 4-month period. A computed 420 acre-feet were delivered at the potential reservoir site, and the remaining 200 acre-feet leaked from the pipeline. No pond was created due to the high rates of infiltration. Water levels in the nearest well (about 0.1 mile from the recharge site) rose almost 25 feet. Computer simulations indicate that this 4-month pumping-recharge experiment would cause stream depletions from the nearby South Platte River for the first 16 months, thereafter, stream accretions due to the recharge would exceed stream depletions due to pumpage. If the experiment was conducted annually, the simulations indicate that stream depletions would occur for 6 months of each year and stream acretions for the remaining 6 months once the system reached an equilibrium condition. To reach the cyclic equilibrium condition would take at least 7 years. (USGS)
W86-02344

WATER RESOURCES OF THE RATTLESNAKE BUTTE AREA, A SITE OF POTENTIAL LIGNITE MINING IN WEST-CENTRAL, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02350

GROUND-WATER HYDROLOGY OF THE SEVIER DESERT, UTAH, WITH RESULTS OF DIGITAL-COMPUTER MODELING,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02351

PRELIMINARY STUDY OF THE AQUIFERS OF THE LOWER MESILLA VALLEY IN TEXAS AND NEW MEXICO BY MODEL SIMULATION,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02353

APPRAISAL OF THE SURFICIAL AQUIFERS IN THE POMME DE TERRE AND CHIPPEWA RIVER VALLEYS, WESTERN MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02357

GROUND-WATER CONDITIONS AND WELL YIELDS IN FRACTURED ROCKS, SOUTHWESTERN NEVADA COUNTY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02364

GEOLOGY OF THE SURFICIAL AQUIFER SYSTEM, BROWARD COUNTY, FLORIDA,

Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02383

DELINEATION AND DESCRIPTION OF A ZONE OF HIGHER SECONDARY PERMEABILITY IN THE SURFICIAL AQUIFER OF EASTERN PALM BEACH COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02393

MATHEMATICAL MODEL OF THE TESUQUE AQUIFER SYSTEM NEAR POJOAQUE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02402

SUMMARY OF RESULTS OF AN INVESTIGATION TO DEFINE THE GEOHYDROLOGY AND SIMULATE THE EFFECTS OF LARGE GROUNDWATER WITHDRAWALS ON THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN NORTHWESTERN MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
D. M. Sumner, and B. E. Wasson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4343, 1984. 17 p, 10 fig, 10 ref.

Descriptors: *Groundwater availability, *Irrigation effects, *Model studies, *Simulation analysis, *Alluvial aquifers, Groundwater recharge, Potentiometric level, *Mississippi, *Mississippi alluvial plain, Yazoo Basin, Mississippi River alluvial aquifer.

The 7,000 square-mile Mississippi River alluvial plain in north-western Mississippi (the Delta) is underlain by the prolific Mississippi River alluvial aquifer that currently (1983) yields about 1,100 Mgal/d of water to irrigation wells. Commonly, about 20 feet of clay underlying the Delta land surface is underlain by about 80 to 180 feet of sand and gravel that forms the aquifer. The Mississippi River is in good hydraulic connection with the alluvial aquifer. Generally smaller streams are less likely to have good hydraulic connection with the aquifer. Direct vertical recharge to the alluvial aquifer is small. A two-dimensional finite-difference computer model of the alluvial aquifer was constructed, calibrated, and verified using water levels observed for five dates within the period April 1981 to September 1983. The model shows that the aquifer had a net loss in storage of about 360 Mgal/d for the 2-year period April 1981 to April 1983, when pumpage was about 1,100 Mgal/d. The net inflows from the sources of recharge were: Mississippi River, 390 Mgal/d; recharge along east edge of the Delta, 170 Mgal/d; streams within the Delta, 81 Mgal/d; and areal recharge from infiltration, 180 Mgal/d. The effects of several levels of pumpage by wells were projected 20 years into the future. In 2003, the result of continued pumpage at the 1,100 Mgal/d pumping rate would be lowered ground-water levels of more than 20 feet in a large area in the central part of the Delta, and ground-water levels would continue to decline. (USGS)
W86-02405

HYDROLOGY OF PRAIRIE DOG CREEK VALLEY, NORTON DAM TO STATE LINE, NORTH-CENTRAL KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
L. E. Stullken.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4162, 1984. 49 p, 10 fig, 1 tab, 16 ref.

Descriptors: Hydrology, Steady-state model, *Groundwater flow, Recharge, Discharge, Baseflow, *Hydrogeology, Water levels, *Water yield, *Surface-groundwater relationships, *Prairie Dog Creek Valley, *Kansas.

Development of water resources has been a major factor in the economy of Prairie Dog Creek Valley in north-central Kansas. Releases from Norton Reservoir to the Almena Irrigation District averaged 6,900 acre-feet per year during 1967-76. The number of irrigation wells increased from 4 to 147 during 1947-78. Ground water in the valley is derived mostly from the alluvial aquifer. The effects of irrigation on the aquifer are indicated by water-level changes. The water in storage increased from 130,000 to 136,000 acre-feet during 1947-78 due to recharge from surface-water irriga-

tion. A steady-state model of the aquifer prior to irrigation (1947) indicated that most recharge was from precipitation (88 percent) and most discharge was to streams (54 percent) and reparian transpiration (26 percent). Although aquifer storage increased in this area, storage generally decreased in other areas of western Kansas. (USGS)
W86-02406

EVALUATION OF MAJOR DIKE-IMPOUNDED GROUND-WATER RESERVOIRS, ISLAND OF OAHU, WITH A SECTION ON FLOW HYDRAULICS IN DIKE TUNNELS IN HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
K. J. Takasaki, and J. F. Mink.
Available from Dist Branch, USGS, 604 S. Pickett St, Alexandria, VA 22304. USGS Water-Supply Paper 2217, 1985. 77 p, 40 fig, 12 tab, 51 ref.

Descriptors: *Dikes, *Groundwater barriers, *Hydraulics, *Groundwater storage, *Hawaii, Hydrogeology, *Oahu, Koolau Range, Waianae Range.

Ground-water bodies impounded by volcanic dikes constitute important reservoirs of high-quality water. These reservoirs have high hydraulic heads and are mostly isolated from saline water. The most important and productive of these reservoirs occur in the Koolau Range, where the top of the impounded water ranges to an altitude of at least 1,000 feet. The storage above sea level of these reservoirs has been roughly estimated at 550 billion gallons. In the Waianae Range the top of the impounded water ranges to an altitude of at least 2,000 feet and the estimated storage above sea level is about 100 billion gallons. Water-development tunnels have, by breaching dike controls, reduced storage by a least 50 billion gallons in the Koolau Range and by about 5 1/2 billion gallons in the Waianae Range. A significant part of the storage thus reduced by each tunnel can be restored by bulkheading the dike or dikes which impounded the most water, as indicated by flow records gathered during tunneling. (USGS)
W86-02407

PROGRESS REPORT ON BLACK MESA MONITORING PROGRAM-1984,
Geological Survey, Flagstaff, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02408

GEOLOGY, HYDROLOGY, AND WATER QUALITY OF THE CAMBRIAN AND ORDOVICIAN SYSTEMS IN NORTHERN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02414

4C. Effects On Water Of Man's Non-Water Activities

HYDROGEOLOGY AND EFFECTS OF TAILINGS BASINS ON HYDROLOGY OF SANDS PLAIN, MARQUETTE COUNTY, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01927

EFFECTS OF URBANIZATION OF THREE PONDS IN MIDDLETON, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
L. B. House.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4051, 1984. 17 p, 9 fig, 5 tab, 7 ref.

Descriptors: *Urbanization, Storm runoff, Urban watersheds, Ponds, Watershed models, Water quality, Hydrologic budget.

A digital hydrologic model was used to simulate the effects of future residential development on pond inflow volumes and resulting water levels of three ponds in Middleton, Wisconsin. The model computed the daily water budget and the resulting water level for each pond. The results of the model calibration are presented in the report, along with the existing watershed hydrologic conditions and runoff volumes for the 1982 study period. Data was collected during 1982 to calibrate the model; the data included pond stage, ground-water levels, precipitation and other meteorological characteristics. In addition, water-quality samples were collected at each pond to characterize the water quality. Simulation of pond levels with the 1982 rainfall and fully developed watersheds did not result in stages greater than those observed in 1982. Simulation of pond levels with rainfall having a 20-year recurrence interval (1978) and hypothetical, fully developed watersheds resulted in maximum pond stages above those observed in 1982. Peak stage of Tiedeman's Pond would increase by 2.77 feet, Stricker's Pond by 3.91 feet, and Esser's Pond by 1.44 feet. Simulation of pond levels with an estimated 100-year rainfall and hyopthetical, fully developed watersheds would result in peak stage increases of 5.30, 5.32, and 1.97 feet above the peak 1982 observed stages for Tiedeman's, Stricker's, and Esser's Ponds, respectively. (USGS)
W86-01949

SIMULATED EFFECTS OF SURFACE COAL MINING AND AGRICULTURE ON DISSOLVED SOLIDS IN ROSEBUD CREEK, SOUTHEASTERN MONTANA,
For primary bibliographic entry see Field 5B.
W86-01962

PARAHO ENVIRONMENTAL DATA: BIBLIOGRAPHY,
Development Engineering, Inc., Rifle, CO.
For primary bibliographic entry see Field 10C.
W86-01983

ANALYSIS OF SALT YIELDS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF PARIETTE DRAW WILDLIFE AREA, UTAH,
Bureau of Land Management, Denver, CO.
W. L. Jackson, and S. Hudson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 549-558, 5 fig, 1 tab, 3 ref.

Descriptors: *Salinity, *Saline water, Water pollution, Utah, Dissolved solids, Construction.

A fifty-percent increase in annual salt yield has been recorded at the downstream (7300) gage at Pariette Draw following the beginning of construction of the Pariette Draw Wildlife Management Area. This increase occurred during a period when there was a much smaller (11%) increase in salt yield at the upstream (7200) station. However, analysis of water discharge data and station salt-loading functions (Q vs. TDS) indicate that 94% of the increase in annual salt yield at the downstream station is due to the increase in mean monthly flow, following the beginning of construction of the wildlife management area, and 6% of the increase is due to a small though statistically significant (alpha=0.05) change in the salt loading function (Q vs. TDS) at the downstream station. It is hypothesized that increased inflows from Castle Peak tributary caused downstream flows during the post-construction period to increase proportionally more than flows entering the area upstream. Because the 6-year period of record is short for this type of analysis, any results or conclusions must be considered tentative. (Author)
W86-02313

SECONDARY SALINIZATION OF WATER RESOURCES IN SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
M. L. Sharma, and D. R. Williamson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 571-580, 3 fig, 2 tab, 22 ref.

Descriptors: *Salinity, *Saline water, *Water pollution sources, *Land management effects, Groundwater, Evapotranspiration, Groundwater recharge, Groundwater movement, Australia.

Secondary salinization is a problem of considerable magnitude in southern Australia. The situation arises as a consequence of clearing of indigenous Eucalyptus vegetation for development of dryland agriculture. Because of reduced evapotranspiration from crops and pasture there is excess water available to mobilize the large mass of salts stored in the deep profiles. The current understanding of the various mechanisms involved is reviewed. The development of a quantitative approach to the salinization problem has provided a basis for establishing appropriate methods for prevention and reclamation. (Halterman-PTT)
W86-02315

MAGNITUDE AND FREQUENCY OF FLOOD VOLUMES FOR URBAN WATERSHEDS IN LEON COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02354

RAINFALL-RUNOFF RELATIONSHIPS AND WATER-QUALITY ASSESSMENT OF COON CREEK WATERSHED, ANOKA COUNTY, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02370

HYDROLOGY OF AREA 60, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NEW MEXICO, COLORADO, UTAH, AND ARIZONA,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02382

EFFECTS OF STORMWATER RUNOFF ON AN URBAN LAKE, LAKE ELLYN AT GLEN ELLYN, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02392

4D. Watershed Protection

ERODING SOILS: THE OFF-FARM IMPACTS,
Conservation Foundation, Washington, DC.
E. H. Clark, J. A. Maverkamp, and W. Chapman.
1985. 252 p.

Descriptors: *Erosion control, *Sediment transport, *Soil erosion, *Soil conservation, *Nonpoint source pollution, Agricultural engineering, Farm management, Nutrients, Nitrogen, Phosphorus, Erosion rate, Water pollution effects, Precipitation, Pesticides, Bacteria, Viruses, Streams, Lakes, Reservoirs, Economic aspects, Recreation, Sedimentation, Fish, Environmental effects, Wildlife, Water quality, Eutrophication, Salinity, Water storage, Flood damage, Canals, Contours, Terracing, Land management, Sedimentation basins, Silting.

Erosion is a major problem, not only on agricultural land, but off the farm. Among erosion's impacts are waterways polluted by sediment, fertilizers, and pesticides; accelerated siltation of reservoirs and lakes; destruction of breeding grounds for fish and other aquatic life; and increased costs for dredging harbors; siltation in rivers leading to increased flooding. This comprehensive analysis of the off-farm problems reviews basic chemical, physical, hydrological, and ecological principles pertinent to the erosion problem. Detailed cost

estimates show that erosion causes $6 billion (1980 dollars) of damages each year in the U.S. Known erosion control techniques are discussed. No single technique or group of techniques is suitable and cost effective in all situations. In general, conservation tillage and contour plowing are less expensive than structural measures such as terraces and sediment basins. Nutrient transport is most easily controlled with terraces and contour plowing. Enough information exists to mitigate the most serious erosion problems. This may involve removing the most rapidly eroding land from row-crop production or completely from production. Farm management techniques are available to control off-farm erosion impacts. However, the question is whether U.S. society has the will to implement them. (Cassar-PTT)
W86-02247

QUALITY AND QUANTITY OF URBAN RUNOFF AND ATMOSPHERIC DEPOSITION IN URBAN AREAS OF SALT LAKE COUNTY, UTAH, 1980-1981,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02346

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

PHYSICAL BEHAVIOR OF PCBS IN THE GREAT LAKES.

Ann Arbor Science, Ann Arbor, MI. 1983. 442 p.
Edited by Donald Mackay, Sally Peterson, Steven J. Eisenreich, and Milagros S. Simmons.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, *Aromatic compounds, *Great Lakes, Model studies, Bioconcentration potentials, Environmental sinks, Environmental persistence, Lake Michigan, Saginaw Bay, Environmental fluctuations.

PCBs are among the most notorious environmental contaminants, and the Great Lakes are invaluable as a natural resource. This book is a collection of papers presented to increase our understanding of the environmental behavior of PCBs in the Great Lakes. The topics included in this collection of papers are high resolution PCB analysis, model studeis, bioconcentration potentials, environmental sinks, environmental persistence, environmental fluctuations, physical properties, vapor exchange, and monitoring of PCBs in the Great Lakes. (Halterman-PTT)
W86-02012

HIGH RESOLUTION PCB ANALYSIS,

Texas A and M Univ., College Station. Dept. of Veterinary Physiology and Pharmacology.
S. Safe, M. Mullin, L. Safe, C. Pochini, and S. McCrindle.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 1-13, 5 fig, 4 tab, 31 ref.

Descriptors: *Pollutant identification, *Toxic wastes, *Polychlorinated biphenyls, *High resolution analysis, *Aroclors, Gas liquid chromatography, Aromatic compounds, Toxicity, Mass spectrometry, Proton magnetic resonance.

A major problem associated with the analysis and toxicology of PCBs as well as other halogenated aromatics is the multiplicity of possible isomers and congeners. Furthermore, PCB toxicity is dependent on the structure of the individual compounds. Thus, the potential environmental and health impact of PCBs must account not only for the integrated quantification of the PCB mixtures, but also the concentrations of specific congeners which are potentially toxic. This work confirms the feasibility of high resolution PCB analysis of the commercial and environmental PCB mixtures. It is anticipated that this approach will be used to accurately measure the concentrations of specific PCB isomers and to determine the effects of PCB structures on their ecological dynamics. The methodology entails high resolution glass capillary column separation coupled with EC or MS detection and requires all 209 PCB reference standards for calibration. Data, in the form of high resolution capillary gas chromatograms, were presented for Aroclor 1016 singly and combined, as well as for a PCB fraction from a fish extract. (Halterman-PTT)
W86-02013

PHYSICAL CHEMICAL PROPERTIES OF POLYCHLORINATED BIPHENYLS,

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, W. Y. Shiu, J. Billington, and G. L. Huang.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 59-69, 1 tab, 15 ref.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, Vapor pressures, Fugacity, *Solubilities, Henry's law constant, Octanol-water partition coefficient, Organic carbon sorption coefficient, Chemical partitioning, Biological magnification.

For predicting and interpreting the environmental behavior of PCBs, it is essential to have reliable data for their physical-chemical properties, notably those properties such as vapor pressure, aqueous solubility, Henry's law constant and the various partition coefficients such as those for octanol-water, organic carbon-water and biota water. Since it is not economically or practically feasible to derive these data for all 209 congeners, it is necessary to infer values for one compound from another. Results suggest that the addition of one chlorine reduces solubility and vapor pressure by approximately a factor of 3 (thus the Henry's law constant is little changed) and the octanol-water partition coefficient increases by a similar factor. The methodology for this study entailed reviewing the literature pertaining to the physical chemical properties of PCBs and compiling and statistically analyzing the available data. From these analyses selected values for the properties of congeners of Aroclor were inferred. (Halterman-PTT)
W86-02015

REACTIVITY AND ENVIRONMENTAL PERSISTENCE OF PCB ISOMERS,

Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
W. B. Neely.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 71-88, 2 fig, 7 tab, 23 ref.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, *Polychlorinated biphenyl isomers, *Environmental persistence, Solubility, Vapor pressure, Fish, Transport bioaccumulation, Air-water interface, Biodegradation, Water pollution.

Analyses of environmental samples have often resulted in the identification of a variety of the components of PCB fluid, ranging from unsubstituted biphenyl to the fully chlorinated homologue. These component compounds were examined in an effort to identify the properties that cause certain congeners to accumulate in environmental systems. Water solubility, vapor pressure, boiling point and rate constants for microbial degradation are presented for a large number of homologues of PCB. These values were applied to a model constructed to describe the distribution of the homologues in the water column and fishes of Lake Michigan. Values of vapor pressure, water solubility, octanol water solubility and molecular weight that are associated with optimum accumulation of PCB-related compounds in fish must be sufficiently low in order that the chemicals can build up in the various environmental compartments. (Halterman-PTT)
W86-02016

REVERSIBLE AND RESISTANT COMPONENT MODEL OF HEXACHLOROBIPHENYL ADSORPTION-DESORPTION RESUSPENSION AND DILUTION,

Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
D. M. Di Toro, and L. M. Horzempa.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 89-113, 9 fig, 1 tab, 24 ref. R805229.

Descriptors: *Toxic wastes, *Hexachlorobiphenyl, *Polychlorinated biphenyls, Adsorption, Desorption, Model studies, Suspension, Suspended sediments, Dilution, Suspended particles.

The complete understanding of the fate of toxic chemicals in natural waters depends, in part, on the ability to determine the rates of adsorption to and desorption from suspended particles. To this end, experimental data on these variables were gathered and entered into a theoretical framework for a model of adsorption and desorption of hexachlorobiphenyl. In addition, data were gathered on the effects of varying suspended sediment concentrations under conditions that might be encountered in field situations. (Halterman-PTT)
W86-02017

PCBS IN THE LAKE SUPERIOR ATMOSPHERE 1978-1980,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, B. B. Looney, and G. J. Hollod.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 115-125, 1 fig, 2 tab, 34 ref. CR806084.

Descriptors: *Toxic wastes, *Path of pollutants, *Polychlorinated biphenyls, *Lake Superior, *Great Lakes, Lake Michigan, Air Pollution, Air-water partition coefficients, Aerosolization, Air-water interface, Volatility.

Atmospheric concentrations of PCBs were measured over Lake Superior during the summers of 1978 and 1980, the years before and after the 1979 legislated ban on their production and use. These tests were conducted to determine if the ban resulted in a decrease in the atmospheric burden of these compounds. There is no substantive indication that atmospheric levels of PCBs are decreasing. Shipboard atmospheric samplers were used to measure air-borne concentrations above Lake Superior. Samples of atmosphere above Minneapolis were taken, as well, for comparison purposes. PCB levels over Lake Superior ranged from 0.9 to 3.5 ng per cu m in 1978 and ranged from 0.1 to 2.5 ng per cu m in 1980. Although the mean PCB concentration decreased by 33%, no statistically valid decrease can be assigned. The values observed at Lake Superior are similar to those observed for southern Lake Michigan. (Halterman-PTT)
W86-02018

PCB ACCUMULATION IN SOUTHERN LAKE MICHIGAN SEDIMENTS: EVALUATION FROM CORE ANALYSIS,

Wisconsin Univ.-Madison. Water Chemistry Lab.
D. E. Armstrong, and D. L. Swackhamer.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 229-244, 3 fig, 2 tab, 20 ref. CR-807836-01-1.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Michigan, Sediment, Gas chromatography, Water pollution, Volatility, Transport, Radioactive dating.

The analysis of sediment core samples from lakes can serve as an indicator of loading of PCBs to a lake system. The work described here indicates that PCB deposition has occured in Lake Michigan since 1928 plus or minus 9 years, and that total PCB accumulation in southern Lake Michigan sediments is about 3400 to 5000 kg. Box corers obtained 9 x 24 x 25.5 cm lake sediment samples. Samples were analyzed for PCBs and dated using Pb-210 dating methodologies. Data on PCB concentrations in core depth profiles are presented for four sampling stations located in south-central Lake Michigan. (Halterman-PTT)
W86-02024

ESTIMATING BIOCONCENTRATION POTENTIAL FROM OCTANOL/WATER PARTITION COEFFICIENTS,

Environmental Research Lab.-Duluth, MN.
G. D. Veith, and P. Kosian.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 269-282, 3 fig, 2 tab, 2 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Bioconcentration potentials, *Partition coefficients, Model studies, Bioaccumulation, Clorinated hydrocarbons, Fathead minnow, Bluegill, Rainbow trout, Mosquito fish, Coho salmon, Guppy, Flagfish, Spot, Sheepshead minnow, Carp, Channel catfish, Topmouth Gudgeon.

A previously derived structure-activity relationship (SAR), which is used to estimate the bioconcentration potential of fish from the n-octanol/water partition coefficient (P), was calculated from data on approximately 50 tests on five general classes of chemicals. That SAR is summarized as: log BCF equals 0.85 log P - 0.70. To assure optimal accuracy in work involving estimating the bioconcentration of potentials, it is useful to determine if the most appropriate SAR is used. This study presents a new SAR, based on over twice as many tests as that previously described. Although the two are slightly different, they predict identical bioconcentration factors (BCF). The authors reviewed 122 tests in order to derive the new SAR, which is summarized as follows: log BCF equals 0.79 log P - 0.40. (Halterman-PTT)
W86-02026

MODEL SIMULATION OF PCB DYNAMICS IN LAKE MICHIGAN,

De Paul Univ., Chicago, IL.
P. W. Rodgers.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 311-327, 4 fig, 4 tab, 16 ref. 807412.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, *Lake Michigan, Water pollution, *Model studies, Suspended solids, Adsorption, Sediments, Sediment-water interface, Partition coefficients, Mass balance.

In the 1970s, the findings of high concentrations of PCBs in fish flesh in Lake Michigan led to the need to accurately determine their dynamics in that water body. The development of a model of PCB loadings and the processes which influence their distribution are detailed. The model was derived using four primary mass balance equations on solids in the water column and sediment layer, and PCB in the water column and sediment layer. Resuspension rates, sedimentation rates, and partitioning coefficients were also major variables of the program. Research is continuing on the use of the model for historical trends in PCB loading. Currently, the model is appropriate for answering questions of system response to various loading scenarios, losses and coefficient values. (Halterman-PTT)
W86-02028

MONITORING OF PCBS IN WATER, SEDIMENTS AND BIOTA OF THE GREAT LAKES - SOME RECENT EXAMPLES,

Ontario Ministry of the Environment, Toronto.
P. B. Kauss, K. Suns, and A. F. Johnson.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 385-409, 11 fig, 4 tab, 11 ref.

Descriptors: *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, *Monitoring, Sediments, Niagara River, Freshwater clams, Sportfishes, Forage fishes, Spottail shiners, Smallmouth bass, Yellow perches, White sucker, Coho salmon, American eel.

Continued monitoring is an important aspect of our understanding and predictive capabilities regarding PCBs in the Great Lakes region. To this end, the Ontario Ministry of the Environment monitors PCBs in the waters, sediments and biota of the Great Lakes. Examples of the monitoring programs and some of the results are presented. Lake and river water, sediments, industrial and municipal inputs, suspended sediments, freshwater clams, sportfish and forage fish were sampled and analyzed. PCB concentrations in bottom sediments of the Niagara River sampled in 1979 ranged from non-detectable to 2700 micrograms per kilogram. Raw water sampled downstream of known sources had the highest PCB concentrations. PCB levels in migratory fish were not useful for pinpointing PCB sources. Young-of-the-year spottail shiners collected near specific sites thought to be sources, exhibited high PCB concentrations. Also, clams collected near certain sources had elevated levels of PCBs. (Halterman-PTT)
W86-02030

SIMULATED PRECIPITATION REFERENCE MATERIALS, IV,

National Bureau of Standards (NML), Gaithersburg, MD.
W. F. Koch, G. Marinenko, and J. W. Stolz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-139378, Price codes: A02 in paper copy, A01 in microfiche. Report NBSIR 82-2581, June 1982. 17p, 12 tab, 10 ref. AD-13-F-2-535-0.

Descriptors: *Pollutant identification, *Water analysis, *Acid rain, Precipitation, Hydrogen ion concentration, Acidity, Precipitation, Standards, Chemical analysis, Trace elements, Conductance.

A fourth series of simulated precipitation reference material was characterized. Stability of samples from the first three series of simulated precipitation was evaluated. These samples, stored in glass ampoules, were not stable with respect to pH, conductance, acidity, alkali metals, and several of the transition elements. It was recommended that future sample series be divided--one set simulating the major components (mineral acids, alkali salts, and alkaline earth salts) and the other, stabilized with nitric acid, simulating the trace elements. All samples should be stored in clean polyethylene bottles. Variations in pH measurements using different electrodes indicated that this protocol needs revision. An interim pH measurement method is described. Determination of acidity by titrating to a fixed pH endpoint was not accurate enough for acid rain analysis. Preferred techniques are titration to an inflection point (or multiple inflection points for mixed acid systems) or the Gran method. (Cassar-PTT)
W86-02040

BROAD-SPECTRUM ANALYSIS OF THE REMOVAL OF TRACE ORGANICS IN AN OZONE-GRANULAR ACTIVATED CARBON POTABLE-WATER PILOT PLANT STUDY,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W86-02165

ANALYSIS OF ORGANIC COMPOUNDS ADSORBED ON GRANULAR ACTIVATED CARBON FILTERS USED IN TREATMENT PLANTS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. S. Millington, D. J. Bertino, T. Kamei, and R. F. Christman.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 445-454, 4 fig, 1 tab, 8 ref. CR808551.

Descriptors: *Pollutant identification, *Water treatment, *Activated carbon, *Organic compounds, Gas chromatography, Mass spectrometry, Extraction, Sample preparation, Filters, Solvents, Chromatography.

Solvent extraction with Soxhlet apparatus, solvent extraction with ultrasonic agitation, and thermal desorption were compared in desorbing organic matter in carbon samples from water treatment plants. Preliminary results indicated that thermal desorption was least time-consuming and gave a clearer picture of the early eluting components. However, some problems concerning the apparent loss of the high-boiling compounds and the possibility of thermal changes in composition warrant further study. Of the two extraction methods, ultrasonic agitation seemed simpler, faster, and less error-prone. About 60 compounds or groups of compounds were identified. Many of these identifications have not been confirmed by comparison with authentic compounds. (Cassar-PTT)
W86-02166

NEW APPROACHES TO THE PRODUCTION OF 36 CL-LABELED CHLORINATING AGENTS AND THE MEASUREMENT OF 36CL INCORPORATED INTO BIOLOGICAL MATERIALS,

Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
H. A. Ghanbari, W. B. Wheeler, and J. R. Kirk.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 543-553, 4 fig, 1 tab, 14 ref. PFR 78-27067.

Descriptors: *Fate of pollutants, *Chlorine, *Radioactive tracers, Tracers, Chlorine dioxide, Hypochlorous acid.

Cl36-labeled hydrochloric acid was used to produce two labeled radioactive tracers for use in studying the fate of chlorine: (1) Cl36-labeled hypochlorous acid by potassium permanganate oxidation at a yield of 80% and (2) Cl36-labeled chlorine dioxide by an electrolytic process at 43% yield. A biological material pyrohydrolyzer was developed to prepare samples for chlorine analysis while retaining 99% of the introduced radioactivity. (Cassar-PTT)
W86-02172

ANALYSIS OF ORGANIC N-CHLORAMINES,

Old Dominion Univ., Norfolk, VA. Dept. of Chemical Sciences.
F. E. Scully, J. P. Yang, M. A. Bempong, and F. B. Daniel.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 555-561, 2 fig, 1 tab, 7 ref. CR807254-01.

Descriptors: *Pollutant identification, *Chloramines, *Water analysis, 5-Dimethylamino-1-naphthalenesulfinic acid, Chromatography.

Identification of N-chloramines in chlorinated water systems has been performed using a newly synthesized aromatic sulfinic acid (5-dimethylamino-1-naphthalenesulfinic acid monohydrate). This compound reacts with the chloramines to produce highly fluorescent dansyl derivatives. To detect chloramines at molar concentrations of 10 to the minus 6 power to 10 to the minus 4 power, the reagents are added to a test tube in the following order: 42 mg of sodium bicarbonate, 1 ml of chloramine solution, 1 ml acetonitrile, 100 microliters of 0.1 M solution of the sulfinic acid compound in 0.5M sodium bicarbonate, and 2 drops of 1M sodium hydroxide. The reagents are mixed, and the tube is sealed and placed in the dark for 3 hours. After extraction with chloroform, the product is concentrated for analysis by high performance liquid chromatography. Derivatives of chlorine and the following compounds have been studied: ammonia, aniline, sec-butylamine, ethylenediamine, piperidine, L-leucine. For N-chloropiperidine, the lower limit of detectability is about 10 ng. The fluorescence of the sulfinic acid derivatives is directly proportional to the original concentration of the underivatized N-chloramine. (Cassar-PTT)
W86-02173

NEW METHODS FOR GAS CHROMATOGRAPHIC ANALYSIS OF WATER POLLUTANTS,

Radian Corp., Austin, TX.

L. H. Keith, R. C. Hall, R. C. Hanisch, J. E. Henderson, and R. G. Landolt.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 563-582, 16 fig, 2 tab, 5 ref. 68-03-2965.

Descriptors: *Pollutant identification, *Chromatography, Gas chromatography, Chlorinated hydrocarbons, Organic compounds, Pesticides, Trihalomethanes, Acetonitriles, Polychlorinated biphenyls, Haloacetonitriles.

Two enhancements of gas chromatographic analysis for aquatic pollutants are described: the thermally modulated electron-capture detector (TMECD) and two-dimensional gas chromatography. The TMECD consists of two electron-capture detectors separated by a temperature-controlled pyrolysis unit. It relies on the differences before and after pyrolysis to produce a peak area ratio. Pyrolysis can affect signals in three ways--enhancement, diminishing, or no change--depending on the compound. With the two-dimensional system (post-detector-peak recycling) a sample is chromatographed on one column; the peaks of interest are trapped and thermally desorbed onto a second column, which differs from the first column. The compound can be identified using two retention times. These methods are applied to mixtures of haloacetonitriles and trihalomethanes in drinking water. The TMECD system is also applicable to mixtures of chlorinated hydrocarbon pesticides, polychlorinated biphenyls, and phthalate esters. (Cassar-PTT)
W86-02174

NEW DEVELOPMENTS IN DYNAMIC HEADSPACE ANALYSIS OF HALOGENATED ORGANICS,

A. R. Trussell, J. G. Moncur, F-Y. Lieu, R. R. Clark, and L. Y. Leong.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 583-592, 5 fig, 1 tab, 11 ref.

Descriptors: *Pollutant identification, *Chromatography, *Water analysis, *Organic compounds, Chlorinated hydrocarbons, Pesticides, Insecticides, Aromatic compounds, Capillary columns, Purge and trap procedures.

Use of capillary columns in the purge and trap technique for analysis of halogenated organics in environmental samples has improved quality assurance with capillary resolution. In addition the following advantages were shown: (1) Minimum detection limits for halogenated organics are in the low nanogram-per-liter range. (2) The purge-desorb-analyze procedure allows processing of two samples per hour. (3) The range of recovered compounds has been extended to include organics with boiling points as high as 300 degrees C, for example, dichlorobenzenes, trichlorobenzenes, hexachloroethane, hexachlorocyclopentadiene, hexachlorobutadiene, chlorinated naphthalenes, and chlorinated biphenyls. (4) The fused silica capillary column used in the volatile analysis is coated with liquid-phase SE-54, which also resolves other extractable chlorinated organics and pesticides. This allows simultaneous analysis of volatile and extractable chlorinated organics. (Cassar-PTT)
W86-02175

GAS CHROMATOGRAPHIC ANALYSIS OF PURGEABLE HALOCARBON AND AROMATIC COMPOUNDS IN DRINKING WATER USING TWO DETECTORS IN SERIES,

SRI International, Menlo Park, CA.
B. A. Kingsley, C. Gin, D. M. Coulson, and R. F. Thomas.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 593-608, 6 fig, 2 tab, 7 ref. 68-03-3031.

Descriptors: *Pollutant identification, *Water analysis, *Chromatography, *Organic compounds, Chlorinated hydrocarbons, Trihalomethanes, *Gas chromatography, Aromatic compounds.

Water samples were monitored for both halocarbons and aromatic compounds in a single analysis, using serially connected photoionization detection and electrolytic conductivity detection. This allowed resolution of many identification problems caused by coeluting compounds. The following advantages were demonstrated. (1) Greater sensitivity is obtained than can be obtained by effluent splitting. (2) More information is provided by the simultaneous analysis than by use of either analysis separately. Misidentification of benzene in samples containing trichloroethylene is eliminated. (3) The ability to confirm halocarbon contaminants in trihalomethane-containing water is greatly increased. (4) Analysis time and instrument costs are reduced because one gas chromography performs the work of two. (Cassar-PTT)
W86-02176

REVIEW OF ANALYTICAL METHODS FOR REACTIVE OXIDANT SPECIES IN CHLORINATED WATERS,

Oak Ridge National Lab., TN.
R. L. Jolley, and J. H. Carpenter.
IN: Water Chlorination: Environmental Impact and Health Effects: Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 611-652, 9 tab, 76 ref.

Descriptors: *Pollutant identification, *Literature reviews, *Water analysis, *Chlorine, Oxidation, Chemical analysis, Potentiometers, Amperometry, Colorimetry, Spectrophotometry, Chemiluminescence, Titrimetry, Seawater, Chloramines, Wastewater analysis.

The literature concerning analytical methods for active chlorine-containing species in water has been reviewed. A table summarizes the principal techniques currently in use, their applicability, and the lower limits of detection. These methods are potentiometry, spectrophotometry, colorimetry (8 specific methods listed), chemiluminescence, and titrimetry (4 specific methods listed). With currently available data, selection of a method most suitable for a particular water sample is difficult. EPA-recommended methods for chlorine in water are iodometric titration, DPD (N,N-diethyl-p-phenylenediamine)-colorimetric, or DPD-titrimetric. Specific methods are discussed for the following types of samples: natural and treated waters, polluted waters (which often have unsatisfied chlorine demand), and seawater. Criteria are given for making judgments on reported concentrations of chlorine or oxidants: water quality, analyst expertise, methodology, and statistical significance. Problems of detecting oxidants in the trace and parts-per-billion range are discussed. (Cassar-PTT)
W86-02177

CHLORINE ANALYSIS: PERSPECTIVES FOR COMPLIANCE MONITORING,

Public Service Electric and Gas Co., Newark, NJ.
R. Sugam.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 653-666, 1 fig, 5 tab, 11 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Oxidation, Residual chlorine, Monitoring, Amperometry, Titration, Seawater, Brackish water, Chlorine flux monitor.

Several methods for total residual chlorine analysis were evaluated in the field at fresh water, brackish water, and seawater sites. Methods included manual amperometric titration, automatic amperometric titration, amperometric back-titration, and chlorine flux monitor. Two amperometric (forward) titration methods (manual and automatic) were recommended as the best methods for low-level chlorine analysis. Under optimum conditions they can be used accurately and precisely to levels as low as 0.030 (manual) and 0.016 (automatic) mg/liter chlorine. Relative precision (95% confidence level) over a range of at least 1.0 mg/liter was +20%, -17% for the manual method and +30%, -23% for the automatic method. Cost of instrumentation for the manual method is considerably less, but endpoint detection is easier with automatic titration. Analytical precision was poorest at the seawater site, reflecting the more rapid decay of brominated oxidants compared with chlorinated analogs. The chlorine flux monitor recovered less oxidant than the other methods at the brackish water and seawater sites. It was not suitable at levels below 0.016 mg/liter. Back-titration recovered slightly less oxidant than forward titration. Amperometric back-titration was not suitable for levels less than 0.061 mg/liter; it was too complex for routine use. (Cassar-PTT)
W86-02178

EXPERIENCE WITH AMPEROMETRIC TITRATIONS FOR TOTAL CHLORINE IN THE MICROGRAMS-PER-LITER RANGE: LIMITATIONS TO ACCURACY,

Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, D. A. Jaworske, and L. Kosak-Channing.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 667-680, 5 fig, 1 tab, 19 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, *Amperometry, Iodine, Bromine, Oxidation, Trace levels, Accuracy, Residual chlorine, Errors, Iodates, Chemical analysis.

Chemical factors which limit accuracy of amperometric titration of chlorine-produced oxidants in natural water are related to iodine chemistry. Factors affecting accuracy (systematic errors) include additive errors (interferences from natural oxidizing agents such as oxygen or iodate ion, colloidal manganese tetrahydroxide, and reagent impurities) and multiplicative errors (volatilization of iodine or other oxidant species during determination). In seawater the disproportionation of iodine to form iodate can cause systematic underdetermination of chlorine-produced oxidants by a factor of 3 or more. The apparent rapid oxidation loss during analysis of free bromine is not caused primarily by volatilization, but by formation of iodate. Some precautions for minimizing the effect of systematic error on a result include (1) avoiding the mixing order, (sample + buffer) + iodide, (2) using the standard additions method with a minimum of two additions, and (3) monitoring unchlorinated intake water for interferences. (Cassar-PTT)
W86-02179

SENSITIVE, SIMPLE DETERMINATION OF OXIDANTS IN CHLORINATED WATERS,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. H. Carpenter, R. G. Zika, and C. A. Moore.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 681-697, 9 fig, 14 ref.

Descriptors: *Pollutant identification, *Water analysis, *Rhodamine B, *Fluorescence, *Chlorine, Oxidation, Bromine, Trihalomethanes, Organic compounds, Hypobromous acid.

The use of rhodamine B, a fluorescent compound, was explored in a method for determining chlorine-produced oxidant in water. The reaction of hypobromous acid with rhodamine B was studied by adding increments of hypobromus acid to the dye at pH 4 and a seawater bromide ion concentration. The predominant species was molecular bromine. Fluorescence decreased in direct proportion to the amount of added hypobromous acid. However, at concentrations lower than 0.004 ppm chlorine equivalent the reaction of rhodamine B with hypobromous acid appeared to change character. Different ranges of chlorine equivalent were handled by using four aliquots of sample and adding different amounts of rhodamine B, corresponding to 0.02, 0.10, 0.50, and 2.00 mg/liter chlorine equivalent. Different responses of rhodamine B were noted at pH 4 and pH 8. Four analytical classes were considered for differentiation: free

chlorine, free bromine, combined chlorine, and combined bromine. Fluorescence decreases at pH 8 were greatest with HOBr, followed by HOCl, NHBr2, and NH2Cl. (Cassar-PTT)
W86-02180

MEASUREMENT OF RESIDUAL CHLORINE COMPOUNDS IN WASTEWATER WITH AMPEROMETRIC MEMBRANE ELECTRODES,

Xertex Corp., Hauppauge, NY.
J. W. Stanley, and R. Nossel.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 699-715, 11 fig, 2 tab, 13 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Chlorine, *Chloramines, Residual chlorine, Amperometry, Electrodes, Membranes.

The 82125 total residual chlorine analyzer measures molecular iodine liberated by oxidation of iodide by reproducing existing accepted methodology, but with limited selectivity for active ammonia chloramines. An added feature is minimal electrode fouling for low-maintenance operation. The membrane electrode and accompanying reagent addition system is suitable for quantitative and continuous measurement of total residual chlorine in domestic and light industrial wastewaters. The 82125 CAC (chloramine) analyzer incorporates iodide in a supporting internal electrolyte and measures triiodide ion liberated by membrane-permeable halogen species. This current response is proportional to the active ammonia chloramine fraction of the measured residual and is independent of pH (5-8.5) and temperature (5-25 degrees C). Observed current sensitivities indicate that the minimum detection limits for the membrane electrode designs are about 0.022 mg/liter as chlorine and 0.092 mg/liter as chlorine for the total residual chlorine and chloramine designs respectively. (Author)
W86-02181

SIMULTANEOUS KINETIC ANALYSIS OF CHLORINE AND CHLORAMINE IN AQUEOUS SOLUTION AT MICROMOLAR CONCENTRATION LEVELS,

Hartford Univ., West Hartford, CT. Dept. of Chemistry.
E. T. Gray, and H. J. Workman.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 723-731, 3 fig, 6 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Simultaneous kinetic analysis, N,N-diethyl-p-phenylenediamine, Chloramines, Iodides.

A simultaneous kinetic method of analysis for free and combined chlorine-containing compounds is feasible when using N,N-diethyl-p-phenylenediamine (DPD) with an iodide catalyst. The sensitivity of 1-2 micromoles is limited by the cell path length and the molar absorptivity of the oxidized DPD. Further investigations are aimed toward lowering the detection limit of this technique to the nanomolar levels by varying the primary reducing agent. (Author)
W86-02182

IMPROVED DETERMINATION OF TOTAL RESIDUAL CHLORINE AT LOW (MICROGRAM-PER-LITER) CONCENTRATIONS IN NATURAL WATERS,

New York State Office of Public Health, Albany. Center for Labs. and Research.
E. Canelli, and S. O. Quinn.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 733-741, 1 fig, 4 tab, 9 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, N,N-Diethyl-p-phenylenediamine, Colorimetry, Residual chlorine, Trace levels.

The N,N-diethyl-p-phenylenediamine (DPD) method combined with preliminary ethyl acetate extraction produces a simple, rapid colorimetric field method for determining total residual chlorine at a detection limit of less than 5 micrograms/liter chlorine. The method involves reduction of free or combined chlorine with an excess of potassium iodide at pH 4.7. The triiodide ion prepared is extracted with ethyl acetate and reacted with aqueous DPD reagents. The reaction product is then extracted into the water phase and measured spectrophotometrically at 515 nm. The ethyl acetate removes interferences from turbidity-causing substances such as insoluble carbonates, silicates, metal oxides, manganese dioxide, and plankton. (Cassar-PTT)
W86-02183

FLOW-STREAM DETERMINATION OF CHLORINE SPECIES WITH AN OXYGEN AMPEROMETRIC DETECTOR,

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. T. Coburn, J. B. Kafil, K. G. Schick, and C. O. Huber.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 743-750, 5 fig, 5 ref. 1435.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, *Chloramines, Amperometry, Hydrogen peroxide, Iodides, Electrodes, Trace levels.

A technique for rapid, direct, and sensitive determination of specific chlorine species below parts-per-million levels depends on the catalytic effect of iodide to separate chlorine species reacting in the following order: HOCl>NH2Cl>NHCl2. Iodide and hydrogen peroxide are added as individual streams to the sample. The detector consists of a Teflon membrane-covered circular, planar platinum electrode with an internal silver-silver chloride reference electrode. Limits of detection as mg/liter chlorine are as follows: HOCl, 0.008; NH2Cl, 0.08; and NHCl2, 0.2. Since monochlorinated amino acids react similarly to monochloramine, these compounds cannot be separately identified. (Cassar-PTT)
W86-02184

HYPOCHLORITE AND MONOCHLORAMINE DETERMINATIONS USING THE SILVER IODIDE VOLTAMMETRIC ELECTRODE,

Wisconsin Univ.-Milwaukee. Dept. of Chemistry.
T. N. Morrison, A. N. Tsausis, and C. O. Huber.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 751-759, 4 fig, 1 tab, 3 ref. 1435.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Trace levels, Chloramines, Voltammetry, Hypochlorite, Monochloramine.

Silver iodide as a voltammetric electrode material provides for useful new chlorine species analytical methods. Configuration of the electrodes and nature of the applied potentials can be selected to optimize the measurements. Major advantages of the silver iodide electrode methods are: no reagents are required, data are rapidly accumulated, it is amenable to flow injection techniques, low (parts-per-billion) limits of detection are possible, the circuitry is relatively simple, and electrodes are easily prepared and maintained. A disadvantage of the silver iodide electrode is that no response has been observed for dichloramine at pH 7-8. This deficiency is somewhat offset by the instability of dichloramine at this pH. (Author)
W86-02185

POTENTIOMETRIC TOTAL RESIDUAL CHLORINE ANALYSIS IN A CONTINUOUS-FLOW SYSTEM,

G. Scarano, M. G. Saroglia, and V. Festa.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 761-772, 8 fig, 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorine, Electrodes, Oxidation, Seawater, Residual chlorine, Orion 97-70 electrode, Monitoring, Potentiometry.

The Orion 97-70 electrode is a rapid, simple means for continuous determination of low-level total residual oxidant in fresh water and seawater. The electrode responds rapidly enough for use in automated flow analysis. The sensor consists of a platinum redox electrode that develops a potential based on relative levels of iodine and iodide ions in solution and an iodide-ion selective electrode that develops a potential based exclusively on the iodide level in solution. The difference in these two potentials is related to the iodine concentration present in solution that is equal to the total residual oxidant concentration after reaction with the iodide reagent in a pH 4 acetate buffer solution. The accuracy and precision compare with those of the amperometric titration method. Since this sensor is not specific for chlorine, bromine oxidants are also included in the determination. The method is usable over a total residual oxidant range of 0.005 to 1 mg/liter. (Cassar-PTT)
W86-02186

MONITORING TOTAL RESIDUAL CHLORINE BY POTENTIOMETRIC ANALYSIS,

ORION Research, Inc., Cambridge, MA.
J. Soderberg, and J. Synnott.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 773-788, 7 fig, 2 tab, 12 ref.

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Chlorine, Oxidation, Potentiometers, Monitoring, Amperometry, Seawater, Cooling water.

Total residual chlorine was measured in five types of water samples by potentiometric and amperometric methods. The samples included cooling water, treated industrial waste from organic industries, treated industrial waste from inorganic industries, treated industrial waste from aluminum industries, and combined domestic/industrial/storm water treated waste. Excellent correlation between the two methods was obtained for all samples at the low part-per-billion level. The potentiometric method compared with the N,N-diethyl-p-phenylenediamine method in a drinking water sample also gave excellent correlation. A commercially available chlorine monitor performed satisfactorily in the field in three situations: river cooling water, treated municipal wastewater, and saline cooling water. (Cassar-PTT)
W86-02187

ENVIRONMENTAL 'TERMITE' INSPECTIONS,

W. A. Duvel.
IN: Hazardous Waste Management for the 80's, Ann Arbor Sciences, Ann Arbor, MI, 1982. p 143-162, 1 fig, 1 tab, 2 exhibits.

Descriptors: *On-site investigations, *Environment, *Pollutants, Economic aspects, Field tests, Groundwater, Water quality, Financial feasibility.

The Environmental Termite Inspection is a new term being applied to site evaluations conducted in relation to commercial and industrial real estate transactions. The inspection usually entails a source characterization, evaluation of hydrogeologic conditions, development of a site map, a detailed site reconnaissance, some subsurface exploration, some evaluation of the population potentially exposed, and a summary risk assessment. The importance of considering water features of the land is stressed, and techniques for non-invasive and invasive subsurface exploration are described. These techniques can include ground surface radar (for determining groundwater depth), resistivity testing, radioactivity detection, organic vapor detection, and analyses of water, soil, waste, and sludge samples. The inspection looks at what hazardous materials are present on the parcel of land; what pathways might serve as conduits for off-site migration; what population is exposed to these

materials; and what adverse conditions could result from this exposure. The cost of such investigations is considered, and the level of investigation required is discussed in relation to the proposed use of the land. (Halterman-PTT)
W86-02223

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT,

Butterworth Publishers, Boston. 1983. Edited by G. Choudhary, L. H. Keith, and C. Rappe. 416 p.

*Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology.

The growing concern for the health hazards of exposure to chlorinated dioxins and dibenzofurans in the total environment led to a symposium held in conjunction with the national meetings of the American Chemical Society. The topics covered include chemical characterization, environmental transport, residues in Great Lakes, breakdown products, levels in wastewater, levels in environmental samples, analytical procedures, and occupational exposures and effects. (Halterman-PTT)
W86-02233

2,3,7,8-TETRACHLORODIBENZO-P-DOXIN AND 2,3,7,8-TETRACHLORODIBENZOFURAN RESIDUES IN GREAT LAKES COMMERCIAL AND SPORT FISH,

Health and Welfare Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W86-02234

DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN INDUSTRIAL AND MUNICIPAL WASTEWATERS, METHOD 613: DEVELOPMENT AND DETECTION LIMITS,

California Analytical Labs., Inc., Sacramento.
A. S. Wong, M. W. Orbanosky, P. A. Taylor, C. R. McMillan, and R. W. Noble.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston, 1983. p 165-192, 9 fig, 1 tab, 4 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, Chlorinated dioxins, Chemical analysis, Gas chromatography, Chromatography, Public health, Regulations.

As a result of public comment and recent advances in analytical procedures, the standard method of determination of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-tetra-CDD) recognized by the EPA has been developed. The final version of the procedure is typical of the methodologies developed for other priority pollutants requiring solvent extractables, except that the labelled internal standard is added to every sample. The aqueous sample is extracted with methylene chloride, which is then exchanged to hexane, which is then washed with 10 N NaOH and concentrated sulfuric acid, to remove acidic and basic co-extracts and any neutral compounds that react easily with concentrated sulfuric acid. The assay step is performed using a capillary column that gives a unique isomer-specific separation for 2,3,7,8-tetra-CDD and is coupled to an MS detector operating in the SIM mode. Criteria for qualitative confirmation are that the GC column be isomer-specific; all 2,3,7,8-tetra-CDD (native and internal standard) coelute; the chlorine isotope ratio is within 10% of the calibration standard; and all peaks are greater than 2.5 times the noise level. (Halterman-PTT)
W86-02235

OCCURRENCE OF TETRACHLORODIBENZO-P-DIOXIN IN ENVIRONMENTAL SAMPLES FROM SOUTHWEST MISSOURI,

Environmental Protection Agency, Kansas City, MO. Region VII.
R. D. Kleopfer, W. W. Bunn, K. T. Yue, and D. J. Harris.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston. 1983. p 193-201, 1 fig, 2 tab, 9 ref.

Descriptors: *Chlorinated hydrocarbons, *Water pollution, *Missouri, *Hydrocarbons, *Chlorinated dioxins, Chemical analysis, Gas chromatography, Public health, Ecosystems, Ecology, Fish.

Following the discovery of illegally disposed tetrachlorodibenzo-p-dioxin (tetra-CDD) in southwest Missouri, a series of investigations has been conducted to determine the extent of contamination in the area. Water, fish, soil, sediments and air samples were analyzed. The highest levels ranged from 33,000 to 343,000 ppb, found in storage tanks and a contaminated horse arena. The highest levels in fish were found in suckers, ranging from 5 to 55 ng/kg. The highest levels found in fish were from specimens collected from the area where the highest sediment levels were observed. Although cleanup efforts are underway, investigations and monitoring of the problems are expected to continue for several years to come. (Halterman-PTT)
W86-02236

COMPOSITION OF POLYCHLORINATED DIBENZOFURAN AND DIBENZO-P-DIOXIN RESIDUES IN SEDIMENTS OF THE HUDSON AND HOUSATONIC RIVERS,

Columbia National Fisheries Research Lab., MO.
J. D. Petty, L. M. Smith, P-A. Bergqvist, J. L. Johnson, and D. L. Stalling.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston, 1983. p 203-207, 3 tab, 12 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology, Fish, Sediments.

The methodologies and results of analysis of sediment and fish samples, from the Hudson and Housatonic Rivers, for polychlorinated dibenzofuran and dibenzo-p-dioxin (PCDF and PCDD, respectively) are outlined. The variable results obtained indicate the need for additional work in this area. The samples contained both compounds, primarily the higher-chlorinated congeners. The hepta- and octa-congeners predominated in sediments and tetra- and penta-congeners predominated in fish. Insufficient evidence exists to determine the differences between the profiles in fish and sediments. (Halterman-PTT)
W86-02237

NEW GAS CHROMATOGRAPHIC DETECTOR FOR TETRACHLORODIBENZO-P-DIOXIN AND TETRACHLORODIBENZOBURAN ANALYSES,

Radian Corp., Austin, TX.
L. H. Keith, L. D. Ogle, A. E. Jones, R. C. Hanisch, and R. C. Hall.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston. 1983. p 239-257, 12 fig, 8 tab, 4 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology.

Gas chromatography and a new prototype detector, a thermally modulated electron-capture detector (TMECD) appear to offer a unique new method for screening for tetrachlorodibenzo-p-dioxin and tetrachlorodibenzofuran at trace levels in complex samples. A great benefit of this method is its high sensitivity to most pollutants of interest. The lower limit of detection for these samples was about 1 ppb. The technique can be used to analyze tissues, fly ash, soil, water and transformer oils. It has the potential to save large sums of money because samples can be screened, and negative samples can be eliminated from costly mass spectrometry analyses. (Halterman-PTT)
W86-02238

VALIDATION STUDY FOR THE GAS CHROMATOGRAPHY/ATMOSPHERIC PRESSURE IONIZATION/MASS SPECTROMETRY METHOD FOR ISOMER-SPECIFIC DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,

National Center for Toxicological Research, Jefferson, AR.
R. K. Mitchum, W. A. Korfmacher, and G. F. Moler.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston. 1983. p 273-286, 7 fig, 6 tab, 18 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology.

Following the increased need for an isomer-specific method for 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-tetra-CDD) determinations, new laboratory and analytical techniques have been developed. The apparatus, reagents, sample clean-up procedures, homogenization, digestion, extraction, silica HPLC, reverse-phase HPLC, sample quantification, recovery experiments, and a series of validation experiments are described. The validation experiments have been successful in identifying and quantifying these compounds. (Halterman-PTT)
W86-02239

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT II,

Butterworth Publishers, Boston. 1985. Edited by Lawrence H. Keith, Christopher Rappe, and Gangadhar Choudhary. 547 p.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Aquatic environment, *Water analysis, *Chemical analysis, *Fish, *Aquatic insects, *Biological magnification, Ecosystems, Polychlorinated dibenzo-p-dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin, Polychlorinated dibenzofuran.

Current research on various aspects of the contamination of the total environment (air, water, soil) with chlorinated dioxins and dibenzofurans is presented. Discussion topics include synthesis, isolation, characterization and destruction of these compounds; the fate and distribution of polychlorinated dioxins (PCDD) and polychlorinated di dibenzofurans (PCDF) in the aquatic environment (including analysis of sediment samples, bioavailability to aquatic insects and residues found in fish); the analysis and effects of human exposure to PCDD and PCDF; soil sampling and analysis; and emission from incineration sources. (Halterman-PTT)
W86-02240

HISTORICAL RECORD OF POLYCHLORINATED DIOXINS AND FURANS IN LAKE HURON SEDIMENTS,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. M. Czuczwa, and R. A. Hites.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 59-63, 2 fig, 11 ref. 80EV-10449.

Descriptors: *Polychlorinated dibenzo-p-dioxins, *Water pollution sources, *Chlorinated hydrocarbons, *Hydrocarbons, *Aquatic environment, Polychlorinated dibenzofurans, Great Lakes, Lake Huron, Gas chromatography, Mass spectrometry, Water analysis, Chemical analysis.

Sediment core sampling was used in a study designed to assess the historical input of combustion-generated polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) into the environment. The goal of the investigation was to determine whether these compounds (including some highly toxic isomers) are formed primarily from the pyrolysis of chlorinated aromatic precursors present in the fuel or are formed during the combustion of naturally occurring organic materials. Four core samples from southern Lake Huron were extracted with isopropanol followed by methylene chloride, and final extracts were analyzed by gas chromatographic mass spectrometry

using methane-negative chemical ionization. This technique allows determination of PCDD and PCDF at low parts per trillion levels. The most abundant species tended to be the highly chlorinated PCDD and PCDF, with octachlorodioxin predominating in all samples. There was no evidence of degradation of PCDD or PCDF. Depth vs. concentration profiles show that the input of these two compounds increased dramatically in approximately 1940, which corresponds to an increased production of chlorinated aromatic compounds, including those used in herbicides and wood preservatives. Thus, combustion of municipal waste is suggested as a major source. It was concluded that the high levels found do not reflect natural combustion processes, but rather anthropogenic combustion, primarily combustion of chlorinated precursors present in combustion fuels. (Halterman-PTT)
W86-02241

ANALYSIS OF PCDD-PCDF IN ENVIRONMENTAL SAMPLES,

Department of the Environment, Ottawa (Ontario).
R. C. Lao, R. S. Thomas, C. Chiu, and K. Li.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Buttworth Publishers, Boston, 1985. p65-78, 7 fig, 6 tab, 11 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Water pollution sources, *Aquatic environment, *Water analysis, Wastewater, Sludge disposal, Industrial wastes, Gas chromatography, Mass spectrometry, Polychlorinated dibenzo-dioxins, Polychlorinated dibenzofurans, Chemical analysis, Ecosystems.

Several environmental sources were analyzed for polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in an effort to identify more actual or potential PCDD-PCDF pathways to the environment. The samples analyzed were: aquatic discharges from wood preservative plants; influent raw sewage, wastewater effluents and exhaust gases from a sludge incinerator; effluent gas stream from a coal preparation plant; gaseous effluent and the cooling water stream from a plasma hydrolysis process (a prototype apparatus for destruction of organic halide waste); gaseous samples from open-air wire insulation burning; and exhaust gases from a hospital waste incinerator. Analysis was by gas chromatography-mass spectrometry, using the Townsend discharge technique. One or more PCDD-PCDF compounds were present in all samples. The concentrations, extent of chlorination and isomeric distributions were notably dependent on the feedstock and destruction process, and on operational parameters. An array of PCDD-PCDF was identified in main effluent discharge from the wood preservation plant and was also readily identified at 0.8 km downstream from the discharge, although at a remarkably reduced level. In the sludge-burning samples, the preliminary mass-balance calculations suggest that sludge accumulates all the PCDD-PCDF, and the resultant mass loading to the incinerator is about 1 gm/day. (Halterman-PTT)
W86-02242

OCTANOL-WATER PARTITION COEFFICIENT OF 1,3,6,8-TCDD AND OCDD BY REVERSE PHASE HPLC,

Manitoba Univ., Winnipeg. Dept. of Soil Science.
G. R. B. Webster, L. P. Sarna, and D. C. G. Muir.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 79-87, 2 fig, 2 tab, 6 ref. OSU 82-00277.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Water pollution sources, *Chemical analysis, *Aquatic environment, Chromatography, Octachlorodibenzo-p-dioxin, 1,3,6,8-tetrachlorodibenzo-p-dioxin, Water analysis.

To enable the environmental dynamics of the chlorinated dioxins octachloro-dibenzo-p-dioxin (OCDD) and 1,3,6,8-tetrachlorodibenzo-p-dioxin (1,3,6,8-TCDD) to be obtained by simple modeling calculations, key physical properties were determined. The porperties studied were octanol-water partition coefficient and water solubility, since these are closely related to a substance's ability to pass through biological membranes and bioaccumulate or to partition between environmental media. A reversed-phase high-performance liquid chromatography method for determination of these two properties is presented. Since standard methods are not effective with these hydrophobic substances, a modification using a quadratic equation is presented. The data presented indicate that the quadratic-derived values of the log of the octanol-water partition coefficient for both 1,3,6,8-TCDD and OCDD agree with the water solubility-determined values very well. (Halterman-PTT)
W86-02243

BIOAVAILABILITY OF 14C-1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN AND 14C-OCTACHLORODIBENZO-P-DIOXIN TO AQUATIC INSECTS IN SEDIMENT AND WATER,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W86-02244

ANALYSIS OF POLYCHLORINATED DIBENZOFURANS AND DIOXINS IN ECOLOGICAL SAMPLES,

Umea Univ. (Sweden). Dept. of Organic Chemistry.
C. Rappe, P. A. Bergqvist, and S. Marklund.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 125-138, 8 fig, 5 tab, 16 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chemical analysis, *Aquatic environment, Polychlorinated dibenzo-p-dioxin, Polychlorinated dibenzofuran, Gas chromatography, Fish, Herring, Baltic Sea.

The need for a highly sensitive and specific analytical technique for the measurement of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibensofurans (PCDF) is emphasized, and the requirements to be met by such a method are discussed. A recovery study of the cleanup system analyzing fish samples fortified at three different spiking levels using synthetic PCDD and PCDF standard is reported. The PCDF and PCDD were extracted and separated from interfering substances in two series of sequential chromatographic processes. Detection was accomplished by gas chromatography-mass spectrometry. Recoveries of the various isomers at spiking levels of 0, 20 and 100 ppt are reported. In addition, studies on the elution order of the same isomers on an alumina column are presented. Also included are results from analyses of herring and guillemot samples from the Baltic Sea. A series of PCDD and PCDF has been identified in these samples at the ppt level. (Halterman-PTT)
W86-02246

ANALYSIS OF PCBS USING SPECIFIC ISOMER HIGH RESOLUTION CAPILLARY GAS CHROMATOGRAPHY,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
M. D. Mullin, C. Pochini, S. H. Safe, and L. M. Safe.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 165-176, 4 fig, 3 tab, 30 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish, Gas chromatography, Chromatography.

The problems associated with the toxicology and analytical chemistry of polychlorinated biphenyls (PCBs) are primarily due to the large numbers of theoretically possible isomers. The toxicity of PCBs is a function of the structure of the individual isomer. It is not sufficient to quantify the total amount of PCBs present in an environmental sample; the concentrations of the isomers which are potentially more toxic must also be determined. High resolution gas chromatographic analytical techniques are outlined and examples of resultant chromatograms are presented. The use of high resolution capillary gas chromatography, in conjunction with the use of PCB isomers as reference standards, is presently a viable analytical technique for the analysis of commerical PCB formulations and environmental samples from many different matrices. (Halterman-PTT)
W86-02254

WATER ANALYSIS, VOLUME 1: INORGANIC SPECIES, PART 1,

Academic Press, Inc., Orlando, FL. 1982. Edited by Roger A. Minear and Lawrence H. Keith. 287 p.

Descriptors: *Water analysis, *Reviews, *Trace elements, *Inorganic compounds, *Theoretical analysis, Organic compounds, Alkalinity, Acidity, Conductance, Dissolved soilds, Oxidation-reduction potential, Turbidity, Water quality, Natural waters, Wastewater analysis.

This volume is the first of three volumes designed to present both the theoretical and the practical aspects of understanding and determining the trace-level components that are found in all natural, pristine, and polluted waters. Volume I is the first of two focusing on the inorganic constituents in water. The first chapter presents a background on the inorganic constituents found in water. A general treatment of the sources of representative species found in both natural waters and wastewaters is followed by a discussion on the effects of hydrolysis, complexation, and dissolution in conjunction with redox and pH in the environmental dynamics of these species. Chapters 2 and 3 include a detailed discussion of these topics. The fourth chapter deals with conductance, a general measure of solution ionic content. The in-depth treatment of light scattering theory principles in Chapter 5 is intended to give the reader a sufficient understanding of the complexity of turbidimetric responses. Chapter 6 concludes the volumen with a survey of general water quality analytical procedures used for measuring individual inorganic species. (Geiger-PTT)
W86-02257

REDOX POTENTIAL: ITS MEASUREMENT AND IMPORTANCE IN WATER SYSTEMS,

Maryland Geological Survey, Baltimore.
For primary bibliographic entry see Field 2K.
W86-02259

ALKALINITY AND ACIDITY,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-02260

CONDUCTANCE: A COLLECTIVE MEASURE OF DISSOLVED IONS,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1B.
W86-02261

THEORY AND MEASUREMENT OF TURBIDITY AND RESIDUE,

Hach Co., Loveland, CO.
For primary bibliographic entry see Field 2K.
W86-02262

SUMMARY OF METHODS FOR WATER-QUALITY ANALYSIS OF SPECIFIC SPECIES,

Geological Survey, Arvada, CO. Water Resources Div.
H. E. Taylor.
IN: Water Analysis, Academic Press, Orlando, FL, 1982, Volume 1: Inorganic Species, Part 1. 1982, p 235-273, 2 fig, 7 tab, 42 ref.

Descriptors: *Water analysis, *Water quality, *Chromatography, *Electrochemistry, *Pollutant identification, *Spectrophotometry, Chemical properties, Wastewater analysis, Natural waters, Gas chromatography, Conductance, Potentiometers, Mass spectrometry, Photometry, X-ray spectroscopy.

In the past 20 years, a variety of methods have been developed to solve specific analytical water quality problems. Several categories of analysis are available depending on the objective of the application. These are: qualitative, semiquantitative, and quantitative. Most modern methods of instrumental analysis base their quantitation on the method of direct comparison with a synthetic standard or a known concentration reference material for standardization. Classical methods are generally considered to be in one of two categories, either gravimetric or volumetric analysis. Usually classical method are not employed in the modern water quality laboratory because of their time requirements. Spectroscopic methods of analysis can be broken down into two major categories - absorption techniques and emission or fluorescence techniques. Molecular and atomic absorption methods are described. Emission methods examined include atomic emission, molecular emission, atomic fluorescence, x-ray fluorescence, neutron activation, and mass spectrometry. Electrochemical methods of water analysis can be grouped into several different categories. They include: potentiometric techniques, voltammetric techniques, amperometry, and conductance techniques. Chromatography is one of the most effectively known methods of separating interfering constituents prior to analysis. The principles of chromatographic analysis are described. (Geiger-PTT)
W86-02263

GEOCHEMICAL IDENTIFICATION OF SALINITY SOURCES,

Kansas State Geological Survey, Lawrence.
D. O. Whittemore.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 505-514, 5 fig, 14 ref.

Descriptors: *Saline water, *Salinity, *Water pollution sources, *Pollutant identification, *Brines, Oil field brines, Chemical analysis, Dissolved solids, Isotope studies, Kansas.

The assessment of the concentrations and ratios of dissolved constituents and isotopes to identify salinity sources is described. For instance, values of Na/Cl weight ratios are 0.5 for oil-field brines in Kansas, and 0.65 for salt-solution brines in near-surface Permian rocks. The significance of ratios of B/Cl, Li/Cl, Br/Cl, and I/Cl are also discussed. Major sources of salinity in Kansas, including near-surface evaporate solutions and oil-field brines, are described. Case histories of salinity source identification are outlined, including those from Smokey Hill River Valley, Great Bend Prairie, Equus Beds, and the Blood Orchard area. (Halterman-PTT)
W86-02309

QUALITY OF GROUND WATER IN THE PRINCIPAL AQUIFERS OF NORTHEASTERN-NORTH CENTRAL WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02345

PRELIMINARY ANALYSIS OF GEOHYDROLOGIC DATA FROM TEST WELLS DRILLED NEAR CHESTER, ON KENT ISLAND, QUEEN ANNES COUNTY, MARYLAND,

Maryland Dept. of Natural Resources, Annapolis.
F. K. Mack.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 82-854, 1983. 31 p, 11 fig, 4 tab, 12 ref.

Descriptors: Groundwater, Geohydrologic units, *Water wells, Coastal Plain, *Water quality, Water temperature, *Aquifer testing, Borehole geophysics, Hydrographs, *Maryland, *Queen Annes County, Kent Island.

A test hole drilled on Kent Island, Queen Annes County, Maryland, to a depth of 2548 feet, penetrated 2518 feet of Coastal Plain sediments and 30 feet of the underlying bedrock. Drill cuttings, cores, and geophysical logs were used to identify five aquifers: the Patuxent, lower Patapsco, upper Patapsco, Magothy, and Aquia. Water samples and pumping test data obtained from wells completed in the aquifers were used to determine the water quality and transmissivities of the aquifers. Transmissivity of each, in feet squared per day, was found to be >800, 1,400, 4,000, 5,800, and >320 respectively. Chemical analyses showed that water from each aquifer is fresh and is distinctly different in chemical character from the others. Iron exceeded the limit recommended by EPA for drinking water in each of the aquifers. Water in the deeper aquifers is soft but water in the Aquia aquifer has a hardness of 160 milligram/Liter. Water levels in the wells are (1) affected by tidal changes in nearby estuaries of Chesapeake Bay, and (2) are highest in the deepest aquifer (16 feet above sea level) and progressively lower in each of the shallower aquifers. (USGS)
W86-02349

ANALYSIS OF GROUND-WATER-QUALITY DATA IN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02361

CHEMICAL AND ISOTOPIC CHARACTERISTICS OF BRINES FROM THREE OIL- AND GAS-PRODUCING FORMATIONS IN EASTERN OHIO, WITH APPLICATIONS TO THE GEOCHEMICAL TRACING OF BRINE SOURCES,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02365

GROUND-WATER QUALITY DATA FOR THE ATLANTIC COASTAL PLAIN: NEW JERSEY, DELAWARE, MARYLAND, VIRGINIA, AND NORTH CAROLINA,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02374

5B. Sources Of Pollution

DATA ON SURFACE-WATER QUALITY AND QUANTITY, TRUCKEE RIVER SYSTEM, NEVADA AND CALIFORNIA, 1979-81,

Geological Survey, Carson City, NV. Water Resources Div.
k. J. La Camera, R. J. Hoffman, J. O. Nowlin, L. F. Smith, and S. M. Lima.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-238, 1985. 191 p, 2 fig, 36 tab, 17 ref.

Descriptors: *Channel morphology, *Synoptic analysis, *Travel time, *Water quality, *Water temperature, Aeration, Dyes, Interstitial water, Phytoplankton, Tracers, *Truckee Canal, *Truckee River, *California, *Nevada.

Selected hydrologic data were collected between May 1979 and October 1981 at 59 sites on the Truckee River, 10 sites on selected tributaries and smaller diversions, and 9 sites on the Truckee Canal. The data were collected in support of the water-quality and hydrologic investigation components of the Truckee-Carson River-Quality Assessment by the U.S. Geological Survey. This report contains data from: (1) diel and antecedent measurements made in conjunction with four synoptic water-quality studies, (2) analyses of phytoplankton samples to supplement other biological data collected during the synoptic studies, (3) an investigation of surface and intragravel water quality to determine the suitability of the river as a spawning habitat for Lahontan cutthroat trout, (4) 10 water-temperature recorders, (5) 11 dye-tracer studies, (6) 5 gas-tracer reaeration studies, (7) summaries of dye-tracer travel times derived from the dye and reaeration studies, and (8) discharge measurements with associated channel-geometry descriptions at 46 miscellaneous sites on the river, selected tributaries, and the canal. (USGS)
W86-01924

COMPUTER MODEL OF ONE-DIMENSIONAL EQUILIBRIUM CONTROLLED SORPTION PROCESSES,

Geological Survey, Denver, CO. Water Resources Div.
D. B. Grove, and K. G. Stollenwerk.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4059, 1984. 58 p, 15 fig, 2 tab, 9 ref.

Descriptors: *Water pollution, *Computer models, *Mathematical models, Groundwater, Ion transport, Ion exchange, Chemical reactions, *Groundwater movement, Sorption processes, *Finite-difference methods, *Path of pollutants.

A numerical solution to the one-dimensional solute-transport equation with equilibrium-controlled sorption and a first-order irreversible-rate reaction is presented. The computer code is written in FORTRAN language, with a variety of options for input and output for user ease. Sorption reactions include Langmuir, Freundlich, and ion-exchange, with or without equal valance. General equations describing transport and reaction processes are solved by finite-difference methods, with nonlinearities accounted for by iteration. Complete documentation of the code, with examples, is included. (USGS)
W86-01925

TEST WELL INSTALLATION AND WATER QUALITY, HOLLYWOOD DUMP AREA, MEMPHIS, TENNESSEE,

Geological Survey, Memphis, TN. Water Resources Div.
D. D. Graham.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4214, 1985. 35 p, 10 fig, 4 tab, 12 ref.

Descriptors: *Landfills, *Groundwater contamination, Aquifers, Water quality, *Tennessee, Memphis, Waste pollution sources, Path of pollutants.

The Hollywood Dump in north Memphis, Tennessee is known to contain hazardous wastes. Monitor wells were installed and sampled to determine if contaminants have entered the underlying Wolf River alluvium and concentrated near the base of this unconfined aquifer. Four water-quality samples were collected from each of nine monitor wells screened in the Wolf River alluvium at the Hollywood Dump between June 1982 and June 1983. Also sampled during this period was one well screened in the fluvial (terrace) deposits, about one-half mile upgradient from the dump, and three nearby wells screened in the Memphis Sand artesian aquifer. Low levels of several organic compounds, including heptachlor, chlordane and chlordene, were detected in water from the Wolf River alluvium. High concentrations of barium and arsenic were also detected. Water from the Memphis Sand showed no traces of synthetic organic compounds. Other constituents and properties were found to be at levels that are normal for that aquifer. Five of the Wolf River alluvium wells sampled were newly installed. Geophysical logs made in these wells, supplemented by drillers logs and split spoon samples, show that clay underlies the alluvial aquifer at the well locations. (USGS)
W86-01928

GROUND-WATER HYDROLOGY OF VOLUSIA COUNTY, FLORIDA, WITH EMPHASIS ON OCCURRENCE AND MOVEMENT OF BRACKISH WATER,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01932

HYDROLOGY OF AREA 11, EASTERN COAL PROVINCE, OHIO, KENTUCKY, AND WEST VIRGINIA,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-01937

OCCURRENCE OF SALINE WATER IN THE ALLUVIAL AQUIFER IN THE BOEUF-TENSAS BASIN, ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
D. J. Fitzpatrick.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4029, 1985. 1 sheet, 3 fig, 1 tab, 10 ref.

Descriptors: *Groundwater pollution, Water quality, *Saline water intrusion, Aquifers, Groundwater, *Arkansas, Gulf Coastal Plain, Boeuf-Tensas basin.

The occurrence of saline water in the alluvial aquifer in the Boeuf-Tensas basin in southeastern Arkansas has been of increasing concern. A band of saline water containing chloride concentrations of greater than 50 milligrams per liter extends through the entire length of the basin. The most severely affected area is located in the southern part of the basin where chloride concentrations are as high as 1,360 milligrams per liter. The origin of the saline water in the alluvial aquifer is not definitely known, but can probably be attributed at least in part, to both upward movement from the Arkansas River. Upward instrusion of saline ground water has probably occurred through one or more of the following: 1) leakage where the Jackson confining unit is thinned or absent, 2) leakage along a fault, and 3) movement through abandoned oil and gas test holes. (USGS)
W86-01940

NITROGEN, SULFATE, CHLORIDE, AND MANGANESE IN GROUND WATER IN THE ALLUVIAL DEPOSITS OF THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, WELD COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
N. G. Gaggiani.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4088, 1984. 2 sheets, 6 fig, 15 ref.

Descriptors: *Groundwater pollution, *Alluvial aquifers, *Water quality, Feedlots, Irrigation effects, Groundwater irrigation, Groundwater recharge, Chlorides, Nitrates, Sulfates, Manganese, *Colorado, *Cattle wastes, *Valley-fill deposits, South Platte River Valley, Kersey.

Ground water from the valley-fill deposits of the South Platte River Valley and its tributaries is used extensively for agriculture in the study area, about 10 miles east of Greeley and about 50 miles northeast of Denver, Colorado. The valley-fill deposits, which consist of alluvial and terrace deposits, are in a valley system eroded in Laramie Formation bedrock. Water samples collected from 53 wells during 1974 and 1980 were analyzed for nitrite plus nitrate nitrogen, sulfate, chloride, and manganese. Median concentrations changes in these constituents from 1974 to 1980 are as follows: 6.0 to 8.8 milligrams per liter for nitrite plus nitrate nitrogen, 850 to 900 milligrams per liter for sulfate, and 94 to 120 milligrams per liter for chloride. Manganese concentrations were greater than 1,000 micrograms per liter in both 1974 and 1980 in a small area at the mouth of Box Elder Creek. (USGS)
W86-01941

EFFECTS OF URBANIZATION OF THREE PONDS IN MIDDLETON, WISCONSIN,

Geological Survey. Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-01949

CHEMICAL QUALITY OF WATER AT 14 SITES NEAR KESTERSON NATIONAL WILDLIFE REFUGE, FRESNO AND MERGED COUNTIES, CALIFORNIA,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
J. A. Izbicki.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-582, 1984. 17 p, 1 fig, 2 tab, 2 ref.

Descriptors: *Irrigation-return flow, *Water pollution sources, trace elements, Trace metals, Water quality, *Kesterson Reservoir, West Side San Joaquin Valley, San Luis Drain, *California, Agricultural drainage.

Data were collected to determine concentrations of major ions, nutrients, and selected trace elements in collector drains tributary to the San Luis Drain; the San Luis Drain near Kesterson Reservoir; Kesterson Reservoir; and selected drains, canals, and sloughs near but not tributary to Kesterson Reservoir, California. Results from 14 samples collected during January 24-26, 1984, are summarized in tables, and the sample locations are shown on maps. (USGS)
W86-01959

SIMULATED EFFECTS OF SURFACE COAL MINING AND AGRICULTURE ON DISSOLVED SOLIDS IN ROSEBUD CREEK, SOUTHEASTERN MONTANA,

R. F. Ferreira.
Available from OFSS, USGS BOX 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4101, 1984. 94 p, 4 fig, 25 tab, 43 ref.

Descriptors: *Coal mines, Strip mines, Dissolved solids, *Water pollution sources, irrigation effects, *Simulation analysis, *Surface mining, Rosebud Creek, *Montana.

Dissolved-solids concentrations in five reaches of Rosebud Creek in southeastern Montana were simulated to assist in evaluating the effects of surface coal mining and agriculture on the dissolved-solids concentration. A mass balance of streamflow and dissolved-solids load was used. Mined acreage, dissolved-solids concentrations in mined spoils, and irrigated acreage were varied in the model to study relative changes in the dissolved-solids concentration of each reach of Rosebud Creek. Both simulated monthly streamflow and dissolved-solids load generally are within the 95-percent confidence limits of the mean monthly values calculated for Rosebud Creek at the mouth near Rosebud, Montana. From May through September, the simulated mean monthly streamflows vary by no more than 15 percent of the historical mean values. Except for January, May, and December, the simulated mean monthly dissolved-solids loads vary by no more than 13 percent of the historical mean values. Simulations based on present mining show irrigation accounting for a larger cumulative percentage of dissolved-solids concentration (3.05 percent in reach 5) than mining (0.38 percent in reach 5). However, with full-scale mining, the cumulative percentage resulting from irrigation in reach 5 (2.50 percent) will be smaller than that resulting from mining (14.69). By not simulating mining of the Kirby coal deposit in reach 1, the cumulative percentage of dissolved-solids concentration resulting from mining in all reaches will be decreased to less than 6.00 percent.
W86-01962

COMPILATION OF DATA COLLECTED AND DERIVED FOR WATER YEARS 1980 AND 1981 FOR THE PURPOSE OF WATER-QUALITY MODELING OF THE LOWER OUACHITA RIVER AND SELECTED TRIBUTARIES, SOUTH-CENTRAL ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
J. C. Petersen, and E. E. Morris.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-727, 1984. 130 p, 16 fig, 40 tab, 36 ref.

Descriptors: *Hydrologic data collection, *Water quality, *Dissolved oxygen, *Nutrients, Coliform, Stream discharge, Algae, Phytoplankton, Chlorophyll, *Arkansas, *Ouachita River, Periphyton, Stream geometry.

This report represents water-quality, sediment oxygen demand, phytoplankton, periphyton, bacteria, instantaneous and mean-daily discharge, stream geometry, time of travel, reaeration data and other water quality collected on the lower Ouachita River (from just upstream of Little Missouri River to Lock and Dam 6), West Two Bayou, Smackover Creek, Haynes Creek and selected tributaries. The data were collected primarily between August 1980 and September 1981. Over 100 sites were sampled, but most were sampled only during two intensive sampling periods in mid-August of 1980 and mid-September of 1981. The water-quality data include measurements of pH, specific conductance, dissolved oxygen, water temperature, whole-water nitrogen species, total phosphorus, total orthophosphorus, dissolved chlorides, dissolved sulfate, ultimate biochemical oxygen demand and organic carbon. The phytoplankton and periphyton data include measurements of chlorophyll a and b, taxonomic identification cell counts and weights. Limited precipitation data are also included. Maps and schematic diagrams of the lower Ouachita River, West Two Bayou, Smackover Creek and Haynes Creek drainage systems show the location of the data-collection sites within the area. (USGS)
W86-01965

GEOCHEMICAL PROCESSES IN THE GASCOYNE LIGNITE MINING AREA, BOWMAN COUNTY, NORTH DAKOTA,

Geological Survey, Reston, VA. Water Resources Div.
D. W. Fisher, D. C. Thorstenson, M. G. Croft, and R. L. Houghton.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4192, 1985. 80 p, 15 fig, 15 tab, 32 ref.

Descriptors: *Strip mines, *Water quality, *Groundwater, Chemical reactions, Carbon radioisotopes, Carbonates, Cation exchange, Aeration zone, *Coal mining effects, *Fort Union formation, *North Dakota, Dissolved gases, Gas analyses, Sulfate reduction.

A study was begun in 1975 to determine the geochemical processes that have affected groundwater quality as a result of a lignite strip mine at Gascoyne, North Dakota. Ground waters and surface waters on or near the mine were analyzed for major and minor dissolved constituents, tritium and carbon-13 isotopes, and dissolved gases. Compositions and carbon isotopes were determined in gas samples from various horizons at six unsaturated-zone sites. Mineralogic and cation-exchange data were obtained from core samples and surface solids from the mine and from nearby farms. Reactions that control ground-water chemistry at the mine include: (1) Oxidation of organic matter and ferrous iron minerals in the saturated zone; (2) Dissolution of C02, carbonates and sulfates in unsaturated-zone water; (3) Cation exchange reactions on clays and on lignite; (4) Sulfate reduction and pyrite deposition in the lignite; (5) leaching of halides and of organic matter from the lignite; and (6) Silicate hydrolysis near the lignite outcrop. Gascoyne area ground waters are near neutral to moderately alkaline sodium sulfate solutions containing several hundred to several thousand mg/L dissolved sulfate. Mining operations will probably increase the dissolved sulfate levels in the groundwater reservoir at Gascoyne. (USGS)
W86-01970

RESULTS OF THE SEPARATIONS AREA GROUND-WATER MONITORING NETWORK FOR 1981,

Atomics International Div., Richland, WA. Energy Systems Group.
J. S. Wilbur, and M. J. Graham.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020562,

Price codes: A03 in paper copy, A01 in microfighe. Report RHO-HS-SR--5P, July 1982. 43 p, 18 fig, 4 tab, 10 ref, 6 append. DE-AC06-77RL01030.

Descriptors: *Fate of pollutants, *Water pollution sources, *Radioactive wastes, *Radioisotopes, Tritium, Monitoring, Water quality, Groundwater pollution, Hanford Site, Nuclear reactors, *Washington.

Results of the 1981 groundwater monitoring program at the Rockwell Hanford Site Separations Area indicated few changes from 1980. Samples from monitoring wells were analyzed for total alpha, total beta, Co60, Ru106, Cs137, Sr90, tritium, uranium, and nitrate. Tritium levels exceeded the guidelines for tritium (3000 pCi/ml) iin three wells which monitor active sites. With the exception of tritium, all contamination greater than 10% of the guidelines was caused by past disposal to inactive sites. The zone of contamination appears stable and highly localized for the sites represented by these samples. Groundwater migrating out of the Separations Area at this time contain pollutants at levels less than the guidelines. (Cassar-PTT)
W86-01977

ASSESSMENT AND CONTROL OF WATER CONTAMINATION ASSOCIATED WITH SHALE OIL EXTRACTION AND PROCESSING,

Los Alamos National Lab., NM.
E. J. Peterson, A. V. Henicksman, J. P. Fox, J. A. O. O'Rourke, and P. Wagner.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82 019186, Price codes: A03 in paper copy, A01 in microfiche. Report LA-9084-PR; UC-91, April 1982. 48 p, 8 fig, 23 tab, 24 ref, 3 append.

Descriptors: *Water quality control, *Oil shale, Shales, Trace elements, Metals, Heavy metals, Leaching, *Water pollution sources.

Laboratory studies on the potential water contamination associated with oil shale operations, focus on the mineralogy, trace element concentrations in solids, and leaching characteristics of raw and spent shales. Process parameters in modified in situ retorting are extreme. Mineralogic characterization of field generated spent shales indicate that carbonate decomposition and silication reactions occurred in Retort 3E at Logan Wash, Colorado. However, evaluation of leachate compositions indicate that several environmentally sensitive trace elements, including K, Li, F, V, Pb, B, Mo, Ni, Se, and As are not rendered immobile by in situ processing and could be of environmental concern. These conclusions are verified by investigations of laboratory-generated spent shales. This report details the chemical, mineralogic, and solution behavior of major, minor, and trace elements in a variety of shale materials. Control technology research activities have focused on the definition of control technology requirements based on assessment activities and laboratory evaluation of alternative control strategies for mitigation of identified problems. The overall impact of in situ processing on groundwater quality appears to be less significant than previously believed. Most elements leached from spent shales are already elevated in most groundwaters. Analysis indicates that solubility controls by major cations and anions will aid in mitigating water quality impacts with the exception of V, Pb, and Se. With respect to in situ retort leaching, process control and multistaged counterflow leaching are evaluated as control strategies. (Cassar-PTT)
W86-01979

MECHANISMS FOR GROUNDWATER CONTAMINATION BY UCG: PRELIMINARY CONCLUSIONS FROM THE HOE CREEK STUDY,

Lawrence Livermore National Lab., CA.
F. T. Wang, S. W. Mead, and D. H. Stuermer.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020348, Price codes: A02 in paper copy, A01 in microfiche. Report UCRL--88012, August 3, 1982. 12 p, 6 fig, 5 tab, 5 ref. W-7405-E-48.

Descriptors: *Water pollution sources, *Fate of pollutants, *Water quality control, *Coal gasification, Gasification, Pyrolysis, Hoe Creek, Wyoming, Groundwater pollution, Organic compounds, Ammonia, Leaching.

Changes in groundwater quality were monitored in 60 wells drilled near the three underground coal gasification experiments at Hoe Creek, Wyoming. Five mechanisms were proposed to explain how residual gasification products were introduced into groundwater. (1) Escaping hot product gases may pyrolyze surrounding coal along its natural cracks. This is most likely to happen in an overlying aquifer. However, sand layers are not readily contaminated in this manner. If this mechanism is valid, dewatering wells could lower system pressure and reduce the volume of escaping product gas. (2) After gasification, the residual heat inside the cavity produces further pyrolysis products. (3) Leaching of coal ash by returning groundwater liberates inorganic contaminants. (4) Overburden materials heated to various degrees are the source of inorganic substances which enter the groundwater. (5) Minerals are dissolved by carbon dioxide escaping from the cavity during gasification. These possible mechanisms may be considered in designing monitoring networks and control technologies. For example, in leaky coal seams, monitoring wells should be 100 m or more from the cavity. In a thick coal seam, some wells should be completed in the top portion of the bed. Contaminated groundwater may be treated by pumping water to the surface through a wall in the cavity. The quantity of pyrolysis products can be minimized by preventing gas losses. (Cassar-PTT)
W86-01981

SEDIMENT AND RADIONUCLIDE TRANSPORT IN RIVERS: FIELD SAMPLING PROGRAM FOR CATTARAUGUS AND BUTTERMILK CREEKS, NEW YORK,

Battelle Pacific Northwest Labs., Richland, WA.
W. H. Walter, R. M. Ecker, and Y. Onishi.
Report PNL-3117, Vol. 4, Summary Report. November 1982. 75 p, 41 fig, 10 tab, 6 ref, 2 append.

Descriptors: *Path of pollutants, *Radioactive wastes, *Surface waters, *Radionuclides, *Radioisotopes, Cesium-137, Strontium-90, Plutonium, Americum, Tritium, Curium, Rivers, Sediments, Transport, Buttermilk Creek, *New York.

A field sampling program was conducted on the Buttermilk-Cattaraugus Creek system, New York, to investigate the transport of radionuclides in surface waters as part of a continuing program to provide data for application and verification of Pacific Northwest Laboratory's (PNL) sediment and radionuclide transport model, SERATRA. Based on the evaluation of radionuclide levels in Cattaraugus and Buttermilk Creeks, the Nuclear Fuel Services facility at West Valley, New York, may be the source of Cs-137, Sr-90, Cs-134, Co-60, Pu-238, Pu-239, 240, Am-241, Cm-244 and tritium found in the bed sediment, suspended sediment and water of Buttermilk and Cattaraugus Creeks. Bed sediment, suspended sediment, and water samples were collected over a 45-mile reach of the creek system. Bed sediment samples were also collected at the mouth of Cattaraugus Creek in Lake Erie. Radiological analysis of these samples included gamma ray spectrometry analysis, and radiochemical separation and analysis of Sr-90, Pu-238, Pu-239, 240, Am-241 and Cm-244. Tritium analysis was also performed on water samples. (Author's modified abstract)
W86-01988

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN GROUNDWATER MODELING: SELECTION, TESTING AND USE,

Michigan Dept. of Natural Resources, Lansing.
D. A. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-143206, Price codes: A09 in paper copy, A01 in microfiche. Volume 1, September 1982. 199 p, 98 fig, 6 tab, 62 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Groundwater management, *Model studies, *Michigan, AQUIFEM model, Mass transport, Groundwater movement, Groundwater pollution, Aquifers, Mathematical models, Water quality, Water pollution, Water quality control, Management.

Groundwater models were applied to three field problems in Michigan: a landfill leachate plume, contamination from an unknown source, and domestic wells contaminated with chromium from an industrial plant. The AQUIFEM model was tested at all three sites. Three different models (AQUIFEM, GEOFLOW, and the U.S.G.S. mass transport model) were applied to the chromium pollution situation. AQUIFEM was recommended as the first model to use in a given problem. Mass transport modeling should be attempted only if site complexity, project demand, and a large body of available data require this model type. Some of the uses of groundwater modeling demonstrated in this study include testing working hypotheses, directing where new data should be obtained, simulating various management alternatives, and coordinating the final design with management implementation. (Cassar-PTT)
W86-01989

RESEARCH PROGRAM FOR ATMOSPHERIC CHEMISTRY, RADIATION AND DYNAMICS,

Atmospheric and Environmental Research, Inc., Cambridge, MA.
N. D. Sze, M. K. W. Ko, M. Livshits, W. C. Wang, and P. B. Ryan.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120407, Price codes: A06 in paper copy, A01 in microfiche. Report No. AFGL-TR-82-0207, Final Report, July 1982. 121 p, 50 fig, 5 tab, 115 ref, 2 append. F19628-81-C-0016.

Descriptors: *Chemical reactions, *Atmosphere, Model studies, Ozone, Metals, Heavy metals, Nitrogen oxides, *Acid rain, *Path of pollutants, Water pollution sources, *Atmospheric chemistry.

Progress is summarized in atmospheric research conducted under AFGL contract F19628-81-C-0016 for the period December 1980 to June 1982. Four topics are discussed. (1) New rates for the reactions of OH with HNO3 and HNO4 introduce additional coupling between HOx and NOx species, reducing the OH and HO2 concentrations in the lower stratosphere. (2) The calculated steady state ozone depletion due to continued release of fluorocarbons at the 1977 production level is 6.1%, compared with the depletion rate (16.4%) calculated from 1979 rates. Ozone perturbations due to human activity may interact in nonlinear fashion. For example, an increase in atmospheric carbon dioxide may partially offset the fluorocarbon-induced ozone perturbation. (3) The AER two-dimensional model results were compared with observations of atmospheric gases. Important discrepancies still exist in ClO and some fluorocarbons. (4) Studies on meteoric metals in the atmosphere indicate that metal species have the potential to couple to other chemical cycles and change radical species concentrations. (Cassar-PTT)
W86-01996

PHYSICAL BEHAVIOR OF PCBS IN THE GREAT LAKES,

For primary bibliographic entry see Field 5A.
W86-02012

VAPOR EXCHANGE OF PCBS WITH LAKE MICHIGAN: THE ATMOSPHERE AS A SINK FOR PCBS,

De Paul Univ., Chicago, IL.
T. J. Murphy, J. C. Pokojowczyk, and M. D. Mullin.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 49-58, 3 tab, 10 ref. CR-807412.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Atmosphere, *Vaporization, *Lake Michigan, Great Lakes, Henry's law constants, Chlorobiphenyls, Gas chromatography, Aroclors.

Research was conducted to answer the question of whether there is net transport of PCB vapor into or out of the water, a major problem remaining in determining the PCB budgets of the Great Lakes. These studies indicate that the net movement of PCB vapor is from the water to the atmosphere. The methods used to draw these conclusions involve determining the ratios of PCB concentrations in solution and in vapor above the solution. The ramifications of the results of this work with regard to precipitation are as follows: a water concentration of 1 ng/1 of a PCB with Henry's law constant (HLC of 0.00033 atm-cu m/mol) will support a vapor PCB concentration of 13.3 ng/cu m. Thus, precipitation in equilibrium with an atmospheric vapor concentration of 2 ng/ cu m of PCB, will have a dissolved PCB concentration of 0.15 ng/1. This is a concentration two orders of magnitude or more lower than is normally found in precipitation and indicates that vapor scavenging can account for less than 1% of the wet deposition PCB inputs. (Halterman-PTT)
W86-02014

PHYSICAL CHEMICAL PROPERTIES OF POLYCHLORINATED BIPHENYLS,

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W86-02015

REACTIVITY AND ENVIRONMENTAL PERSISTENCE OF PCB ISOMERS,

Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
For primary bibliographic entry see Field 5A.
W86-02016

REVERSIBLE AND RESISTANT COMPONENT MODEL OF HEXACHLOROBIPHENYL ADSORPTION-DESORPTION RESUSPENSION AND DILUTION,

Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.
For primary bibliographic entry see Field 5A.
W86-02017

PCBS IN THE LAKE SUPERIOR ATMOSPHERE 1978-1980,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5A.
W86-02018

PROCESSES DETERMINING THE FLUX OF PCBS ACROSS AIR/WATER INTERFACES,

Wisconsin Univ.-Madison.
A. W. Andren.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 127-140, 1 fig, 4 tab, 39 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Michigan, Great Lakes, Air-water interface, Vapor particle partitioning, Vaporization, Adsorption, Desorption, Model studies.

Because of the high concentrations of PCBs in fish eaten by humans, it is important to understand the routes by which PCBs first enter the water and ultimately fish tissues. In order to evaluate these transport processes, it is instructive to study the environmental behavior of these compounds. The primary phenomenon noted here is the atmospheric removal of the particle-associated fraction. The overall input of PCBs to Lake Michigan was estimated to range from about 300 to 550 kg per year. These estimates were obtained by combining a series of models and data, obtained from published literature, which covered the major transport mechanisms. Estimates were made for inputs from vapor-particle partitioning, vapor washout, particle-associated washout. dry deposition of particle-associated PCBs, vapor phase transfer, bubble stripping and bubble bursting. (Halterman-PTT)
W86-02019

EVIDENCE FOR THE ATMOSPHERIC FLUX OF POLYCHLORINATED BIPHENYLS TO LAKE SUPERIOR,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, and B. B. Looney.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 141-156, 1 fig, 3 tab, 36 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, *Lake Superior, Air-water Partition coefficients, Air pollution, Transport, Water pollution, Model studies, Air-water interface.

Because of the magnitude of the PCB concentrations in marine, the Great Lakes, and urban atmospheres, atmospheric transport has been implicated as a primary input pathway to aquatic ecosystems. The calculation of PCB vapor flux across the air/water interface, which is critically important in quantifying atmospheric inputs, is described and quantified. Determinations were made by using reported air/water partition coefficients and comparing the results to a surface flux estimated from PCB and temperature profiles observed in Lake Superior, July 1978. The surface influx of PCB from the atmosphere was estimated as about 0.02 to 0.2 micrograms per square meter per day as compared to the gas-phase controlled influx calculated as about 0.17 micrograms per square meter per day. (Halterman-PTT)
W86-02020

ROLE OF SURFACE MICROLAYERS IN THE AIR-WATER EXCHANGE OF PCBS,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. P. Rice, P. A. Meyers, and G. S. Brown.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 157-179, 4 fig, 5 tab, 31 ref. NA-79 RA-H-00001 NA-80 AA-D-00072.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Michigan, *Air-water exchange, Surface microlayers, Air-water interface, Great Lakes, Aroclors, Suspended solids, Partition coefficients.

Recently, there is much interest in trying to explain the cycling of PCBs between the major environmental compartments, i.e., atmosphere, hydrosphere and lithosphere, and hence new compartments are being defined. One of these is the surface microlayer. Determinations of the concentrations of PCB in the microlayer and subsurface waters of Lake Michigan are presented. Results of these studies indicate that the portion of PCBs associated with the particulate phase is related to their cycling at this interface. Surface samples for the study were collected from throughout Lake Michigan during 1979 and 1980 with screen and plate samplers. Subsurface samples were collected from a 1 m depth. Data on concentrations of PCBs, suspended particulates, and partition coefficients for the surface microlayer and the subsurface waters are presented. (Halterman-PTT)
W86-02021

PCB DYNAMICS IN LAKE SUPERIOR WATER,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. J. Eisenreich, P. D. Capel, and B. B. Looney.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 181-211, 8 fig, 4 tab, 46 ref. R805172-01. R806084-01.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Lake Superior, Great Lakes, Water pollution, Sediment-water interfaces, Suspended solids, Aroclors, Adsorption.

PCBs are refractory compounds resisting chemical and biological degradation and are predicted to remain active for decades to come. Consequently, it is important to determine the dynamics of these compounds in aquatic ecosystems. A summary is presented of the findings regarding PCBs in the waters of Lake Superior during 1978 to 1980. Samples were taken from subsurface and surface waters, extracted, and analyzed by gas chromatography. Data on variations in concentrations of PCBs in various regions of Lake Superior, as well as in-depth profiles, are presented. (Halterman-PTT)
W86-02022

ROLE OF THE BENTHIC BOUNDARY IN THE CYCLING OF PCBS IN THE GREAT LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie, C. P. Rice, and W. A. Frez.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 213-228, 5 fig, 2 tab, 24 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Sediment-water interface, Great Lakes, Lake Michigan, Suspended solids, Sedimentation, Water pollution, Transport, Partition coefficients, Air pollution.

Transport processes within the benthic boundary layer (BBL) are important in determining the residence times of compounds, such as PCBs, in the Great Lakes. A review of the available information on this topic is presented, as well as the results of studies on recent sediment accumulation, resuspension, and transport of PCBs within the BBL, Data from analyses of water column and sediment trap samples indicate that approximately 14% of the current water column inventory of particle-associated PCB can be accounted for by winter resuspension. Reentrainment of pore water-associated PCB is small, but may be significant if associated with soluble natural organics or colloidal material. The net effect of resuspension is to increase the residence time for contaminants in active ecosystems. (Halterman-PTT)
W86-02023

PCB ACCUMULATION IN SOUTHERN LAKE MICHIGAN SEDIMENTS: EVALUATION FROM CORE ANALYSIS,

Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 5A.
W86-02024

PCBS IN SEDIMENT AND FLUVIAL SUSPENDED SOLIDS IN THE GREAT LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. L. Thomas, and R. Frank.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 245-267, 3 fig, 7 tab, 28 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, Sediments, Water pollution, Suspended solids, Lake Superior, Lake Michigan, Lake Erie, Lake Huron, Lake Ontario, Lake St. Clair.

PCBs are ubiquitous in the Great Lakes water column, sediment and fish. However, the extent of their distribution is thought to be best demonstrated in bottom sediment and sediment introduced by rivers and lake drainage. Levels of PCBs observed within the Lakes reflect point and diffuse sources from industrial regions (high levels) within the basin as well as widely dispersed origins from the atmosphere (low levels). This program entailed sampling a grid pattern of 216 stations in Lake Ontario in 1968; 176 stations in Lake Huron in 1969; 55 stations in Lake St. Clair in 1970 and 1974; 259 stations in Lake Erie in 1971; 214 stations in the Bay of Quinte in 1972-1973; 405 stations in Lake Superior, 115 stations in Georgian Bay and 55 stations in North Channel in 1973; and 279 stations in Lake Michigan in 1975. (Halterman-PTT)
W86-02025

ESTIMATING BIOCONCENTRATION POTENTIAL FROM OCTANOL/WATER PARTITION COEFFICIENTS,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W86-02026

STEADY STATE MODELING OF TOXIC CHEMICALS-THEORY AND APPLICATION TO PCBS IN THE GREAT LAKES AND SAGINAW BAY,

Manhattan Coll., Bronx, NY.
R. V. Thomann, and J. A. Mueller.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 283-309, 11 fig, 4 tab, 14 ref. CR 07853-01.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great Lakes, Saginaw Bay, Model studies, Suspended solids, Water pollution, Toxicity transport, Volatility.

Understanding the fate of a chemical such as PCB in a natural water system one must recognize the dynamic relationship between atmospheres, water column andd sediments. However, there are several advantages to using steady state calculations. The authors developed a simplified steady state model that provides increased understanding of the processes that are operative and permits unambiguous estimations of model parameters. The mechanisms that result from the derivation of the model are presented, with specific reference to PCBs. The application of the model to Saginaw Bay and the Great Lakes as a whole is presented. Predictions of PCB loadings, volatilization, PCB concentrations, fluxes to sediments, and fluxes to downstream are also made. (Halterman-PTT)
W86-02027

MODEL SIMULATION OF PCB DYNAMICS IN LAKE MICHIGAN,

De Paul Univ., Chicago, IL.
For primary bibliographic entry see Field 5A.
W86-02028

DYNAMIC MASS BALANCE OF PCB AND SUSPENDED SOLIDS IN SAGINAW BAY -- A CASE STUDY,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
W. L. Richardson, V. A. Smith, and R. Wethington.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 329-366, 15 fig, 9 tab, 19 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Great lakes, *Saginaw Bay, Aroclors, Lake Huron, Model studies, Suspended solids, Water pollution, Air pollution, Transport, Volatility, Sedimentation, Mass balance.

A serious problem concerning PCBs in the Great Lakes area is how long PCB concentrations in fish will remain above the FDA action limit of 5 mg per kg. Many 'reservoirs', including landfills, roads sealed with PCB-oil mixtures, contaminated sediments and long-range atmospheric transport and deposition, still act as sources of contamination, In order to answer questions posed by regulators concerning the possible future status of PCBs, studies were conducted on data obtained in the Great Lakes region during 1979. Studies resulted in the development of a model for the dynamic mass balance of PCB and suspended solids in Saginaw Bay. The model was used to determine volatilization rates and to estimate the expected longevity of PCBs in the system. The model was constructed with 1979 data on PCB concentrations in the water column (total, dissolved, particulate), suspended solids, mass PCB on solids and distribution coefficients. The best comparison of model simulations to the measured concentrations was made with the distribution coefficients for A 1242, of about 60% of those for A 1260 and with a volatilization rate for Aroclor 1242 of 0.2 m per day. The volatilization rate for a 1260 was determined to be no more than 0.05 m per day. The calibrated volatilization rate for Aroclor 1242 compares well with the theoretical value, but that calibrated for Aroclor 1260 is much smaller than the theoretical value. Total PCB is calculated to decrease by 90% within 10 years. (Halterman-PTT)
W86-02029

MONITORING OF PCBS IN WATER, SEDIMENTS AND BIOTA OF THE GREAT LAKES - SOME RECENT EXAMPLES,

Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5A.
W86-02030

VOLATILIZATION OF PCB FROM SEDIMENT AND WATER: EXPERIMENTAL AND FIELD DATA,

New York State Dept. of Environmental Conservation, Albany.
T. J. Tofflemire, T. T. Shen, and E. H. Buckley.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 411-422, 1 fig, 42 ref.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Volatility, Sediments, Control techniques, Vegetation, Water pollution, Air pollution, Transport, Air-water interface, Waste dumps.

As for a number of toxic chlorocarbons, the volatilization losses of PCB are substantial in spite of very low vapor pressures. Studies were conducted on PCB volatilization, air monitoring, and PCB levels in vegetation. Data indicate that volatilization of PCBs can be an important source of air pollution under certain environmental conditions. PCB concentrations are fairly high in ambient air and in vegetation near PCB dump sites. Air concentrations are 0.002 to 0.11 of the sediment concentrations. Extremely high levels of PCBs (up to 2800 ppm) were found in plants growing on PCB dumps, while levels of 0.1 or 0.2 ppm were observed in plants collected in areas removed from known sources. (Halterman-PTT)
W86-02031

APPLICATION OF A SEDIMENT DYNAMICS MODEL FOR ESTIMATION OF VERTICAL BURIAL RATES OF PCBS IN SOUTHERN LAKE MICHIGAN,

Environmental Research Lab.-Duluth, MN.
D. Weininger, D. E. Armstrong, and D. L. Swackhamer.
IN: Physical Behavior of PCBs in the Great Lakes, Ann Arbor Science, Ann Arbor, MI. 1983. p 423-439, 6 fig, 2 tab, 13 ref. 68-01-0502.

Descriptors: *Path of pollutants, *Toxic wastes, *Polychlorinated biphenyls, *Sedimentation, *Lake Michigan, Sediments, Water pollution, Model studies, Great Lakes, Transport.

The rate of recovery of Lake Michigan from PCB contamination is affected by the release of PCBs from the sediments. Sedimentation acts as a burial process, rendering the PCB-laden surficial sediments as sinks. A sediment dynamics model is presented for use in estimating these vertical burial rates. An expected response of Lake Michigan sediments to burying surficial PCBs is 5 - 10 years. It appears that the surficial sediments over most of the southern basin have reached their maximum PCB concentration and are now decreasing in concentration. (Halterman-PTT)
W86-02032

ECOLOGICAL EFFECTS OF ACID PRECIPITATION,

Sigma Research, Inc., Richland, WA.
For primary bibliographic entry see Field 5C.
W86-02039

HAZARDOUS AND TOXIC WASTES: TECHNOLOGY, MANAGEMENT AND HEALTH EFFECTS,

The Pennsylvania Academy of Science, Easton, PA. 1984. Edited by S. K. Majumdar and E. W. Miller. 442 p.

Descriptors: *Fate of pollutants, *Water pollution sources, *Waste disposal, Water quality control, Landfills, Geology.

Selected papers from this volume concerning water resources include hazardous waste disposal by pozzolanic cementation, geological factors in disposal site selection, the time perspective in waste management, selection of suitable sites for constructing hazardous waste facilities, and the character, fate, and effects of coal tar wastes. (Cassar-PTT)
W86-02041

TIME PERSPECTIVE IN THE SUBSURFACE MANAGEMENT OF WASTE,

Pennsylvania State Univ., University Park.
R. R. Parizek.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 137-169, 8 fig, 8 tab, 24 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Groundwater pollution, Organic compounds, Aquifers, Solute transport, Geohydrology, Geochemistry, Waste disposal, Rivers, Sediments, Lakes, Estuaries, Metals, Water quality.

Groundwater pollution from waste disposal sites may not be apparent in the short term. The time perspective is very important in waste management because many pollutant transport processes are not well understood on the scale of thousands of years. Of urgent concern are hydrologically active areas, land areas which contribute pollutants directly to ground and/or surface waters, even during minor precipitation events. Pollutants may enter drainage basins via the atmosphere, rivers and streams, groundwater, and erosion in lakes and estuaries. Each pathway has its own travel time, attenuation mechanisms, and control measure potential. The effects of toxic substances in lake sediments are exaggerated because of recycling and biomagnification. Wastes are characterized according to persistence and toxicity. Easily biodegradable substances are less likely to survive long-term transport in slowly moving systems, whereas highly persistent compounds and metals may pose hazards for many years. Conditions favoring contamination of groundwater are permeable surficial deposits, great differences in permeability between surface and bedrock layers, low relief terrain, drainage tiles, sinkholes, secondary openings in bedrock, shallow aquifers, and confined aquifers. (Cassar-PTT)
W86-02044

COAL TAR WASTES: THEIR ENVIRONMENTAL FATE AND EFFECTS,

Pennsylvania Power and Light Co., Allentown.
J. F. Villaume.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 362-375, 3 fig, 3 tab, 22 ref.

Descriptors: *Water pollution sources, *Fate of pollutants, Coal gasification, Coal tar, Metals, Cyanide, Organic compounds, Adsorption, Wastewater treatment.

Coal tar, a byproduct of coal gasification, is a complex mixture of free carbon and up to 10,000 organic compounds, principally polynuclear aromatic hydrocarbons. In the past much of this byproduct was disposed of in injection wells or lagoons. Several instances of drinking water well contamination by coal tar have been reported. The chief problems are taste and odor, heavy metals, and cyanide. Free coal tar readily moves through the unsaturated zone only where the water table is deep or where the tar is less dense than water. In the saturated zone coal tar denser than water moves in a separate liquid phase according to the distribution of capillary pressure forces. At Stroudsburg, Pa., 8000 gallons of nearly pure coal tar have been recovered in a depression in relatively impermeable silty sand. Phenolics and naphthalene levels increase more rapidly in groundwater than simple dilution can produce. Available reme-

dial actions include containment with a bentonite slurry wall, pumping of coal tar collected in pools, lime treatment mixture with a proprietary diluent, hydraulic isolation, and emulsification with in situ water flooding. However, these methods are costly and not always immediately and totally effective. (Cassar-PTT)
W86-02046

ESTUARY AS A FILTER,
For primary bibliographic entry see Field 2L.
W86-02070

ESTUARY AS A FILTER: AN INTRODUCTION,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 2L.
W86-02071

TURBULENCE AND MIXING IN ESTUARIES,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W86-02072

TRANSPORT VARIABILITY IN A FJORD,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W86-02074

ESTUARINE INTERACTION OF NUTRIENTS, ORGANICS, AND METALS: A CASE STUDY IN THE DELAWARE ESTUARY,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 2L.
W86-02081

ANTHROPOGENIC NITROGEN LOADING AND ASSIMILATION CAPACITY OF THE HUDSON RIVER ESTUARINE SYSTEM, USA,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 2L.
W86-02083

ENVIRONMENTAL CHARACTERIZATION OF CHESAPEAKE BAY AND A FRAMEWORK FOR ACTION,
Environmental Protection Agency, Annapolis, MD. Chesapeake Bay Program.
For primary bibliographic entry see Field 2L.
W86-02092

LOCATING THE GROUNDWATER POLLUTION SOURCES USING COMPUTER MODELS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
J. D. Hwang, A. Ayubcha, J. S. Chieh, and S. Richardson.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 534-547, 9 fig. 4 tab, 5 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, *Computer models, *Numerical analysis, *Solute transport, Test wells, Organic solvents, Fate of pollutants, Model studies, Monitoring.

Two different computer numerical approaches were used to locate groundwater pollution sources at the Emmaus site, Little Creek Valley, Pennsylvania: nonsequential and sequential optimization. Results for detecting trichloroethylene (TCE) pollution sources in test wells are presented. TCE in this site study is assumed to be a dissolved pollutant dispersed in and convected by the groundwater. The actual point source was later determined to be about 100 ft from the node showing the highest pollutant concentrations. The models were applied to solute transport studies for TCE at the Curtiss Well Pollution Site in Southington, Connecticut. Initial investigations indicated that the groundwater pollution at the well may have started as early as 1955. The results clearly demonstrate that there is an area-source in the northwest side of Quinnipac River and a point source south-southwest to one of the production wells. The computer prediction of area source location agrees quite well with the actual field investigation results. This technique holds the promise of being able to determine where additional wells should be located for on-going pollution monitoring. (Geiger-PTT)
W86-02121

WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS; VOLUME 4, BOOK 1: CHEMISTRY AND WATER TREATMENT,
For primary bibliographic entry see Field 5F.
W86-02135

SUMMARY OF STUDIES ON MODELING PERSISTENCE OF DOMESTIC WASTEWATER CHLORINE IN COLORADO FRONT RANGE RIVERS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
T. J. Heinemann, G. F. Lee, R. A. Jones, and B. W. Newbry.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 97-112, 4 fig, 2 tab, 12 ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Chlorination, *Chloramines, Model studies, Colorado Front Range, Effluents, Kinetics.

A modeling approach has been developed based on several Colorado Front Range streams in the vicinity of chlorinated wastewater treatment plant effluent discharges to estimate the persistence of chloramines in natural water systems. It was found through a series of simple measurements and tests that rate constants can be developed to describe the dissipation rate of chlorine and its dilution so that estimates can be made of the persistence of the chlorine downstream of the wastewater treatment plant discharges. This approach reliably predicts chlorine persistence in most sites evaluated and has been verified to a limited extent in Colorado Front Range streams. (Author)
W8o-02141

NATURAL DECHLORINATION KINETICS OF SECONDARY MUNICIPAL EFFLUENTS,
Beak Consultants Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 5D.
W86-02142

EFFECT OF BROMIDE AND NITRITE ON THE DEGRADATION OF MONOCHLORAMINE,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. L. Valentine, and R. E. Selleck.
IN: Water Chlorination: Environmental Impact and Health Effects: Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 125-137, 7 fig. 2 tab, 14 ref. W-7405-eng-48.

Descriptors: *Fate of pollutants, *Chlorination, *Chloramines, Nitrites, Bromides, Monochloramine, Chemical degradation, Catalysts, Kinetics, Oxidation.

The effect of nitrite on monochloramine disappearance in the presence of bromide was evaluated by measuring total oxidant concentration with time using monochloramine with nitrite, with bromide, and with nitrite and bromide. Nitrite in the presence of bromide greatly accelerated the rate of oxidant decay, which was independent of the initial monochloramine concentration. The nitrite was not significantly consumed in a 1:1 stoichiometric oxidation by monochloramine. If the effect of nitrite is catalytic, it may also accelerate other oxidation-reduction reactions. If not, a complex-oxidation reduction, possibly involving bromide as a catalyst, is indicated. (Cassar-PTT)
W86-02143

CHEMISTRY OF COMBINED RESIDUAL CHLORINATION,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
S. F. Leao, and R. E. Selleck.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 139-149, 6 fig, 10 ref. W-7405-eng-48.

Descriptors: *Fate of pollutants, *Chlorination, *Chloramines, Chlorine residual, Kinetics, Ammonia, Chemical degradation.

The decomposition of monochloramine and dichloramine was observed at pH 6.6. Monochloramine decayed continuously (described as second-order at low concentrations), reaching a rather flat peak at about 120 hours. Dichloramine concentrations increased slightly up to about 10 hours, then continuously decreased. The overall second-order rate decreased with larger ammonia concentrations. The concentration of dichloramine was more or less independent of ammonia concentration. This shows that, in the absence of free chlorine, the concentration of ammonia does not appear to affect the rate of disappearance of the residual other than through the formation of NHC12 by NH2C1 hydrolysis. The reaction between NHC12 and ammonium ion to form NH2C1 is either much slower than reported or has a rate-limiting step not involving ammonia or ammonium ion. (Cassar-PTT)
W86-02144

PRODUCT DISTRIBUTION AND RELATIVE RATES OF REACTION OF AQUEOUS CHLORINE AND CHLORINE DIOXIDE WITH POLYNUCLEAR AROMATIC HYDROCARBONS,
Minnesota Univ.-Duluth. Dept. of Chemistry.
R. J. Liukkonen, S. Lin, A. R. Oyler, M. T. Lukasewycz, and D. A. Cox.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 151-165, 3 tab, 41 ref. EPA R807455.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Aromatic hydrocarbons, Chlorine, Chlorine dioxide, Polynuclear aromatic hydrocarbons, Organic compounds, Oxidation, Kinetics.

Substituting chlorine dioxide for chlorine in water treatment was studied by treating aqueous solutions of polynuclear aromatic hydrocarbons (PAHs) with either compound. Two major considerations were indicated. (1) The reaction rates of chlorine dioxide with PAHs in water were slower than those of chlorine. Chlorine dioxide reactions paralleled the half-wave potential of the PAHs. (2) The products formed by reaction of the PAHs with chlorine and chlorine dioxide were generally similar (phenols, quinones, chloro derivatives) with structural variations dependent on the particular reactive species such as molecular chlorine, hypochlorous acid, hypochlorite, or hlorine dioxide). A table lists about 20 PAHs and their reaction times, and depicts the structures of the reaction products. (Cassar-PTT)
W86-02145

REACTIONS OF CHLORINE AND CHLORINE DIOXIDE WITH FREE FATTY ACIDS, FATTY ACID ESTERS, AND TRIGLYCERIDES,
Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
H. A. Ghanbari, W. B. Wheeler, and J. R. Kirk.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 167-177, 1 fig, 3 tab, 10 ref. PFR 78-27067.

Descriptors: *Fate of pollutants, *Chlorination, *Lipids, *Fatty acids, *Organic compounds, Chlorine, Chlorine dioxide, Triglycerides.

The following lipids were chlorinated with hypochlorous acid and chlorine dioxide: oleic acid, methyl oleate, linoleic acid, methyl linoleate, linolenic acid, methyl linolenate, arachidonic acid, methyl arachidonate, triolein, olive oil triglycerides, and wheat germ triglycerides. Rate constants were determined. The free fatty acids were more reactive toward the chlorinating agents than their corresponding esters. For example, the rate constant for hypochlorous acid reacting with oleic acid was -11.44 per min; foor methyl oleate, -76.13 per min. Reaction with labeled chlorinating agents showed that fatty acids incorporated more chlorine than the corresponding esters. Oleic acid reacted with hypochlorous acid for 60 min incorporated 10.4% of the chlorine; methyl oleate, 1.67%. The major product of oleic acid and hypochlorous acid was identified as 9-chloro, 10-hydroxyl methyl stearate. (Cassar-PTT)
W86-02146

CHLORINATION PRODUCTS FROM AQUATIC HUMIC MATERIAL AT NEUTRAL PH,

North Carolina Univ. at Chapel Hill. School of Public Health.
D. L. Norwood, J. D. Johnson, R. F. Christman, and D. S. Millington.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 191-200, 3 fig, 1 tab, 14 ref. CR 806679.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Humic acids, *Fulvic acids, *Organic matter, Chlorine demand, Organic compounds, Aromatic compounds.

Products of the aqueous chlorination of a natural humic material at pH 7 were identified with a double-focusing, magnetic mass spectrometer capable of fast scan rates. Three common features were noticeable. (1) All compounds were methyl esters with the exception of chloroform and chloral. (2) Most compounds contained chlorine. Examples are methyl mono-, di-, and trichloroacetate, methyl-2,2-dichloropropionate, dimethylmonochlorosuccinate, dimethylmonochloromaleate, dimethyldichloromalonate, dimethyldichlorossucinate, and dimethyldichloramaleate. (3) Most non-chlorine-containing compounds were aromatic. Examples are dimethylphthalate and isomers, benzene tricarboxylic acid trimethyl ester, and benzene tetracarboxylic acid tetramethyl ester. Both fulvic acid and humic acid fractions produced extremely similar products. However, the fulvic chlorination sample contained 60% more organically bound chlorine than the humic sample, even though the reaction time of the humic sample was twice as long. (Cassar-PTT)
W86-02148

FULVIC ACID AND CHLORINATED FULVIC ACID IN WATER AND SEDIMENT: HPLC FRACTIONATION AND SPECTROSCOPIC CHARACTERIZATION,

North Texas State Univ., Denton. Inst. of Applied Sciences.
F. Y. Saleh, and M. Mokti.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 201-217, 8 fig, 3 tab, 14 ref. R-8058-22.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Fulvic acids, *Organic matter, Chlorine demand, Trihalomethanes, Organic compounds, Liquid chromatography, Lakes, Sediments.

Fulvic acid, obtained from water and sediment from three reservoirs in Texas, Oklahoma, and Louisiana, and chlorinated fulvic acid were fractionated and characterized by high performance liquid chromatography using C-108 column, weak anion exchange and reverse-phase. The fulvic acids from different sources had common characteristic components. The pH profile of the carrier solvents and the extent of protonation of the fulvic acid macromolecule controlled the fractionation. The higher the apparent molecular weight of the fulvic acid, the less its potential for trihalomethane formation. (Cassar-PTT)
W86-02149

ORGANIC REACTION PRODUCTS OF CHLORINE DIOXIDE AND NATURAL AQUATIC FULVIC ACIDS,

North Carolina Univ. at Chapel Hill. School of Public Health.
C. A. Colclough, J. D. Johnson, R. F. Christman, and D. S. Millington.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 219-229, 3 fig, 2 tab, 9 ref. R804430.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Fulvic acids, *Chlorine dioxide, Chlorine demand, Organic matter.

The oxidation of aquatic humic materials by chlorine dioxide was conducted at ph 7.8 to simulate natural surface water conditions and at pH 3 to take advantage of the full oxidizing activity of chlorine dioxide. About 70% of the original total organic carbon was recovered after the reaction; about 30% was lost as carbon dioxide or other volatile compounds. Products isolated represented only a small fraction of the initial fulvic material, much of which did not degrade sufficiently for analysis by the techniques used. Products produced at pH 7.8 and at pH 3 did not differ significantly. Of the identified compounds, most were methyl esters of the following classes: benzenepolycarboxylic acid methyl esters, aliphatic dibasic acid dimethyl esters, carboxyphenylglyoxylic acid methyl esters, and aliphatic acid monomethyl esters. Benzene di- and tricarboxylic acid methyl esters and palmitic esters and their isomers were found in abundance in both the undegraded control and the chlorinated product mixture. Also identified were methylated aromatic derivatives of glyoxylic acid, furan and dioxane derivatives, monochloromalonic acid dimethyl ester, monochlorosuccinic acid dimethyl ester, and dichloroacetic acid methyl ester. Results indicate that, at neutral pH, only limited reaction occurs between chlorine dioxide and aquatic fulvic acid. (Cassar-PTT)
W86-02150

INFLUENCE OF AQUATIC HUMIC SUBSTANCE PROPERTIES ON TRIHALOMETHANE POTENTIAL,

Canada Centre for Inland Waters, Burlington (Ontario).
B. G. Oliver, and E. M. Thurman.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 231-241, 3 fig, 2 tab, 26 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Humic acids, Organic matter, Chlorine demand, Color, Trihalomethanes, Chlorinated hydrocarbons, Fulvic acids, Phenols.

There are site variations in trihalomethane (THM) potential for humic materials from diverse climatic and geologic environments. Groundwater humics had the lowest THM potentials, marsh-bog humics had the highest THM potentials, and surface water humics had intermediate THM potentials. Trends of higher THM potential with higher phenolic content and larger molecular size were observed, but the best correlation was between THM potential and color. Color was used to predict the THM potential of various natural waters. (Author)
W86-02151

EMPIRICAL MODEL FOR PREDICTING CHLOROFORM FORMATION FROM HUMIC AND FULVIC ACIDS,

B. A. Engerholm, and G. L. Amy.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 243-252, 3 fig, 2 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Organic matter, Humic acids, Fulvic acids, Chlorine demand, Model studies, Trihalomethanes, Chloroform, Chlorinated hydrocarbons.

A multiparameter equation was developed for predicting chloroform formation from humic substances in water. The basic equation for humic acid encompasses the reaction time, temperature, pH, and the initial total organic carbon and chlorine/total organic carbon ratio. Also presented is a generalized equation, containing precursor-related constants, for predicting the chloroform concentration derived from fulvic acid or other precursors. Application of this equation is limited to situations in which a free chlorine residual is present and requires caution for reaction times of less than 1 hour or greater than 96 hours. (Author)
W86-02152

FORMATION OF TRIHALOMETHANES FROM THE HALOGENATION OF 1,3-DIHYDROXYBENZENES IN DILUTE AQUEOUS SOLUTION: SYNTHESIS OF 2-13 C-RESORCINOL AND ITS REACTION WITH CHLORINE AND BROMINE,

California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
S. D. Boyce, A. C. Barefoot, D. R. Britton, and J. F. Horning.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1; Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 253-267, 6 fig, 2 tab, 20 ref. C3049NAET.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Organic matter, Resorcinol, Dihydroxybenzenes, Aromatic compounds, Trihalomethanes, Chloroform, Bromoform, Chlorine demand, Bromination, Chemical reactions.

Halogenation of labeled resorcinol (1,3-dihydroxybenzene) produced labeled chloroform, labeled bromoform, and other products. This indicates that trihalomethane formation occurs via electrophilic halogenation and subsequent bond clevage at the C2 site of the aromatic ring. Five generalizations were made from this study. (1) In acidic, neutral, or alkaline solution 1,3-dihydroxyaromatic substrates react with chlorine and bromine to produce higher yields of chloroform and bromoform than do the corresponding 1,2- and 1,4-dihydroxy isomers. (2) Maximum yields of trihalomethanes from 1,2-dihydroxyaromatic compounds occur between pH 8 and 10. (3) Bromination of acetone, 2-butanone, and 2-pentanone shows pH dependence of bromoform yields. Chlorination of these compounds does not produce significant chloroform. (4) All bromination reactions produce equivalent yields of bromoform as measured by direct injection analysis. Chlorination reactions produce higher yields for each substrate at low pH. This difference may have been the result of formation of labile chloroform-substituted intermediates in acidic solution which decomposed to chloroform during analysis. (5) Each 1,3-dihydroxyaromatic substrate shows a maximum chloroform or bromoform yield at a reactant ratio (halogen/substrate) of 7, except for 1,3-dihydroxynaphthalene (Maximum at 5:1). (Cassar-PTT)
W86-02153

KINETICS AND MECHANISM OF HALOFORM FORMATION: CHLOROFORM FORMATION FROM TRICHLOROACETONE,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
M. D. Gurol, A. Wowk, S. Myers, and I. H. Suffet.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 269-284, 9 fig, 3 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Chlorine demand, Chloroform, Trichloroacetone, Organic compounds, Chlorinated hydrocarbons, Chemical reactions, Hydrolysis.

The kinetics and mechanism of trichloroacetone (TCA) degradation was studied to determine

whether any chloroform is formed by this pathway. TCA at concentrations of 7 to 40 mg/liter was reacted at 25 degrees C at pH of 6 to 8 in the presence of 0 to 75 mg/liter chlorine. Hydrolysis and chlorination of TCA occurred simultaneously in chlorinated water. The total rate of chloroform formation by these two reaction pathways is too slow to account for the chloroform concentrations observed under typical conditions of water treatment. For example, at pH 7 and with free available chlorine of 10 mg/liter, only 10% of TCA degrades into chloroform during a contact time of 60 min. This corresponds to the formation of about 0.07 micrograms/liter of chloroform if the steady-state concentration of TCA in water is 1 microgram/liter. An additional 3 microgram/liter of chloroform is expected to form in the distribution system after 5 days in the presence of 2 mg/liter free available chlorine. A reaction that causes further halogenation of the chlorinated intermediate with eventual degradation to chloroform occurs simultaneously with hydrolysis of the chlorinated intermediate to chloroform, as opposed to the haloform reaction. The reaction between TCA and chlorine is faster than the hydrolysis reaction for chlorine concentrations above 1.5 mg/liter and at neutral pH. (Cassar-PTT)
W86-02154

QUANTITATIVE EFFECTS OF BROMINE ON THE FORMATION AND DISTRIBUTION OF TRIHALOMETHANES IN GROUNDWATER WITH A HIGH ORGANIC CONTENT,

Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, L. M. Meyer, C. C. Bofill, and E. Cordal.
IN: Water Chlorination: Environmental Impact and Helath Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 285-296, 8 fig, 1 tab, 15 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Chlorine demand, Bromides, Chlorinated hydrocarbons, Trihalomethanes, Organic matter.

The effect of bromide on trihalomethane (THM) formation was studied at four levels of added bromide 0.008, 0.08, 0.8, and 8.0 mg/liter) and four levels of added chlorine (8.35, 16.7, 25.1, and 33.4 mg/liter). Water used in the experiments was lower Florida peninsula groundwater with 6 mg/liter total organic carbon and 50 units of color. The presence of bromide significantly affected the formation and distribution of THMs. The chloroform concentration differed only slightly between the natural groundwater and bromide-augmented groundwater at the lower two bromide levels (at all levels of added chlorine) indicating that a minimum bromide concentration is necessary to influence chloroform formation. However, at the higher bromide concentrations chloroform concentration decreased significantly. The effect of bromide on CHC12Br formation was also minimal at the two lowest bromides levels. At 0.8 mg/liter bromide the CHC12Br level increased; at 8.0 mg/liter bromide, its formation was retarded. Formation of CHC1Br2 and bromoform increased with added bromide, but the relationships were not linear. The total concentration of THMs formed was not influenced greatly by bromide addition. (Cassar-PTT)
W86-02155

FORMATION OF BROMINATED TRIHALOMETHANES: EXTENT AND KINETICS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould, L. E. Fitchhorn, and E. Urheim.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 297-310, 7 fig, 2 tab, 8 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Bromination, Trihalomethanes, 2,46-Trihydroxyacetopheonone, Organic compounds, Chlorine demand, Kinetics, Chemical reactions, Model studies.

A bromine incorporation factor was used to examine trends in the extent and rate of formation of brominated trihalomethanes (THMs). This factor represents bromination as a single quantitative measure, greatly simplifying the interpretation of data on the concentrations of the four THMs (CHC13, CHC12Br, CHC1Br2, and CHBr3). Phloroacetophenone (2,4,6-trihydroxyacetophenone) was selected as the model precursor. The degree of bromine incorporation was dependent on the initial characteristics of the reaction system (pH, bromide concentration, HOC1 concentration, precursor concentration) but largely independent of time. An extension of an empirical model developed by Kavanaugh for chloroform was also used to study the kinetics of individual THM formation. On the basis of this mode, bromination kinetics were substantially faster than chlorination kinetics. These studies show that a conclusive model for THM formation kinetics cannot be developed until the complete mechanism of THM formation has been fully explained. (Cassar-PTT)
W86-02156

BROMOFORM PRODUCTION IN TROPICAL OPEN-OCEAN WATERS: OCEAN THERMAL ENERGY CONVERSION CHLORINATION,

California Univ., Berkeley. Lawrence Berkeley Lab.
E. O. Hartwig, and R. Valentine.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 311-330, 6 fig, 7 tab, 22 ref. W-7405-eng-48.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Bromoform, Trihaomethanes, Chlorine demand, Organic matter, Ocean Thermal Energy Conversion process, Hawaii, Cooling water, Evaportation discharge, Condensers, Seawater.

Formation of bromoform and other volatile organics during chlorination of evaporator and condenser seawater used for the Ocean Thermal Energy Conversion process is reported. Bromoform was the major halogenated organic compound produced as a result of chlorinating seawater at chlorine doses less than 1 mg/liter. Significantly greater quantities of bromoform were produced in evaporator water than in the condenser water as a function of total residual oxidant in both chlorinated and dechlorinated (with sodium thiosulfate) stored samples. No immediate bromoform production was detected in the dechlorinated condenser water, but 1-2 micrograms/liter was immediately produced in dechlorinated evaporator water. The difference in bromoform concentrations of dechlorinated evaporator and condenser water was related to water quality. Mean values for pH and total organic carbon (micrograms/liter) for evaporator water were 8.27 and 1.17; for condenser water, 7.64 and 0.758. Evaporator water temperature was about 25 degrees C; condenser water 5.6 degrees C. Daily potential bromoform production by this plant with a mixed discharge of 34.9 million liters/hour, 0.2 mg total residual oxidant/liter, and 2 hours of chlorination per day equals 1.3 billion micrograms. Considering a 20-fold dilution within 2 hours, the bromoform concentration of the discharge water would be 0.93 micrograms/liter. (Cassar-PTT)
W86-02157

DISPERSION OF CHLORINE AT SEVEN SOUTHERN CALIFORNIA COASTAL GENERATING STATIONS,

Southern California Edison Co., Rosemead.
R. S. Grove.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 333-346, 5 fig, 3 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Powerplants, Southern California Edison Company, Seawater.

The fate of chlorine in powerplant cooling systems and the dispersion of chlorine in receiving waters were monitored at seven coastal generating stations of the Southern California Edison Company. Remarkable variability was observed in chlorine injection concentrations, condenser outlet concentrations, outfall concentrations, and dissipation rates among the generating stations. Less variability was seen within surveys done at the same generating station. No patterns of chlorination could be discerned among the data except for one station with a rigorous chlorine control program. Chlorine levels were below the detectable limit of 0.08 mg/liter at over half of the plant outfalls. The surveys also showed that a much higher level of coordinated chlorine assessment work is necessary to fully characterize factors controlling chlorine release to the environment. These factors, which are site-specific, include (1) seasonal varability in water chlorine demand and slime growth in condenser tubes, (2) chlorine demand of piping and conduits beyond the condensers, (3) influence of macrofouling control heat treatment methods on chlorine demand, and (4) scouring effect of silty water on condenser tubes. (Cassar-PTT)
W86-02158

MODEL FOR PREDICTING CHLORINE CONCENTRATION WITHIN MARINE COOLING CIRCUITS AND ITS DISSIPATION AT OUTFALLS,

Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
M. H. Davis, and J. Coughl
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 347-257, 5 fig, 1 tab, 18 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Chlorine demand, Model studies, Seawwater, Powerplants.

A model for predicting the behavior of chlorine in powerplant cooling systems using seawater differs from previous models in two ways: (1) it supposes an exponential, rather than a hyperbolic decay and (2) it accomodates discrete rate constants for the discharged and receiving waters. Temperatures decrease only slightly in discharge canals, allowing a high decay rate. Dilution is responsible for the most significant decreases in temperature and chlorine concentration. Simulations show that the chlorine loss curve generated by serial dilutions is steeper than the theoretical dilution curve, even when allowance is made for continuing decay. This is partially explained by the additional chlorine demand introduced with the diluting water. Instantaneous chlorine demand is higher at open-coast sites than at estuarine sites. The decay curve of chlorinated samples, from open-coast sites, regenerates a breakpoint curve which is out of phase with the original. The decay of estuarine samples does not regenerate a pronounced breakpoint. (Cassar-PTT)
W86-02159

WATER CHLORINATION PROGRAMS AT ONTARIO HYDRO FOSSIL-FIRED GENERATING STATIONS,

Ontario Hydro, Toronto.
F. Butler, R. Kozopas, G. T. Haymes, and J. S. Griffiths.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 359-372, 6 fig, 3 tab, 4 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Chlorination, *Fish, *Cooling water, Rainbow smelt, Smelt, Fish eggs, Eggs, Larvae, Lambton Generating Station, Lakeview Generating Station, R.L. Hearn Generating Station, Powerplants, Toxicity.

A chlorination regimen for controlling biofouling has been developed for Ontario Hydro's Lambton Thermal Generating Station. Normal maintenance chlorine dose is 0.19 kg/min for 20 min, twice a week. To combat excessive biofouling, shock chlorination in stages up to 900 kg/day for 30 min is used. During chlorination, adult fish (white bass and suckers) show an avoidance response at chlo-

rine concentrations below reported lethal concentrations. This response involves increased activity toward areas of reduced chlorine concentraion. Chlorine plume studies at three coal-fired stations outline the limited use zones for each area. In all cases no chlorine is detected at a depth greater than 3 m outside the influence of the jet stream from the outfall channel. During the chlorine studies a three-electrode continuous, on-line, automatic chlorine analyzer was developed. In a study of the effects of shock chlorination on fish eggs and fry, chlorine concentrations below 0.1 mg/liter (the maximum expected in discharges) have little effect on rainbow smelt eggs or larvae. Survival rates dropped raipdly as the temperature rises to 20 degrees C. (Cassar-PTT)
W86-02160

HALOGENATED ORGANIC STUDY AT SELECTED TENNESSEE VALLEY AUTHORITY FOSSIL-FUELED POWER PLANTS,

Tennessee Valley Authority, Chattanooga.
C. V. Seaman, L. O. Hill, B. W. Vignon, T. B. Stanford, and M. D. Hunter.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 373-382, 4 fig, 3 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, Organic compounds, *Cooling water, Trihalomethanes, Chloroform, Organic compounds, Tennessee Valley Authority, Powerplants.

Water samples were collected for organic analysis at the intake, outlet, and several points throughout the cooling systems of three Tennessee Valley Authority fossil-fueled steam plants. Chloroform was detected at each plant more than 90% of the time. Highest concentration detected was 18.0 mg/liter. Other volatile halogenated organics detected were bromodichloromethane, dibromochloromethane, 1,2-dichloroethane, trans-1,2-dichloroethylen, methylene chloride, and 1,1,1-trichloroethane. Semivolatile halogenated organics detected were 1-chloronaphthalene, 2-chlorophenol, and 1,2-dichlorobenzene. Comparison of inlet and outlet samples showed that outlet chloroform concentrations had a positive linear relationship with chlorine dose and a negative relationship with nitrogen species. The substrate was correlated significantly with chloroform concentration only when the effects of chlorine dosage were removed. Temperature was not apparently correlated with chloroform levels. However, combining the data across plants for the outlet location and removing the effects of other precursors showed a significant relationship. This suggested that temperature influences on chloroform concentrations were masked by effects of other variables. Likewise, the effects of chlorine demand and cooling water flow rate on chloroform production are masked. (Cassar-PTT)
W86-02161

ORGANOHALOGENS IN CHLORINATED COOLING WATERS DISCHARGED FROM NUCLEAR POWER STATIONS,

Battelle Pacific Northwest Labs., Richland, WA.
R. M. Bean, D. C. Mann, and D. A. Neitzel.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 383-390, 4 tab, 8 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Powerplants, Trihalomethanes, Phenols, Organic componds, Chlorinated hydrocarbons, Aromatic compounds, Nuclear powerplants.

Formation of organhalogens, particularly phenolic compounds, during biocide treatment of cooling water was studied at three nuclear powerplants. Chloroform concentrations in the discharges were 0.5 to 1.1 micrgrograms/liter; CHBrC12, 0.7-1.0 micrograms/liter; CHBr2C1, 0.3-0.9 micrograms/liter; and bromoform, 0.1-3.7 micrograms/liter. Concentrations of major phenolic compounds (in micrograms/liter) in chlorinated cooling waters were 2,4,6-trichlorophenol, 0.7; bromodichlorophenol, 0.5; dibromochlorophenol, 0.3; 2,4,6-tribromophenol, 0.4; and dibromodichlorophenol, 0.1. The highest total level of halogenated phenolic compounds at any station was 1.4 micrograms / liter. Conditions favoring the concentrations, longer chlorine residence time, higher bromine concentrations in intake water, low volatility, and presence of the biocide, which prevents biodegradation. In contrast, trihalomethanes tend to be released to the atmosphere in cooling towers. In once-through systems trihalomethanes were predominant.
W86-02162

ATMOSPHERIC EMISSIONS FROM ELECTRIC POWER PLANT COOLING SYSTEMS,

SRI International, Menlo Park, CA.
J. H. Smith, J. C. Harper, and B. C. DaRos.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 391-404, 8 fig, 3 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Cooling water, Organic compounds, Trihalomethanes, Powerplants, Air pollution, Chlorinated hydrocarbons.

Concentrations of volatile halogentated compounds were determined in recirculation water systems and in the tower drift of three powerplants. Maximum concentrations (micrograms/liter) observed in up to 8 separate tests during chlorination of recirculation water were as follows: chloroform, 14.5; bromodichloromethane, 3.1; chlorodibromomethane, 3.3; bromoform, 2.9; trichloroethylene, 1.1; tetrachloroethylene, 0.1; and chloramines, 1.6. In general, chloroform concentrations in the tower basin were 20-30% lower than concentrations in the tower riser, suggesting that the towers strip some of the volatiles during one pass through the tower. Concentrations of volatiles (micrograms/liter) in the tower drift, using several different methods, were chloroform, 0.0002-0.81; trichloroethylene, trace to 0.48; tetrachloroethylene, trace to 1.73; p-dichlorobenzene, 0.07-0.27; and p-chlorotoluene, 0.42-1.45. The sampling techniques for the drift were not considered efficient. (Cassar-PTT)
W86-02163

HYDROGEN PEROXIDE - A REAL ALTERNATIVE TO CHLORINE IN WATER TREATMENT,

North Surrey Water Co., Staines (England).
E. R. Gardiner, N. J. Hobbs, and J. Jeffery.
IN: Water Chlorination: Environmental Impact and Health Effect; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 405-419, 8 fig, 5 tab, 16 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Disinfection, *Hydrogen peroxide, Oxidation, Thames River, Trihalomethanes, Organic compounds, Chlorinated hydrocarbons.

Hydrogen peroxide and a low prechlorine dose reduce the trihalomethane (THM) formation at the prechlorination stage, but high postchlorination still yields high THM values. Hydrogen peroxide cannot be a complete replacement for prechlorination because it would not always achieve complete disinfection and would be difficult to monitor. Hydrogen peroxide with a low prechlorine dose achieves lower plate counts at 22 and 37 degrees C than chlorine alone. In the absence of free chlorine there is a lower value for THM formation in the presence of hydrogen peroxide. The coagulation treatment achieves an appreciable reduction in the potential THM formation. This work was carried out on actual river water samples that were variable. (Author)
W86-02164

BROAD-SPECTRUM ANALYSIS OF THE REMOVAL OF TRACE ORGANICS IN AN OZONE-GRANULAR ACTIVATED CARBON POTABLE-WATER PILOT PLANT STUDY,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
G. T. Coyle, S. W. Maloney, J. Gibs, and I. H. Suffet.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1981. p 421-443, 11 fig, 3 tab, 19 ref. CR806256-02.

Descriptors: *Fate of pollutants, *Pollutant identification, *Activated carbon, *Ozonation, Disinfection, Pilot plants, Adsorption, Water treatment, Temperature effects, Gas chromatography, Organic compounds.

Capillary gas chromatograms of 200-300 peaks were compared using chi-square contingency tables in a study of effluents from a granular activated carbon water treatment pilot plant. Before contacting the carbon, the water (from the Delaware River at Philadelphia, Pa.) was treated by clarification, rapid sand filtration, ozonation, and ozone dissipation. The anlaytical methods were devised to determine the significant differences at p= 0.05 of chromatograms of (1) influent vs. effluent composite samples, (2) influent vs. effluents of the activated carbon columns, (3) location of trace organics on columns, and (4) effects of differences in water temperature on trace organics removal. The following conclusions were drawn. Replicate carbon contactors had reproducible effluent gas chromatogram profiles. Influents to the columns were variable in weeks 3-5, after which they were homogeneous (weeks 6-13). Effluents for weeks 3-11.5 were homogeneous. Effluents were different at the different temperatures. At week 9 core samples from the carbon columns showed differences between warm and cooled water. Chlorinated organics were observed in the influent to the carbon columns and on the surface of the carbon. No chlorinated organics were found in the effluents during the 18-week study. (Cassar-PTT)
W86-02165

INFLUENCE OF PRECHLORINATION ON THE AMOUNT AND TOXICITY OF MICROPOLLUTANTS EXTRACTED FROM WATER AT THE MORSANG PLANT,

Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
F. Fiessinger, R. Cabridenc, I. Chouroulinkov, B. Festy, and P. Lazar.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 467-481, 4 fig, 5 tab, 6 ref.

Descriptors: *Fate of pollutants, *Water treatment, *Chlorination, *Activated carbon, *Organic compounds, Adsorption, Morsang, France, Toxicity, Clarification.

Studies of the Morsang, France, water treatment plant from 1977 to 1980 concerned organic pollutants and the roles of prechlorination and granular activated carbon adsorption. The following conclusions were reached. (1) Prechlorination increased the intrinsic toxicity and hindered reduction of the amount of extracted pollutants in the finished water. Overall activity of the extracts (intrinsic toxicity times relative amount) was reduced by 50% with prechlorination and 85% without prechlorination. (2) Activated carbon applied at low doses did not influence short-term toxicity but seemed to reduce long-term toxicity. In all cases it enhanced the reduction of the weight of extract in the finished water. (3) Clarification (coagulation + flocculation + sedimentation + sand filtration) reduced the extract weight but increased its intrinsic toxicity. Clarification preferentially removed the less harmful substances. (Cassar-PTT)
W86-02168

FORMATION OF ORGANOHALOGEN COMPOUNDS IN CHLORINATED SECONDARY WASTEWATER EFFLUENT,

Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, J. T. Villate, E. M. Ott, R. A. Slifker, and F. Z. Parsons.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry

and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 483-497, 3 fig, 9 tab, 6 ref. 80-034.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Chlorination, Trihalomethanes, Chlorinated hydrocarbons, Brominated hydrocarbons, Organic compounds, Goulds-Perrine Treatment Plant, Virginia Key Treatment Plant, Florida.

The effects of chlorinating wastewater effluents was studied at several Miami, Florida, secondary treatment plants. Chloroform and brominated trihalomethanes were formed before and after the chlorination breakpoint. The concentration of individual trihalomethanes tended to follow the breakpoint curve; lower concentrations were found near the breakpoint. Bromides were present in wastewater from the Virginia Key plant, a result of sea water intrusion into the collection system. A clear trend in the rate of trihalomethane formation with respect to chlorine added was not obtained. (Cassar-PTT)
W86-02169

NONVOLATILE ORGANICS IN DISINFECTED WASTEWATER EFFLUENTS: CHEMICAL CHARACTERIZATION,

Oak Ridge National Lab., TN.
R. L. Jolley, R. B. Cumming, N. E. Lee, L. R. Lewis, and J. E. Thompson.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 499-523, 4 fig, 2 tab, 25 ref. EPA-IAG-D7-01027.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Disinfection, *Organic compounds, Chlorination, Ozonation, Ultraviolet radiation, Toxicity, Mutagens, Chromatography, Oxidation.

Disinfection of secondary and tertiary effluents by chlorination destroyed some nonvolatile organic constituents and produced others in the majority of samples examined. Mutagenicity of certain fractions was similarly affected. Ozonation both destroyed and produced some nonvolatile organic compounds, including those showing mutagenic activity. Ultraviolet radiation had a definite but slight effect on nonvolatile organic constituents; it decreased mutagenicity in some effluents and increased it in others. Chemical composition and mutagenicity varied with plant and the date sampled. A total of 106 nonvolatile compounds were identified in the concentrates of control and disinfected effluents. The mutagenic fraction contained 70 constituents; the nonmutagenic fraction, 65. Twenty-nine constituents were found in both mutagenic and nonmutagenic fractions. No known mutagens were identified in the mutagenic fractions from undisinfected, chlorinated, ozonated, and ultraviolet-irradiated effluents. Phosphate identified in the chromatographic fractions was attributed to degradation during trimethylsilylation or anion exchange preparation. (Cassar-PTT)
W86-02170

FORMATION OF VOLATILE HALOORGANIC COMPOUNDS IN THE CHLORINATION OF MUNICIPAL LANDFILL LEACHATES,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould, R. E. Ramsey, M. Giabbai, and F. G. Pohland.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 525-539, 5 fig, 5 tab, 31 ref. A-088-GA.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Chlorination, *Leachates, *Landfills, Organic compounds, Trihalomethanes.

Leachate, obtained from a simulated landfill lysimeter, was chlorinated at doses up to 600 mg/liter chlorine. The landfill consisted of codisposed metal plating sludge and municipal solid waste. The leachate on day 697 after landfilling had a COD of 4291 mg/liter and BOD of 2150 mg/liter. The chlorine demand curve showed a sharp rise in chlorine residual at about 500 mg/liter chlorine dose. A leachate with initial COD of 4875 mg/liter showed increasing COD removal up to about 28% at the maximum chlorine dose of 600 mg/liter. Organisms were not fully removed (8000/ml remaining) even at the 400 mg/liter chlorine dose. Chlorination of the leachate produced a complex mixture of volatile haloorganic compounds, only one of which (methylene chloride) was found in the unchlorinated leachate. Among the products were 1-chloro-4-methylbenzene; chlorobenzene; 2-chloroethylbenzene; benzonitrile; trihalomethanes; halogenated ethanes, propanes, butanes, and heptanes; ketones; halogenated aromatics; and a number of unknown compounds. Until further data are collected, hypochlorous acid should be used cautiously as a disinfectant for landfill leachates. (Cassar-PTT)
W86-02171

NEW APPROACHES TO THE PRODUCTION OF 36 CL-LABELED CHLORINATING AGENTS AND THE MEASUREMENT OF 36CL INCORPORATED INTO BIOLOGICAL MATERIALS,

Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
For primary bibliographic entry see Field 5A.
W86-02172

HAZARDOUS WASTE MANAGEMENT FOR THE 80'S.

For primary bibliographic entry see Field 5E.
W86-02219

ENVIRONMENTAL 'TERMITE' INSPECTIONS,

For primary bibliographic entry see Field 5A.
W86-02223

GROUND-WATER MONITORING AT AN INDUSTRIAL WASTE DISPOSAL SITE IN PENNSYLVANIA,

N. L. Circhowicz, R. M. Cadwgan, and J. R. Ryan.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 389-402, 8 fig.

Descriptors: *Waste disposal, *Groundwater pollution, *Geohydrology, Groundwater, Groundwater movement, Industrial wastes, Benzenes, Environment, On-site investigations, Water analysis.

A two-phase hydrogeologic investigation was carried out at a former industrial waste disposal site in Pennsylvania. Coal-coking sludge, agricultural chemical residue, and desulfurization waste are among the wastes disposed of in trenches at the 35 acre site, located on the tip of a river island. The purpose of Phase I of the study was to determine a preliminary estimate for the discharge rate of organic contaminants to the river via ground water. This was achieved by using data on the flow and quality of groundwater collected at 46 locations beneath, and adjacent to, the site. Benzene was found to be the dominant compound, showing a discharge rate of about 2 lb/day into the river from groundwater. Phase II was designed to better define the hydraulic gradient by continuously monitoring ground and river water levels. The hydraulic gradient of the water table was found to be typically toward the river, and over a two-month period, during low-flow conditions, averaged 0.0015. The direction of groundwater flow was toward the site for approximately six days during the same two-month period at a maximum gradient of 0.0058. (Halterman-PTT)
W86-02231

CASE HISTORIES OF GROUNDWATER ASSESSMENT,

Burgess and Niple Ltd., Columbus, OH.
J. A. Barker-Stonerock.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, I, 1982. p 403-420, 2 fig, 6 tab.

Descriptors: *Groundwater pollution, *Waste disposal, *Industrial wastes, *Landfills, Environment, On-site investigations, Groundwater movement, Water quality, Water sampling, Water analysis.

Case histories of groundwater assessment performed for a variety of purposes (assessment for landfill development, for abandoned landfill, and for surface impoundments) are presented. Groundwater assessments typically include the following: a review of existing water quality data to determine local groundwater quality; performance of test borings and laboratory testing on earth materials obtained during drilling; installation of monitoring wells at those locations where geologic and groundwater conditions indicate the best information may be obtained; estimation of rate of groundwater movement based on transmissivities; collection of water samples from completed monitor wells and analysis in laboratory for specified parameters; and preparation of final report to determine whether additional testing is required. The case histories presented illustrate the need for tailoring the study techniques to meet the individual requirements of each disposal site. (Halterman-PTT)
W86-02232

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT,

For primary bibliographic entry see Field 5A.
W86-02233

2,3,7,8-TETRACHLORODIBENZO-P-DOXIN AND 2,3,7,8-TETRACHLORODIBENZOFURAN RESIDUES IN GREAT LAKES COMMERCIAL AND SPORT FISH,

Health and Welfare Canada, Ottawa (Ontario).
J. J. Ryan, P-Y. Lau, J. C. Pilon, and D. Lewis.
IN: Chlorinated Dioxins and Dibenzofurans in the Total Environment, Butterworth Publishers, Boston, 1983. p 87-97, 1 fig, 4 tab, 10 ref.

Descriptors: *Chlorinated hydrocarbons, *Hydrocarbons, *Chlorinated dioxins, *Chlorinated dibenzofurans, Chemical Analysis, Gas chromatography, Chromatography, Mass spectrometry, Public health, Ecosystems, Ecology, *Great Lakes, *Fish.

Residues of 2,3,7,8-tetrachlorodibenzo-p-dioxin (tetra-CDD)and 2,3,7,8-tetrachlorodibenzofuran (tetra-CDF) were studied in commercial fish and sportfish in the Great Lakes, primarily Lake Ontario, during 1979 and 1980. For the samples with positive results, tetra-CDD ranged from 2.0 to 38.5 ppt, with catfish, eel and smelt having the highest levels. The levels of tera-CDF ranged from 3.2 to 200 ppt, with smelt, salmon and rainbow trout having the highest concentrations. Overall, 25% of the 62 fish sampled had concentrations of these compounds greater than 10 ppt. The highest concentrations were associated with high polychlorinated biphenyls and lipid content of the fish. (Halterman-PTT)
W86-02234

OCCURRENCE OF TETRACHLORODIBENZO-P-DIOXIN IN ENVIRONMENTAL SAMPLES FROM SOUTHWEST MISSOURI,

Environmental Protection Agency, Kansas City, MO. Region VII.
For primary bibliographic entry see Field 5A.
W86-02236

CHLORINATED DIOXINS AND DIBENZOFURANS IN THE TOTAL ENVIRONMENT II.

For primary bibliographic entry see Field 5A.
W86-02240

HISTORICAL RECORD OF POLYCHLORINATED DIOXINS AND FURANS IN LAKE HURON SEDIMENTS,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 5A.
W86-02241

ANALYSIS OF PCDD-PCDF IN ENVIRONMENTAL SAMPLES,
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5A.
W86-02242

OCTANOL-WATER PARTITION COEFFICIENT OF 1,3,6,8-TCDD AND OCDD BY REVERSE PHASE HPLC,
Manitoba Univ., Winnipeg. Dept. of Soil Science.
For primary bibliographic entry see Field 5A.
W86-02243

BIOAVAILABILITY OF 14C-1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN AND 14C-OCTACHLORODIBENZO-P-DIOXIN TO AQUATIC INSECTS IN SEDIMENT AND WATER,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, B. E. Townsend, and G. R. B. Webster.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 89-102, 3 fig, 4 tab, 28 ref.

Descriptors: *Chlorinated hydrocarbons, *Aquactic insects, *Hydrocarbons, *Biological magnification, Polychlorinated dibenzo-p-dioxins, Ecosystems, Aquatic environment, Insects, 1,3,6,8-tetrachlorodibenzo-p-dioxins, Ocatachlorodibenzo-p-dioxin.

The uptake, elimination and bioconcentration of 1,3,6,8-tetrachlorodibenzo-p-dioxin (1,3,6,8-TCDD) and octachlorodibenzo-p-dioxin (OCDD) by five species of aquatic insect were compared in the laboratory in two types of sediment. The purpose was to assess how bioavailability of polychlorinated dioxins (PCDD) in aquatic systems could be influenced by the physical properties of the chemicals, the characteristics of the physical environment, and the characteristics of the animals. Total radioactivity in each animal, and water concentrations of radioactive 1,3,6,8-TCDD abd OCDD were determined using liquid scintillation counting, and bioconcentration factors for each chemical and aquatic insect were calculated from 96 hr. exposure data. Bioconcentration of 1,3,6,8-TCDD and OCDD by aquatic insects was much less than predicted, possibly due to overestimation of the concentration present in water in a bioavailable form. OCDD was poorly accumulated by all animals studied (possibly due to strong sorption to sediment and to poor absorption due to steric factors). The differences in the bioconcentration factors among the various insects studied are discussed in relation to differences in feeding habits and metabolism. The results confirm that PCDD other than 2,3,7,8-TCDD can be mobilized by sediment-dwelling animals. (Halterman-PTT)
W86-02244

PART PER TRILLION RESIDUES OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN MICHIGAN FISH,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
S. W. Kaczmar, M. J. Zabik, and F. M. D'Itri.
IN: Chlorinated Dioxins & Dibenzofurans in the Total Environment II, Butterworth Publishers, Boston, 1985. p 103-124, 7 fig, 2 tab, 11 ref.

Descriptors: *Chlorinated hydrocarbons, *Fish, *Carp, *Sucker, *Hydrocarbons, Polychlorinated dibenzo-p-dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin, Ecosystems, Aquatic environment, Michigan.

A study was carried out to determine whether 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) residues exist in selected Michigan fish samples in areas other than the previously-sampled Tittabawassee River watershed. Samples of carp (Cyprinus carpio) and sucker (Carostomus commersoni) were collected by electroshock at 31 sampling sites in the lower peninsula of Michigan. Samples were extracted, purified, then analyzed for 2,3,7,8-TCDD by gas chromatography-mass spectrometry (with a detection limit of 20 picograms). Detectable residues of 2,3,7,8-TCDD ranged from 17 to 586 ng/kg. Residues of 2,3,7,8-TCDD were detected in fish collected upstream to the chlrophenol manufacturing facility in Midland, and from other portions of the state in entirely different watersheds. The results suggest that low-level contamination of bottom-feeding fishes is relatively widespread in the industrialized portions of the state. (Halterman-PTT)
W86-02245

PCB'S: HUMAN AND ENVIRONMENTAL HAZARDS,
Butterworth Publishers, Boston. 1983. Edited by Frank M. D'Itri and Michael A. Kamrin. 443 p.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

Polychlorinated biphenyls (PCBs) have been used for industrial purposes for over 50 years. Research on the ecology and human health impact of these compounds has, however, been conducted only since 1966. This volume presents varied viewpoints on the hazard of these compounds, the latest research findings, and an overview of the steps that are being taken to solve PCB-related problems in the environment, with an emphasis on the Great Lakes region. The volume stresses five major aspects fo PCBs: (1) background, scientific, social and political information that is important to understand the PCB contamination problem; (2) the current state of the art with respect to chemical analysis and monitoring; (3) information on the metabolism, biotransformation, toxicology and persistence of PCBs; (4) effects of PCBs on human health; and (5) the roles of Federal and state agencies in the regulation of PCBs. (Halterman-PTT)
W86-02248

PCB PROBLEM: AN OVERVIEW,
Michigan State Univ., East Lansing.
J. E. Cantlon.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 5-10.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

The global contamination of the environment with organics began with the burgeoning of industrial chemistry between World Wars I and II and picked up substantially both in diversity of hazardous materials and in the tonages that were released into the earth's hydrosphere, atmosphere, lithosphere, and biosphere after World War II. The halogentated hydrocarbons were manufactured for various kinds of industrial uses, including pesticides, inks, cutting oils, and heat exchange fluids. Among these hydrocarbons are the polychlorinated biphenyls (PCBs), which now appear in the tissues of most living organisms as well as in air, water, soils, and sediments over most of the earth. The Great Lakes have been a particularly interesting contamination area, with substantial food-chain concentrations of these highly fat-soluble compounds. While the manufacture of PCBs is now prohibited in the United States, the size of the environmental burden in waters, sediments, soils, disposal sites, and in deployed transformers and other containers of PCBs is very large, estimated to be 82 million kg. Several observations on these processes are offered. First, research results that bear on urgent decisions rarely have the luxury of science's normal process. Second, decision-makers are often subject to strong public pressures, predominantly from one side or the other, in arriving at their decisions. Third, on occasion, one organization holds both developmental and regulatory responsibilities. (Halterman-PTT)
W86-02249

OVERVIEW OF THE SCIENTIFIC BASIS FOR CONCERN WITH POLYCHLORINATED BIPHENYLS IN THE GREAT LAKES,
Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
W. R. Swain.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 11-48, 6 fig, 8 tab, 56 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

The ubiquitous distribution of residue-forming xenobiotic substances, particularly organochlorine compounds, including polychlorinated biphenyls (PCBs) is rapidly becoming apparent. Widespread dissemination is suggested by a variety of studies of areas presumably remote from the direct industrial and/or cultural influences attributable to man, including melting snow in the Antarctic, mammals of the Artic, in the surface waters and atmosphere above the Sargasso Sea, and inthe sediments of Siberian Lake Baikal. Although a number of these compounds have been banned, or their use has been severely restricted, they are still routinely reported in the Great Lakes basin. The identical characteristics of PCBs which made them industrially desirable, also makes them persist and accumulate in the environment. They are resistant to acid-base reactions, hydrolysis, chemical oxidation, photodegradation, thermal changes, and most chemical agents. Furthermore, they bond tightly to particulate matter such as soils and sediments; they have 8-15 year half-lives; they are extremely soluble in oils and fats, thus they tend to partition into biologic tissue. Several reasons for the particular susceptibility of the Great Lakes to PCBs are listed, and an extensive literature review of data on PCBs observed in fish of the Great Lakes is provided. Various aspects of human health hazards pertaining to PCBs are discussed, including the possiblity of PCBs persisting in the human population for as long as 5 to 8 generations into the future. (Halterman-PTT)
W86-02250

PCBS IN THE GREAT LAKES: SOURCES, SINKS, BURDENS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
S. J. Eisenreich, and T. C. Johnson.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 49-75, 4 fig, 10 tab, 55 ref. R805172-01 R806084-01.

Descriptors: *Polychlorinated biphenyls, *Great Lakes, *Distribution patterns, *Ecological distribution, Distribution reservoirs, Chemical analysis, Water analysis, Monitoring, Sediment-water interfaces, Interfaces, Mud-water interfaces, Air-water interfaces.

Information on the polychlorinated biphenyl (PCB) sources, sinks, and burdens in the Great Lakes is summarized. A mass balance model is described which provides an understanding of the transport and distribution of PCBs in the lakes and an estimate of the residence time that they remain in the ecosystem, or in any compartment. The compartments include the atmosphere, hydroshpere, sediments, and lithosphere. The atmosphere does not represent a significant reservoir of PCBs in the Great Lakes, but appears to be a major pathway of input into the hydrosphere. Sediments, however, are the ultimate sink for PCBs in the Great Lakes. The lower lakes, especially Erie and Ontario, have the highest concentrations, ranging from 50-60 ng/g. The Upper Great Lakes exhibit ranges of concentrations from 3 to 10 ng/g. The upper 0.5 cm of sediment appears to have the highest concentrations within the lakes. The PCB burden for all the Great Lakes combined was estimated to be 417,000 kg in sediments, 25,000 to 87,000 kg in water, and 200 kg in the atmosphere. The principal sources of PCBs to the Great Lakes are atmospheric deposition, tributary input, and municipal/industrial discharges. Considerable uncertainty still exists in estimating fluxes at air/water and sediment/water interfaces. (Halterman-PTT)
W86-02251

ENVIRONMENTALIST'S VIEW OF THE PCBS IN THE GREAT LAKES,

Michigan United Conservation Clubs, Lansing.
T. L. Washington.
IN: PCB's: Human and Environmental Hazards, Butterworth Publisers, Boston, 1983. p 101-108, 9 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

The non-scientific perspective of the concerns of laymen for the problems of polychlorinated biphenyls (PCBs) in the Great Lakes is presented. PCBs in the Great Lakes are particularly important for Michigan anglers. Although the salmon fishery, for example, is expanding, and is important to the tourist industry and to local anglers who consume large quantities of fish annually, there is little information of PCB levels in fish made available to the public. The public health hazards regarding contaminated fish are reviewed. The need for a vastly improved information base on PCBs and other contaminants in the Great Lakes environment, and an improved delivery system, to get that information to the general public, is called for. (Halterman-PTT)
W86-02252

EDIBLE TISSUE SAMPLING FOR FISH CONTAMINANT ANALYSIS,

Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
W. E. McCracken.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 123-139, 1 fig, 2 tab, 22 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish, Michigan.

Considerable controversy exists over which method of preparation is best when fish are to be analyzed for contaminants such as polychlorinated biphenyls (PCBs). The state of Michigan's reasoning on this issue is discussed, along with Michigan's current fish contaminant monitoring program. The objectives of the program are to provide information for assessing potential human exposure to contaminants from consumption of fish; to determine chronological trends in fish contaminants; to identify new residues in fish: to communicate the results of these findings to appropriate government agencies; and to inform the public of public health advisories. The inconsistencies within federal and state testing programs are discussed, and the manner in which Michigan proposes to resolve the question are outlined. The proposed plan includes the determination of a standard edible portion which is specific for each species; and, the analysis of that portion of raw fish which would most likely be eaten after cooking. The various categories for testing include skin-on fillet for such fish as perch, walleye, basses, crappie and sunfishes; skin-off fillet for catfish, pike, whitefish, and trout; and headless, gutted common-sense approach to fish contaminant sampling when the objective is to determine amounts of consumable contaminants present in fish. (Halterman-PTT)
W86-02253

BIOTRANSFORMATION AND PERSISTENCE OF POLYCHLORINATED BIPHENYLS (PCBS) IN FISH,

Medical Coll. of Wisconsin, Inc., Milwaukee. Dept. of Pharmacology and Toxicology.
J. J. Lech, and R. E. Peterson.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 187-201, 9 fig, 14 ref. ES-01080 (JJL).

Descriptors: *Polychlorinated biphenyls, *Public health, *Chemical analysis, Great Lakes, Water analysis, Monitoring, Toxicity, Fish.

Available data indicate that most fish species biotransform the lower chlorinated polychlorinated biphenyl (PCB) congeners at slower rates than mammals. Generally, the overall residue patterns in fish resemble the patterns found in the exposure source. Furthermore, the degree of bioaccumulation of PCBs in fish may be directly related to the fat content of the species in question, and that the major mechanism for reducing PCB concentrations in fish is by dilution by growth, rather than by true elimination of a portion of the total body burden. (Halterman-PTT)
W86-02255

SALINITY IN WATERCOURSES AND RESERVOIRS,

Proceedings of the 1983 International Symposium on State-of-the-Art Control of Salinity. July 13-15, 1983, Salt Lake City, Utah. Butterworth Publishers, Boston. 1984. 622 p. Edited by Richard H. French.

Descriptors: *Salinity, *Saline water, *Groundwater, *Water quality, Irrigation, Water pollution, Dissolved solids, Percolation, Environmental effects, Agriculture, Economic aspects, Legal aspects.

A series of papers pertaining to salinity in watercourses and reservoirs is presented. Specific topics include salinity control policy and planning, salinity sources and problems, salinity data base analysis, modeling applied to salinity problems, salinity control programs in agriculture, non-agricultural salinity control programs, alternative uses of saline water, geochemical and geophysical methods of salinity detection, salinity control project mitigation, and secondary salinization. (Halterman-PTT)
W86-02264

COLORADO RIVER SALINITY - THE USER'S PERSPECTIVE,

Colorado River Board of California, Los Angeles.
M. B. Holburt.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 13-22.

Descriptors: *Colorado River, *Saline water, *Salinity, Irrigation, Flood irrigation, Irrigation practices, Water requirements, Irrigation requirements, Water softening, Water supply, Water use, Water users.

The concern over the Colorado River's comparatively high salt concentration is discussed. Of particular interest is the major economic detriments to both agricultural and urban water users in the lower Basin states (Arizona, California, Nevada) and northwestern Mexico. Steps to control the salinity, begun in 1929 and continuing to the present, are outlined. Measures to reduce the impact of salinity on urban and agricultural areas are discussed. Methods include the use of water softeners by domestic and commercial users, use of corrosion-resistant plumbing, installation of drain pipes in farm fields to carry away the salt, and the lining of laterals with concrete to decrease seepage. (Halterman-PTT)
W86-02265

PROBLEM OF SALINITY AND ITS CONTROL, RIVER MURRAY, AUSTRALIA,

River Murray Commission, Canberra (Australia).
T. A. O'Brien.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 33-42, 4 fig, 1 tab.

Descriptors: *Saline water, *Salinity, Water requirements, Water supply, Water use, Water users, River Murray, *Australia, Monitoring, Water quality management.

The problems of salinity in south-eastern Australia, with emphasis on the River Murray, are described. There are three types of problems discussed: the salinity of water diverted from the river and applied to crops; the salinisation of irrigated land caused by the development of high water tables; and, the salinisation of dry land. The problems which could be common to rivers which form the border between states, or countries, are highlighted. The continued viability of the River Murray, and its importance to Australia, and the priority of government funding are discussed. (Halterman-PTT)
W86-02267

SALINITY SOURCES AND PROBLEMS OF THE DANUBE RIVER BASIN,

North Dakota State Univ., Fargo. Dept. of Soil Science.
A. Maianu.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 105-114, 2 fig, 4 tab, 12 ref.

Descriptors: *Saline water, *Salinity, Irrigation, Water requirements, Water supply, Water users, Groundwater, *Danube River.

Various aspects of the salinity problems of the Danube River Basin are discussed. The primary source of salts is the weathering of tertiary, crystalline, volcanic and cretaceous rocks in the river basin in Czechoslovakia, Austria, Hungary, Yugoslavia, Romania, and the USSR. The salts are then carried to the Danube by surface and ground waters. The composition and concentrations of salts in surface and ground waters are summarized. The hazards of secondary salinization resulting from irrigation are discussed. (Halterman-PTT)
W86-02273

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI,

Army Engineer Div. Southwestern, Dallas, TX.
B. G. Rought.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 115-124, 2 fig, 4 ref.

Descriptors: *Saline water, *Salinity, Water requirements, Water users, Water use, Groundwater, Red River, Colorado River, Texas, Brazos River, Arkansas River, Pecos River, Desalination.

An overview of the salinity problem in the streams of the southwestern United States, from the Continental Divide to the Mississippi River, is presented. The quality of water in the mainstreams of a number of the river systems in this area is seriously degraded by salt emissions from major salt sources in the upper portion of their basins. Environmental and economic impacts of the salinity, including crop loss, increased municipal water treatment costs, and corrosion damage, are discussed. Potential solutions that are outlined include: importing fresh water, desalination, freshwater diversion, impoundment, and collection and disposal of brine. (Halterman-PTT)
W86-02274

ECONOMIC EVALUATION OF SALINITY CONTROL,

Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 6B.
W86-02275

NATURAL SALT POLLUTION CONTROL BRAZOS RIVER BASIN, TEXAS,

Army Engineer District, Fort Worth, TX.
J. A. McCrory.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 135-144, 6 fig, 3 ref.

Descriptors: *Saline water, *Salinity, *Desalination, Water requirements, Water users, Water use, Brazos River, Texas, Economic aspects.

Salt pollution from salt flats in the headwaters of the Brazos River has resulted in poor water quality in approximately 1500 kilometers of the main stem Brazos River from Stonewall County, Texas, to the Gulf of Mexico. The principal mineral pollutants considered in this study were chlorides, sulfates, and total dissolved solids. Various plans to control salinity in the Brazos River, including desalination, pipeline to the Gulf, and redistribution of existing water sources, are discussed. It appears

that desalination by impoundment evaporation techniques presents the most cost effective solution. (Halterman-PTT)
W86-02276

SALINITY BALANCE OF THE LOWER VIRGIN RIVER BASIN, NEVADA AND ARIZONA,

Montana Univ., Missoula. Dept. of Geology.
W. W. Woessner, M. D. Mifflin, R. H. French, A. Elzeftawy, and D. E. Zimmerman.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 145-156, 2 fig, 1 tab, 15 ref.

Descriptors: *Salinity, *Saline water, *Phreatophytes, Groundwater, Total dissolved solids, Virgin River, Nevada, Arizona, Monitoring, Water use, Water users, Water pollution sources.

This 12 month study developed additional hydrologic data for the development of salinity budgets in the Lower Virgin River Valley, Nevada and Arizona, a tributary of the Colorado River. Monthly stream gaging at six locations, groundwater monitoring at existing and new sites, water-quality sampling and soil sampling were included. Results indicate a complex hydrologic system with concentration, storage, and transport of salt occurring iin the study area. Water and salt budget analyses indicate a 36% net loss of water and a 34% net loss in salt for a 61 km reach of river. The majority of water loss is attributed to phreatophyte consumptive use. Salt concentration associated with phreatophyte comsumptive use exceeded consumptive concentration of salt by agriculture and direct evaporation by 2.6 times. Data indicate that phreatophyte areas play a major role in salt accumulation and storage by consumptively utilizing 2.1 to 3.6 m of water per year. TDS concentrations of 5,800 to 11,000 mg/1 were measured in the shallow groundwater underlying phreatophyte areas. (Author)
W86-02277

GRAND VALLEY SALT PICK-UP CALCULATIONS,

Bureau of Reclamation, Grand Junction, CO.
R. R. Inman, D. C. Olson, and D. L. King.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 157-167, 2 fig, 4 tab, 2 ref.

Descriptors: *Salinity, Saline waters, Groundwater, Total dissolved solids, Monitoring, Water use, Grand Valley, *Colorado, *Colorado River, Water pollution sources.

The quantification of salt loading from the Grand Valley in western Colorado, based on an analysis of an inflow-outflow river budget, is presented. The Grand Valley contributes approximately 6 percent of the average salt loading to the Colorado River. An average salt pickup of 528 million kg/yr was determined through analysis of salt and water budgets over a 29 year period. A 95 percent confidence limit on the mean of + or - 84 million kg/yr was established. No significant trend in salt pickup was identified. The Colorado-Utah State Line gage was determined to be the most appropriate gage for estimating the Colorado River outflow. Outflows were adjusted so that the unaccounted flow was zero, which provided a better estimate of salt pickup. (Halterman-PTT)
W86-02278

IMPACT OF RESERVOIRS ON SEASONAL AND HISTORICAL SALINITY OF THE COLORADO RIVER,

Bureau of Reclamation, Salt Lake City, UT.
D. P. Trueman, and J. B. Miller.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 171-180, 4 fig, 3 tab, 9 ref.

Descriptors: *Saline water, *Salinity, Water requirements, Water users, Groundwater, *Colorado River, Desalination, Reservoirs, Multipurpose reservoirs.

The historical perspective of water resources development is presented and the impacts of reservoirs on salinity and the salinity control are evaluated. The increased development of reservoirs over the last several decades has resulted in an increased retention time of Colorado River water to the range of 4-6 years. This retention time has decreased both the seasonal and annual variability of salinity in the basin. Predicted increased discharges will effectively dilute the salinity in the lower basin. Future development, however, in the upper basin, will eventually reduce the flow through the system and cause increased salinity levels. (Halterman-PTT)
W86-02279

HISTORICAL TRENDS IN CONCENTRATION AND LOAD OF MAJOR IONS IN THE COLORADO RIVER SYSTEMS,

Bureau of Reclamation, Denver, CO.
D. K. Mueller, and C. D. Moody.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 181-192, 4 fig, 1 tab, 10 ref.

Descriptors: *Salinity, *Saline water, Model studies, *Colorado River, Water pollution, Solids, Discharge measurements.

A data base development procedure which allows maximum use of existing data to determine reasonable estimates of monthly mean solute concentrations, loads, and mass fractions is described. The data analysis included a regression of seasonal values. Interpretation of results of such analyses is based on several general observations, including: differences between regulated and unregulated sites are clearly seen; significant mean value differences are easier to identify than temporal trends in monthly data; trends are more easily identified for low flow periods, probably due to smaller variance in discharge data; changes in concentration, load and mass fraction are associated with river discharge; several dependent variables appear for solute changes; and no single dependent variable is clearly preferable for identification of changes or trends. (Halterman-PTT)
W86-02280

EFFECT OF ASSUMPTIONS ON MODEL CALIBRATION AND PREDICTION,

Utah Water Research Lab., Logan.
E. K. Israelsen.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 195-201.

Descriptors: *Salinity, *Saline water, *Model studies, Agriculture, Groundwater, Mathematical models, Water pollution sources.

Background information on mathematical descriptions of processes and functions, computer algorithms, and model applications precede a discussion of the effects of assumptions on calibrations and predictive capability of models. Several alternative assumptions used in models concerning salinity are presented, and the subsequent variability in the results is demonstrated. The belief is stated that models will not indicate all the problems of fitting to the real system or any indication of feedback impacts. Furthermore, since models will not indicate all problems, they sometimes make predictions that are not correct, but the model links all the processes together so that the impacts of one process on another show up most of the time. Finally, although models are superior to single process calculations, they are not yet perfect and are subject to making errors as directed by the modeler. (Halterman-PTT)
W86-02281

LONGITUDINAL-VERTICAL HYDRODYNAMICS AND TRANSPORT WITH CHEMICAL EQUILIBRIA FOR LAKE POWELL AND LAKE MEAD,

Edinger (J.E.) Associates, Inc., Wayne, PA.
J. E. Edinger, E. M. Buchak, and D. H. Merritt.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 213-222, 5 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Saline water, *Water pollution sources, Model studies, Lake Powell, Lake Mead, Colorado River, Carbonates, Imperial Dam, Reservoir operation.

The hydrodynamic features and numerical properties of the LARM longitudinal and vertical hydrodynamic and transport model are presented and its use in Lakes Powell and Mead are discussed. The model produces extensive, detailed results including outflow conditions, evaporation rates and detailed circulation patterns for Lake Powell. The use of the model to construct carbonate chemistry in Lake Mead is also described. Data show that there are gypsum sources along the reservoir that can add calcium and sulfate to the system and shift the carbonate balance. Future uses of the model by the Bureau of Reclamation, for assessing long-range impacts of Lake Mead and Lake Powell on the Colorado River system, are described. This is important because projections of future salinity increases and requirements for salinity control are presently based upon the assumption that the reservoirs exert no change on salinity other than concentration by evaporation. (Halterman-PTT)
W86-02283

CONCEPTUAL MODELS OF GEOLOGIC AND AGRICULTURAL SALT LOADS IN STREAMS OF THE UPPER COLORADO RIVER BASIN,

Utah Water Research Lab., Logan.
C. J. Duffy.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 223-233, 4 fig, 5 ref.

Descriptors: *Saline water, *Salinity, *Irrigation, Modeling studies, Colorado River, Groundwater, Furrow irrigation, Irrigation effects, Environmental effects, Irrigation engineering, Irrigation practice.

Some specific aspects of the interaction and mixing of groundwater from near surface saline strata, and infiltration of water and solutes from irrigation are discussed. Subsurface transport in unconsolidated strata is modeled and salt transport in consolidated rocks is described. Preliminary calculations suggest that diffusion from consolidated sediments may contribute significant salinity to groundwater and streams in the region. Little is known, however, about the magnitude of diffusion coefficient, the effective porosity, and the concentration contrast between unconsolidated strata, all of which control the magnitude of this salinity source. Future research, including the exploration of the potential of diffusive salt loading, possibly a major factor in effective salinity control, is also discussed. (Halterman-PTT)
W86-02284

SALINITY CONTROL PROBLEMS ASSOCIATED WITH IRRIGATION IN SOUTH-WEST NEW SOUTH WALES, AUSTRALIA,

Water Resources Commission of New South Wales, Sydney (Australia).
A. van der Lelij, and S. E. Flint.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 265-274, 2 fig, 1 tab, 3 ref.

Descriptors: *Salinity, *Saline water, *Water pollution sources, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture.

In common with irrigation in many other semi-arid regions, irrigation schemes on the Riverine Plain of south-west New South Wales have resulted in rises in ground water levels which have created problems of soil salinization and waterlogging. The raised ground water levels can also lead to salt intrusion into streams and impairment of water quality if they are not controlled. Subsurface drainage presents problems of disposal of saline drainage effluent without increasing the salinity of water to unacceptable levels for downstream users. A range of effluent management options are to be evaluated to achieve the target salinity of 0.4 g/L at the downstream end of the system. These include

reuse of effluent upstream by discharge to, and dilution in, supply channels (limited scope because effluent salinity is often too high); dilution flows to reduce salinity downstream; diversion of the more saline winter drainage flows; on-farm retention of effluent during the irrigation season; disposal of some effluent in evaporation areas. (Halterman-PTT)
W86-02288

CASE STUDY OF A SALINITY CONTROL PROGRAM, VINTA BASIN, UTAH,

Soil Conservation Service, Salt Lake City, UT.
For primary bibliographic entry see Field 5G.
W86-02289

CHARACTERISTICS, TRENDS AND SURFACE WATER QUALITY IMPLICATIONS OF SALINE TILE EFFLUENT,

D. B. Harker.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 325-334, 4 fig, 14 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agriculture, Agricultural hydrology, Alberta, Canada, Saskatchewan River Basin.

The possible negative impact of future saline tile effluent on river water quality within Alberta, Canada is being studied. A network of on-farm tile drainage outlets has been regularly monitored for the past six years - to establish effluent quantities, qualities and apparent trends. Based on general trends, tile drainage is not expected to severely impact on river water quality within the foreseeable future. Some short-term negative impact may occur during periods of extremely low river flow, however. Long-term chemical data from individual sites has annual cycles and multi-year trends otherwise masked by site averaging. Such information indicates that site-specific data could be critical to accurately project seasonal and long-term effluent impact on small receiving systems. (Author)
W86-02294

MEEKER DOME SALINITY INVESTIGATION,

CH2M Hill Central, Inc., Denver, CO.
C. F. Feast.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 359-365, 3 fig, 1 tab, 3 ref.

Descriptors: *Saline water, *Salinity, *Water pollution sources, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Economic sepects, White River, Colorado, Saline aquifers.

Following the drilling of exploratory oil wells, saline water rose through uncased bore holes and recharged an unsaturated aquifer. This led to a drastic increase in salt loading into the nearby White River. Prior to the drilling, the salt load of the White River was 4.5 million kg per year; after drilling, salt loading reached a high of 24 million kg per year. Immediately following cementing of the bore holes, water in the upper aquifer began falling rapidly. An 80% decrease in salt loading into the White River was observed within one year of plugging the wells. On the basis of the reduction in salt loading, the program has had a benefit-to-cost ratio of 5 to 1. This ratio is expected to increase if the saline flows continue to decrease. (Halterman-PTT)
W86-02297

PRICE/SAN RAFAEL RIVER BASINS SALINITY INVESTIGATION,

CH2M/Hill, Boise, ID.
B. A. Johnson, and J. A. Riley.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 407-416, 1 fig, 3 ref.

Descriptors: *Saline water, *Salinity, *Water pollution sources, *Water quality control, Model studies, Groundwater, Water supply, Irrigation, Monitoring, Water use, Cooling water.

Investigations into the agriculture-related contribution of salt to the San Rafael and Price River Basins are discussed. The study approach consisted of analysis of existing data, development of hypotheses concerning salt loading mechanisms, collection of field data to verify quantities and sources of salinity, and formulation and analysis of viable alternatives. Results of the investigations indicate that the most cost effective options include a combined plan for on-farm irrigation improvements and winter water system improvements; collecting and using the drainwater for cooling, using binary cooling tower technology; and, collecting and using the drainwater to develop tar sands. The need for additional research to confirm yields from irrigation drains, to demonstrate the use of saline wqter in binary cooling towers, to refine the use of saline waters in tar sand development, to develop mitigation plans, to refine on-farm efficiencies, and to understand groundwater interactions is stressed. (Halterman-PTT)
W86-02302

STUDY OF SALINITY PRODUCTION FROM WILDLANDS OF PRICE RIVER BASIN, UTAH,

Unitex Corp., Salt Lake City, UT.
A. Lin.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 417-426, 4 fig, 3 tab, 6 ref. YA553-CTI-1064.

Descriptors: *Salinity, *Saline water, Shales, Gypsum, Watersheds, Ephemeral streams, Intermittent streams, Price River Basin, Utah.

Some essential results of a study of salinity production from wildlands are described. The major soluble mineral in Mancos shale is gypsum, with varying quantities of other sulfate minerals. For overland flows, solute pick-up increases as sediment concentration increases and as hill slope increases. Heavy solute pick-up in channels is a function of proximity to Mancos shale. Saline crust accumulations constitute a major source of salts to storm runoff and the estimated storm-related salt load contributed from wildlands ranged from 1% to 50%. The study confirms the importance of hillslope erosion in sediment and salinity production of the study area. (Halterman-PTT)
W86-02303

GEOCHEMICAL IDENTIFICATION OF SALINITY SOURCES,

Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5A.
W86-02309

DETECTION OF SUBSURFACE SALINITY WITHIN THE NORTHERN SLOPES REGION OF VICTORIA, AUSTRALIA,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 7B.
W86-02310

CHEMICAL REACTIONS INFLUENCING SALINITY INCREASE OF SOIL AND GROUNDWATERS IN THE GREAT BASIN, WESTERN UNITED STATES,

Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2K.
W86-02311

ANALYSIS OF SALT YIELDS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF PARIETTE DRAW WILDLIFE AREA, UTAH,

Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 4C.
W86-02313

SECONDARY SALINIZATION OF WATER RESOURCES IN SOUTHERN AUSTRALIA,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
For primary bibliographic entry see Field 4C.
W86-02315

SALINITY CONTROL PROBLEMS: NON-AGRICULTURAL,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
D. F. Peterson.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 583-592.

Descriptors: *Salinity, *Saline water, Groundwater, Water pollution, Seepage control, Seeps, Environmental effects, Groundwater movement.

A summary and critique of fifteen papers, concerning non-agricultural issues of salinity control, is presented. The topics of the papers fall into three categories: salinity sources and problems, salinity control programs, and salinity control project mitigation. 'Salinity sources' covers the Danube Basin and the southwestern United States. 'Salinity control programs' focuses on the Colorado River, Smokey Hill River in Kansas, the Red and Arkansas Rivers, and the general problems of 'produced' water in Kansas. Salinity control project mitigation focuses on a variety of problems in Arizona, California, Montana, and Australia. Technology, economic analyses, and institutionalization, as they relate to salinity control, are discussed. (Halterman-PTT)
W86-02316

CRITIQUE - SALINITY CONTROL PROBLEMS: AGRICULTURAL,

Science and Education Administration, Fort Collins, CO. Agricultural Research.
M. E. Jensen.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 597-608, 2 tab.

Descriptors: *Salinity, *Saline water, Groundwater, Water pollution, Seepage control, Seeps, Environmental effects, Groundwater movement, Agriculture, Agriculture watersheds.

Several papers pertaining to salinity control are reviewed and critiqued. Areas such as upstream vs. downstream users, long-term indicators of emerging problems, barriers to implementing control measures, the role of irrigated agriculture, water consumption by flood plain vegetation, and salt removal are reviewed. Possible distribution of river basin water costs is explored, and specific examples are provided for illustration of the concept. (Halterman-PTT)
W86-02317

SOURCE MOVEMENT AND EFFECTS OF NITROGEN AND PHOSPHORUS IN THE HEADWATERS OF HOP BROOK, MARLBOROUGH, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
J. C. Briggs, and W. D. Silvey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4017, 1984. 5 p, 3 fig, 17 tab, 25 ref.

Descriptors: *Water quality, *Ponds, *Nutrients, Eutrophication, Algal growth, Nitrogen phosphorus, Hager Pond, Grist Millpond, Carding Millpond, Hop Brook, *Massachusetts.

The headwaters of Hop Brook near Marlborough, Massachusetts, contain a series of three in-line ponds--Hager Pond, Brist Millpond, and Carding Millpond--which receive over half of their surface-water inflow as effluent from the Marlborough Easterly Wastewater Treatment Plant. These ponds have a history of summer algal blooms and fish kills. Water entering these ponds contains quantities of nitrogen and phosphorus far higher than the levels known to promote excessive growth of aquatic vegetation. As the water moves

through the three ponds, nitrogen levels decrease. Although some nitrogen is lost to the atmosphere by denitrification, the bulk of the nitrogen probably is retained in the pond sediments. There is a net decrease in phosphorus in the water leaving Carding Millpond compared to the water entering Hager Pond. However, during most sampling periods, the phosphorus concentration of water leaving Carding Millpond is still above the level known to cause excessive growth of aquatic vegetation in lakes. During certain summer periods, there appears to be release of some phosphorus from the sediments in Carding and Grist Millponds. No improvement in water quality of the three ponds can be expected until the concentrations of nutrients entering Hager Pond are reduced to levels that will not support excessive growth of aquatic vegetation. (USGS)
W86-02343

QUALITY AND QUANTITY OF URBAN RUNOFF AND ATMOSPHERIC DEPOSITION IN URBAN AREAS OF SALT LAKE COUNTY, UTAH, 1980-1981,

Geological Survey, Salt Lake City, UT. Water Resources Div.
R. C. Christensen, D. W. Stephens, G. E. Pyper, H. F. McCormack, and J. F. Weigel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4011, 1984. 223 p, 11 fig, 36 tab, 22 ref.

Descriptors: *Urban hydrology, *Utah, *Urban runoff, *Organic pollutants, Sediment composition, Salt Lake County, *Atmospheric deposition, Storm characteristics, Salt Lake County.

Water of good quality from mountain streams is degraded as it moves through urban areas to the Jordan River in Salt Lake County, Utah. The impact of urban runoff and atmospheric deposition on the quality of water in those streams and in storm conduits and canals functioning as storm drains was evaluated using data collected during 1980-81. Atmospheric-wetfall loads for an average storm were as much as 10 pounds per acre for total solids, but the dissolved trace metals were generally present in insignificant quantities. Wetfall-deposition loads generally were greater than storm-runoff loads, indicating that a large quantity of the wetfall load remained as soil deposits. Acid rain fell in more than one-half of the storms sampled, most commonly in September and October. Dustfall concentrations reflected the composition of local soils, particularly with regard to iron, manganese, and chromium; but concentrations of cadmium, copper, lead, zinc, and chloride were considerably enriched. Monthly loads of dryfall solids reached a maximum of 62 pounds per acre in the Little Cottonwood Creek urban basin, but were of the same magnitude as total storm loads for a heavy rainfall. Urban runoff represented about 38 percent of the discharge in three canals. The water in the canals was poorer in quality than the water in the mountain streams. The impact of the canal discharges to the streams is slight, however, owing to their 'relatively small amounts.' Concentrations of sediment, suspended solids, suspended trace metals, phosphorus, and oxygen-demanding substances were much greater during storm runoff than under base-flow conditions. This report contains data for basin and storm characteristics and water-quality information for atmospheric deposition and urban runoff. (USGS)
W86-02346

NUTRIENT AND DETRITUS TRANSPORT IN THE APALACHICOLA RIVER, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
H. D. Mattraw, and J. F. Elder.
Available from Dist Branch, USGS 604 S. Pickett St Alexandria, VA 22304. USGS Water-Supply Paper 2196-C, 1984. 62 p, 27 fig, 32 tab, 62 ref.

Descriptors: *Nutrients, *Detritus, *Floodplains, Flood discharge, Wetlands, Hydrologic budget, Organic matter, Carbon, Nitrogen, Phosphorus, Water quality, Baseline studies, Swamps, *Florida, *Wetlands, *Apalachicola River, *Nutrient transport, *River quality assessment.

The Apalachicola River in northwest Florida flows 172 kilometers from Jim Woodruff Dam to Apalachicola Bay on the Gulf of Mexico. Fifteen percent of the Apalachicola basin is occupied by a bottom-land hardwood floodplain that is relatively undeveloped. The dense floodplain forest produces approximately 800 metric tons per square kilometer of litter fall annually. Spring floods of March and April 1980 carried 35,000 tons of the decaying litter fall (detritus) into Apalachicola Bay. The estuary is predominantly a detrial-based food-web ecosystem which produces important commercial quantities of oyster, shrimp, blue crab, and various species of fish. Two hundred fourteen thousand metric tons of organic carbon were transported into the bay during the 1-year study period, June 1979 to June 1980. Nitrogen transport during the same period was 21.5 x 10 (to the third) tons and phosphorus was 1.7 x 10 (to the third) tons. The Apalachicola River floodplain contribution to the annual transport of carbon, nitrogen, and phosphorus was 34,200 tons, 668 tons, and 197 tons, respectively. Sixteen percent of the organic carbon is derived from less than 1 percent of the Apalachicola-Chattahoochee-Flint River basin. (USGS)
W86-02356

RAINFALL-RUNOFF RELATIONSHIPS AND WATER-QUALITY ASSESSMENT OF COON CREEK WATERSHED, ANOKA COUNTY, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02370

HYDROGEOLOGY OF A LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02371

HYDROLOGY OF AREA 60, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, NEW MEXICO, COLORADO, UTAH, AND ARIZONA,

Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02382

LITERATURE REVIEW OF SURFACE-WATER QUALITY IN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-619, 1984. 30 p, 6 fig, 2 tab, 31 ref.

Descriptors: Streams, *Water quality, Literature review, Dissolved oxygen, Base flow, Storm runoff, Bed load, *Ohio, *Cuyahoga River basin, Cuyahoga Valley National Recreation Area.

The Cuyahoga Valley National Recreation Area in Ohio encompasses about 23 miles of the middle reach of the Cuyahoga River and parts of four major tributaries--Furnace Run, Brandywine Creek, Chippewa Creek, and Tinkers Creek. Water quality in this reach does not meet Ohio water-quality standards for dissolved oxygen, fecal bacteria, ammonia, and lead. Point sources and nonpoint sources of effluent contribute contaminants. On the basis of a review of scientific and technical literature, National Park Service management goals, and water-quality data collected recently by the U.S. Geological Survey, three subject areas in need of study have been identified: (1) the dissolved oxygen regime, (2) chemical quality of base flow and (3) quality of stormwater runoff. (USGS)
W86-02388

TIME OF TRAVEL, WATER QUALITY, AND BED-MATERIAL QUALITY FOR THE CUYAHOGA RIVER WITHIN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-4065, 1985. 49 p, 14 fig, 6 tab, 11 ref.

Descriptors: *Water quality, Biochemical oxygen demand, Dissolved oxygen, Coliforms, Streptococcus, *Traveltime, Dye releases, Trace elements, *Bottom sediments, *Streams, *Path of pollutants, *Ohio, *Cuyahoga River, Cuyahoga Valley National Recreation Area.

Three studies were conducted in the Cuyahoga Valley National Recreation by the U. S. Geological Survey to (1) establish the relationship between time of travel and discharge through the park reach of the Cuyahoga River, (2) characterize water quality of the Cuyahoga River within the park over a 24-hour period, and (3) determine general areas where the streambed might be contaminated by trace metals. Time of Travel between Botzum and Independence is described by the equation $T = 46.9-0.038Q$, where T = time, in hours, and Q = discharge at Independence, in cubic feet per second. On the main stem of the Cuyahoga River, dissolved-oxygen saturation was highest and ultimate carbonaceous biochemical oxygen demand was lowest on the upstream and downstream ends of the reach. Dissolved-oxygen saturation was more than 80 percent in all the tributaries except Furnace Run, Brandywine Creek, and Langes Run. The number of fecal coliform counts per 100 milliliters of sample was high throughout the study area and ranged from 38 to 1,200,000. Concentrations of all metals and nonmetals investigated by means of analysis of bed material were not anomalously high. (USGS)
W86-02389

SELECTED HYDROLOGIC DATA FOR THE SOUTH PLATTE RIVER THROUGH DENVER, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
N. E. Spahr, S. R. Blakely, and S. E. Hammond.
Available from OFSS, USGS, Box 25425, Lakewood, Co 80225. USGS Open-File Report 84-703, 1985. 225 p, 5 fig, 24 tab.

Descriptors: *Waste assimilative capacity, Reaeration, Traveltime, Water quality, *South Platte River, Denver, *Colorado, Water pollution sources, Urban hydrology.

The U.S. Geological Survey, in cooperation with the cities of Littleton and Englewood, Colorado, studied the effects of the discharge of treated effluent from the Bi-City Waste Water Treatment Plant on low-flow conditions of the South Platte River. An 18-mile reach of the South Platte River, beginning below Chatfield Reservoir, through the Denver metropolitan area was studied. Chatfield Reservoir was used to regulate the flow of the South Platte River on four occasions between October 1982 and January 1984. Each flow-regulation period was used to achieve a stable, low-flow condition. Data collection during low flow allowed for the study of waste assimilation during both warm- and cold-water conditions. Water quality, streamflow, channel geometry, traveltime, mixing-zone, reaeration, and benthic-oxygen demand data were collected at selected instream, tributary, and effluent sites. This report presents data collected during four periods of low flow along the South Platte River. (USGS)
W86-02391

EFFECTS OF STORMWATER RUNOFF ON AN URBAN LAKE, LAKE ELLYN AT GLEN ELLYN, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
R. G. Striegl.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-603, 1985. 19 p, 7 fig, 9 tab, 20 ref.

Descriptors: *Urban hydrology, *Storm runoff, *Detention storage, Trace metals, Sediment control, Limnology, Trap efficiency, *Runoff detention, *Illinois, Lake Ellyn.

Detention of urban runoff was observed to have physical, chemical, and biological effects on a small lake located near Chicago, Illinois. Accumulated bottom sediments reduce lake storage and have comparatively high concentrations of metals and organic compounds. Concentrations of many constituents dissolved in the lake water are seasonally cyclic, with annual concentration peaks occurring during the winter. Maintenance of desirable benthic invertebrate and fish communities, and development of undesirable phytoplankton blooms appear to be inhibited by sediments deposited on the lake bottom and suspended in the lake water. (USGS)
W86-02392

ALDICARB-PESTICIDE CONTAMINATION OF GROUND WATER IN EASTERN SUFFOLK COUNTY, LONG ISLAND, NEW YORK,

Geological Survey, Syosset, NY. Water Resources Div.
J. Soren, and W. G. Stelz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4251, 1984. 34 p, 7 fig, 4 tab, 26 ref.

Descriptors: *Water pollution sources, Groundwater quality, Geologic formations, Aquifers, *Hydrogeology, *Groundwater, Water pollution, *Pesticides, *New York, *Groundwater pollution, *Long Island, Eastern Suffolk County, *Aldicarb pesticide.

Aldicarb, a toxic oxime-carbamate pesticide that was believed incapable of reaching ground water, was used in potato-farming areas of eastern Suffolk County, New York during 1975-80. In 1979, aldicarb was found in substantial concentrations in ground water throughout the area. The New York State Department of Health set a limit of 7 micrograms per liter for aldicarb in drinking water. Extensive ground-water sampling into 1980 showed widespread contamination ranging from small amounts to as much as 515 micrograms per liter. In 1980, the U.S. Environmental Protection Agency banned the use of aldicarb on Long Island at the manufacturer's request. A 1982 sampling study found aldicarb to have penetrated to about 40 feet below the water table in concentrations ranging from below detection limit to 239 micrograms per liter. Despite reputed toxicity, no instance of aldicarb poisoning on Long Island has been documented. The excessive aldicarb concentrations in the ground water of eastern Long Island may persist for decades; the duration has not been precisely determined and remains under investigation. (USGS)
W86-02394

VOLATILE TRACE-ELEMENT CONCENTRATIONS IN SNOWMELT CONTRIBUTIONS TO STREAMS MONITORED BY HYDROLOGIC BENCH MARK NETWORK STATIONS IN THE CONTERMINOUS UNITED STATES WHERE AVERAGE ANNUAL SNOWFALL EXCEEDS 12 INCHES,

Geological Survey, Bismarck, ND. Water Resources Div.
R. L. Houghton, and L. Schimke.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4104, 1985. 19 p, 5 fig, 4 tab, 28 ref.

Descriptors: *Snowmelt, *Stream pollution, *Trace metals, *Chemistry of precipitation, *United States, *Hydrologic Benchmark Network.

Water-quality data collected for more than 10 years at 35 Hydrologic Bench-Mark Network stream stations in the snowbelt of the conterminous United States where average annual snowfall exceeds 12 inches were evaluated for evidence of trace-element enrichments during initial springtime snowmelt. Data for at least 1 initial snowmelt period are available at only 11 of these stations. Snowmelt enrichments in the concentrations of volatile trace elements, such as mercury, molybdenum, and selenium, ranged from 0 to 100 percent at stations in North Dakota and Montana. Enrichments in volatile trace-element concentrations were accompanied by pH decreases; and, therefore, pH decreases during snowmelt at other sites may indicate enrichment of volatile trace elements. Although enrichments of some of these trace elements exceeded 90 times their mean concentrations during nonsnowmelt periods, concentrations did not exceed drinking-water standards. However, concentrations of mercury in laboratory-simulated snowmelt exceeded drinking-water standards. (USGS)
W86-02397

DISTRIBUTION AND TRANSPORT OF TRACE SUBSTANCES IN THE SCHUYLKILL RIVER BASIN FROM BERNE TO PHILADELPHIA, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
J. K. Stamer, T. H. Yorke, and G. L. Pederson.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2256-A, 1985. 45 p, 33 fig, 12 tab, 40 ref.

Descriptors: *Bottom sediments, *Trace elements, *Pesticide residues, *Probability distribution, Water quality standards, *Pennsylvania, *Schuylkill River, *Water pollution sources.

From October 1978 to March 1981, the U.S. Geological Survey assessed quality of Schuylkill River from Berne to the Fairmount Dam at Philadelphia, Pennsylvania. The assessment focused on the distribution and transport of trace metals and organic substances. In general, concentrations of trace metals and organic trace substances in the bottom sediments exceeded the background concentrations in the study area, and were greater in the main stem of the Schuylkill River than in its tributaries. Concentrations of most trace metals were lowest at Berne and highest in the urban-industrial Reading area. Concentrations generally decreased from Reading downstream to Philadelphia. Concentrations of chlordane, DDT and its metabolites, and dieldrin generally increased from Berne to Philadelphia, paralleling the increase in urban land use from Berne to Philadelphia. Transport of trace metals in the Schuylkill River is closely related to suspended-sediment transport. About 71 percent of the average annual transport of trace metals is in particular material. The frequency at which concentrations of copper, lead, and zinc in the Schuylkill River at Manayunk at Philadelphia are estimated to exceed domestic water-supply criteria of the U.S. Environmental Protection Agency is less than 1 percent of the time. (USGS)
W86-02410

5C. Effects Of Pollution

RELATIVE SENSITIVITY OF SEABIRD POPULATIONS IN ALASKA TO OIL POLLUTION,

Bureau of Land Management, Anchorage, AK. Alaska Outer Continental Shelf Office.
D. J. Hansen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142091, Price codes: A02 in paper copy, A01 in microfiche. Technical Paper No3, August 1981, 15 p, 2 fig, 4 tab, 13 ref, append.

Descriptors: *Oil pollution, *Waterfowl, *Water birds, *Alaska, *Sensitivity analysis, Water pollution effects, Birds, Arctic Polar regions, Ecological effects, Oil spills.

The oil vulnerability index (OVI) developed by King and Sanger (1979) was used to identify sensitive species of birds in Alaska that could be affected by oil pollution. Many of the most common seabirds in Alaska and species endemic to the Bering Sea or the North Pacific are highly sensitive (a score of 70 or greater OVI) to oil pollution. The southern Bering, northern Bering, and the Chukchi Sea regions have over 80% of their major seabird colony populations rated highly sensitive. Within the Gulf of Alaska, the northwestern region and southwestern region have substantially larger populations of sensitive birds than the northeastern region. In general offshore oil and gas development in the Bering Sea poses a greater risk to seabird and waterfowl populations than would oil development in the Arctic Ocean or in the Gulf of Alaska. Oil and gas activities within the major foraging habitat of vulnerable populations in the Bering Sea represents the greatest concern to seabirds in Alaska. For most endemic waterfowl populations, the Yukon-Kuskokwim Delta represents the most important or critical habitat in Alaska. (Geiger-PTT)
W86-01975

PARAHO ENVIRONMENTAL DATA: BIBLIOGRAPHY,

Development Engineering, Inc., Rifle, CO.
For primary bibliographic entry see Field 10C.
W86-01983

TYPES OF POTENTIAL EFFECTS OF OFFSHORE OIL AND GAS DEVELOPMENT ON MARINE MAMMALS AND ENDANGERED SPECIES OF NORTHERN BERING, CHUKCHI, AND BEAUFORT SEAS,

Bureau of Land Management, Anchorage, AK. Alaska Outer Continental Shelf Office.
C. J. Cowles, D. J. Hansen, and J. D. Hubbard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-146142, Price codes: A02 in paper copy, A01 in microfiche. Technical Paper No9, December 1981. 23 p, 75 ref.

Descriptors: *Mammals, *Marine animals, *Offshore platforms, *Oil pollution, *Oil spills, Seals, Whales, Arctic, Polar regions, Marine plants, Ocean dumping, Water pollution effects, Natural gas, Water birds.

Direct effects of spilled oil to non-endangered marine mammals would vary depending on population density, physiological status, season, meteorological conditions, spill characteristics, duration of exposure and other factors. For many of the species occurring in Alaskan arctic areas, long-term, chronic, and direct or indirect effects associated with oil and gas development are of greater concern than the probability of widespread direct affects on seal populations. One possible result of low-level or chronic pollution would be to contribute to physiological stress on marine populations which may be at or near carrying capacity. Indirect effects of oil pollution on marine mammals would be those associated with changes in availability or suitability of various food sources or essential habitat factors. Mammalian species such as bearded seal or walrus may be most likely to show tropic-related effects in a specific locale since they rely on relatively sedentary benthic food sources. Shock waves and noise disturbance associated with offshore oil and gas development may alter the behavior of marine mammals. Other factors which may directly affect marine mammals include shoreline alteration, facility siting, dredging and filling, and secondary development. Potential factors affecting endangered cetaceans include direct and indirect oil and gas pollution effects, noise and disturbance effects and other factors such as marine disposal of drilling muds, formation waters, and cooling waters, shoreline alterations, and airborne noise. (Geiger-PTT)
W86-01986

ECOLOGICAL EFFECTS OF ACID PRECIPITATION,

Sigma Research, Inc., Richland, WA.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-903148, Price codes: A05 in paper copy, A01 in microfiche. Proceedings of a Workshop held March 4-6, 1981, Atlanta, Georgia. EPRI-EA-2273, February 1982. 98 p, append. EPRI-WA 80-180.

Descriptors: *Acid rain, *Ecological effects, *Water pollution effects, *Air pollution, *Conferences, Acidic water, Ecosystems, Environmental effects, Vegetation effects, Aquatic animals, Lime, Forest watersheds, Crop production, Fate of pollutants, Symposium.

The three-day workshop on Ecological Effects of Acid Precipitation was convened in Atlanta, Georgia, on March 4, 1981. This undertaking, sponsored jointly by the US Environmental Protection Agency (EPA) and the Electric Power Research Institute (EPRI), constituted the initial step in a series of planned, interactive efforts to enhance cooperation between individuals and agencies involved in acid precipitation research. The intent of the co-sponsors was to provide a forum for exchange concerning research directions being pursued by industry and government and to explore the need for coordination and integration of US studies - especially the ecosystem effects studies of EPRI and EPA. Approximately 85 active researchers, managers, and planners attended the workshop. These invited participants were drawn primarily from the fields of aquatic and terrestrial ecosystem research and included representatives from Canada, Norway, Sweden, and the United Kingdom. The workshop included presentations of program descriptions, a limited set of technical research efforts, and summaries of non-US programs in ecosystems studies. It culminated in a series of working group sessions that examined issues in aquatic systems, agricultural systems, natural terrestrial systems, and an overview of effects. Each working group considered outstanding research issues and identified critical areas where coordination and integration of research efforts could accelerate our understanding of the impacts of acid precipitation. (Author)
W86-02039

ENVIRONMENTAL AND ENGINEERING ASPECTS RELATED TO THE RESTORATION OF A FERROUS SULFATE (COPPERAS) WASTE DISPOSAL SITE,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 5E.
W86-02117

WATER CHLORINATION PROGRAMS AT ONTARIO HYDRO FOSSIL-FIRED GENERATING STATIONS,

Ontario Hydro, Toronto.
For primary bibliographic entry see Field 5B.
W86-02160

PUBLIC HEALTH ASPECTS OF WATER SUPPLIES,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
A. W. Hoadley.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 17-36, 1 tab, 72 ref.

Descriptors: *Water treatment, *Drinking water, *Public health aspects, Potable water, Trace metals, Metals, Water analysis, Bacterial analysis, Salmonella, Shigella, Carcinogens.

Engineers involved in water supply must understand potential threats to the health of consumers, standards of quality with which to judge safety, and techniques for evaluating quality. Towards this end, several aspects of public health, related to water supplies are discussed. The most common waterborne infectious disease has been acute gastrointestinal illness. The waterborne bacterial pathogens Salmonella, Shigella, Escherichia coli, Yersinia enterocolitica, and Pseudomonas aeruginosa have all been implicated in major outbreaks of disease. The most common of the waterborne protozoan pathogens is Giardia lamblia. While outbreaks of waterborne Entamoeba hisolytica were reported in the United States prior to 1970, none have been reported since then. Viral diseases, such as hepatitis, are very serious matters with regard to water treatment, because very small numbers of viral particles appear to be capable of causing infection in man. The importance of trace metals in cardiovascular diseases and psychiatric disorders is discussed. Finally, the relationship between known carcinogens in drinking water supplies, and the incidence of various types of cancer is discussed. It appears that asbestos fibers, polynuclear aromatic hydrocarbons, chloroform, and carbon tetrachloride contamination in water has been related to cancers of the urinary organs and the gastrointestinal tract. (Halterman-PTT)
W86-02190

PCB'S: HUMAN AND ENVIRONMENTAL HAZARDS,

For primary bibliographic entry see Field 5B.
W86-02248

PCB PROBLEM: AN OVERVIEW,

Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 5B.
W86-02249

OVERVIEW OF THE SCIENTIFIC BASIS FOR CONCERN WITH POLYCHLORINATED BIPHENYLS IN THE GREAT LAKES,

Amsterdam Univ. (Netherlands). Vakgroep Aquatische Oecologie.
For primary bibliographic entry see Field 5B.
W86-02250

ENVIRONMENTALIST'S VIEW OF THE PCBS IN THE GREAT LAKES,

Michigan United Conservation Clubs, Lansing.
For primary bibliographic entry see Field 5B.
W86-02252

EDIBLE TISSUE SAMPLING FOR FISH CONTAMINANT ANALYSIS,

Michigan Dept. of Natural Resources, Lansing. Surface Water Quality Div.
For primary bibliographic entry see Field 5B.
W86-02253

ANALYSIS OF PCBS USING SPECIFIC ISOMER HIGH RESOLUTION CAPILLARY GAS CHROMATOGRAPHY,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5A.
W86-02254

ECONOMIC IMPACTS OF PCB REGULATION IN FOOD FISH,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. R. Talhelm.
IN: PCB's: Human and Environmental Hazards, Butterworth Publishers, Boston, 1983. p 409-422, 1 fig, 3 tab, 3 ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Social aspects, *Chemical analysis, Great Lakes, Political aspects, Water analysis, Monitoring, Toxicity, Fish.

Following the Food and Drug Administration's (FDA) lowering of the allowable polychlorinated biphenyl (PCB) levels from 5 to 2 mg/kg in the edible portion of fish and shellfish, the National Fisheries Institute claimed that a $7-10 million per year food loss would result. A hearing addressing this issue was presented with data (from the National Marine Fisheries Service) on a large variety of commercially important fish, including whitefish, trout, carp, catfish, striped bass, bluefish, mackerel and lobster. The largest food loss would result from the lobster industry, estimated at $10 million. The total loss for all fish was estimated to be $14 million. The National Fisheries Institute, however, estimated the food loss to be $24 million. The hearing examiner found that the loss would be $13.5 million. However, several mistakes were apparently made, which resulted in errors within several fish categories. However, the total loss figures were similar to the original estimates of the FDA. (Halterman-PTT)
W86-02256

5D. Waste Treatment Processes

ACID MINE DRAINAGE: CONTROL AND ABATEMENT RESEARCH,

Bureau of Mines, Pittsburgh, PA. Pittsburgh Research Center.
A. G. Kim, B. S. Heisey, R. L. Kleinmann, and M. Deul.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-140616, Price codes: A02 in paper copy, A01 in microfiche. Report IC/8905, 1982, 22 p, 16 fig, 3 tab, 28 ref.

Descriptors: *Wastewater treatment, *Water quality control, *Acid mine drainage, *Coal mines, Pyrite, Oxidation, Sulfuric acid, Thiobacillus ferrooxidans, Drainage, Neutralization, Lime, Limestone, Sludge, Surfactants, Mine wastes, Spoil banks.

Acid drainage from coal mines and refuse piles results from oxidation of pyrite to form sulfuric acid. As pH decreases, the pyrite-oxidizing activity of Thiobacillus ferrooxidans is promoted, further increasing the pH. The Bureau of Mines is conducting research to mitigate the impact of acid on streams and aquifers. Mine sealing by flooding can exclude oxygen, eliminating pyrite oxidation. However, long-term sealing has often failed in mines above drainage. Research on mine sealing includes studies on more efficient and less expensive seals, pneumatic stowing of limestone as a seal, outcrop barrier stability, relief wells, and oxygen diffusion in coal refuse piles. Developments in treatment of acid mine drainage before discharge into streams include a limestone neutralization process which produces a denser sludge, the effect of activated carbon catalyst on particles, and a low-cost treatment system for small acid-contaminated streams using artificial sphagnum moss and limestone rubble. Methods for at-source control of acid mine drainage currently under investigation are bactericides to control limestone treatment of freshly exposed pyrite, placement of sumps and pumping systems, and control of groundwater entering mines. (Cassar-PTT)
W86-01978

FEEDWATER CLEANUP FOR COMBINED ELECTROLYSIS CATALYTIC EXCHANGE,

Monsanto Research Corp., Miamisburg, OH.
J. E. Lentz, J. Sienkiewicz, and R. E. Ellis.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019838, Price codes: A02 in paper copy, A01 in microfiche. Report MMM-2970; UC-70, Final Report. July 30, 1982. 13 p, 1 fig, 7 tab. DE-AC04-76-DP00053.

Descriptors: *Wastewater treatment, *Organic compounds, *Oily water, Ion exchange, Activated carbon, Adsorption, Electrolysis catalytic exchange system, *Tritium, *Radioactive wastes, Tritiated water.

A treatment process was developed for removing oil from tritiated wastewater from the combined electrolysis catalytic exchange system at the Mound Facility, Miamisburg, Ohio. The pilot scale process comprised skimming of the oily layer, filtering to remove particulates, absorbing soluble organic material in three traps filled with material such as activated carbon, filtering to remove carbon particles, and removing inorganic contaminates with ion exchange resin. If the treated water was not satisfactory for feeding into the combined electrolysis catalytic exchange system, it was recycled for further treatment. Some inconsistencies in organic removal were possibly a result of channeling in the carbon beds. High flow rates tended to produce better organic removal. Materials tested in the traps were Witco activated carbons, Grades 940, 950, and 965, and three types of Amberlite ion exchange resins, XAD-7, XAD-4, and IRA-938. The ion exchange resins actually added organic matter to the water being treated. Of the activated carbons, Witco 950 was most effective in reducing organic levels. (Cassar-PTT)
W86-01980

PHYSICOCHEMICAL TREATMENT METHODS FOR OIL SHALE WASTEWATER: EVALUATION AS AIDS TO BIOOXIDATION,

California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, R. H. Sakaji, and C. G. Daughton.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020295, Price codes: A02 in paper copy, A01 in microfiche. Report LBL-14666, July 1982. 17 p, 8 fig, 43 ref. DE-AC03-76SF00098.

Descriptors: *Biological wastewater treatment, *Physicochemical treatment, *Biological oxidation, *Oxidation, *Oil waste, Activated carbon, Organic carbon, Wastewater treatment, Ozonation, Wastewater oxidation, Ultraviolet radiation, Mineralization, Sorption.

Biological treatment is usually effective for the mineralization of only one-half of the organic carbon present in retort waters. Several physicochemical treatment methods including sorption and chemical oxidation were evaluated for their ability to complement or enhance biooxidation. The use of spent shale or powdered activated carbon (PAC) effected preferential sorption of the less polar, biorefractory organic compounds from retort water. However, the concurrent application of these sorbents with biooxidation did no promote a synergistic removal. The construction and application of a pilot-scale adiabatic stainless steel and beaded-glass steam stripper for removal of ammonia, hydrogen sulfide and carbon dioxide from oil shale process wastewaters is discussed; emphasis is placed on the benefits steam stripping would accord biooxidation. Ultraviolet radiation had no significant effect on the biorefractory organic solutes in retort water. Extensive ozonation structurally altered 14% of the recalcitrant dissolved organic carbon. Ozonation mediated by ultraviolet radiation had a synergistic effect. Potent chemical oxidation was incapable of effecting sufficient structural alteration of the biorefractory compounds to encourage renewed biooxidation. This implies that oxidative enzyme systems may also be incapable of promoting further alteration or mineralization of these recalcitrant solutes. (Geiger-PTT)
W86-01982

TECHNICAL GUIDE ON BIOLOGICAL NUTRIENT REMOVAL: THE PHOREDOX PROCESS,

National Inst. for Water Research, Pretoria (South Africa).
M. J. N. Simpkins, and A. Gerber.
1981. 20 p, 13 fig, 5 tab, 27 ref.

Descriptors: *Wastewater treatment, *Nutrient removal, Phoredox process, Phosphates, Nitrates, Nitrogen, Denitrification, Biological wastewater treatment, Design criteria, Pilot plants, Anaerobic digestion, Aerobic digestion, Clarifiers, Sludge.

This guide, intended as a help in design and operation of the Phoredox process, was developed from data obtained at a Pretoria pilot plant operating on domestic sewage. The Phoredox process is a five-stage process designed to remove nitrogen and phosphorus by biological means. These stages are as follows: anaerobic–denitrification and phosphate release; primary anoxic–additional denitrification of nitrates; primary aeration--oxidation of biodegradable nitrogen and carbonaceous matter; secondary anoxic and aerated--denitrification of nitrates formed in the previous stage; and clarifier--separation of phosphate-containing solids. A pilot plant experience is detailed. Phosphate removal efficiencies were 78% and 68% for settled sewage feed and raw sewage feed, respectively. Effluent nitrate and phosphate concentrations regularly were higher on weekends, coinciding with the drop in COD. Several critical points in design and operation are emphasized. Aeration must be uniform so that no anaerobic zones exist. The anoxic retention time can be increased during periods of low COD. Excess oxygen uptake in the aeration phases or from the atmosphere should be avoided prior to entering the anoxic phases. (Cassar-PTT)
W86-01998

AQUACULTURE SYSTEMS FOR WASTEWATER TREATMENT: SEMINAR PROCEEDINGS AND ENGINEERING ASSESSMENT,

Environmental Protection Agency, Washington, DC. Municipal Construction Div.
Proceedings held September 11-12, 1979, University of California-Davis. Report EPA 430/9-80-006, September 1979, MCD-67. 485 p.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Fish, Bilogical wastewater treatment, Tertiary wastewater treatment, Lagoons, Wastewater lagoons, Wetlands, Water hyacinth, Nutrient removal.

Papers on wastewater aquaculture are divided into several categories: overview, use of wetlands (creation of new wetlands, use of existing wetlands, and use of cypress domes), aquatic plant systems (mainly water hyacinth), combined systems with aquatic pants and fish or shellfish, and economic and energy aspects. (Cassar-PTT)
W86-02047

ENGINEERING ASSESSMENT OF AQUACULTURE SYSTEMS FOR WASTEWATER TREATMENT: AN OVERVIEW,

Cold Regions Research and Engineering Lab., Hanover, NH.
S. Reed, R. Bastian, and W. Jewell.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 1-12.

Descriptors: *Wastewater treatment, *Aquaculture, Wetlands, Aquatic plants, Fish, Ponds, Stabilization ponds, Water hyacinth, Biological wastewater treatment.

Aquaculture technology was evaluated for its suitability for municipal wastewater treatment. Artificially constructed wetlands show promise of general application. Water hyacinth systems are ready for routine use in municipal wastewater treatment in climates where the plants grow naturally. The possibility of using more cold-tolerant plants should be investigated. In combined systems finfish effectively participate in the treatment process, removing suspended solids in final polishing. Combined systems cannot presently be optimized for both protein/biomass production and wastewater treatment. Although information on operating fish culture units in stabilization ponds is available, routine design for the purpose of wastewater treatment is not yet possible. (Cassar-PTT)
W86-02048

FEDERAL ROLE AND INTEREST BY EPA'S CONSTRUCTION GRANTS PROGRAM IN AQUACULTURE SYSTEMS FOR MUNICIPAL WASTEWATER TREATMENT,

Environmental Protection Agency, Washington, DC.
J. N. Smith, and R. K. Bastian.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 29-33, 6 ref.

Descriptors: *Wastewater treatment, *Aquaculture, Federal jurisdiction, Construction, Grants Program, Innovative/alternative technology.

The subject of water pollution control and wastewater treatment can be seen as a problem of biology rather than simply one of engineering. The scientific basis for treating and the reuse/recycling of wastewater should give greater emphasis to ecology and the management of natural biological systems. Neither the technological problems of designing biological systems nor the political and institutional constraints facing their implementation should prevent the increased future use of aquaculture systems for wastewater treatment. Where these systems can be made to work they should offer effective solutions to the need for cost-effective, environmentally acceptable, and energy efficient wastewater treatment and recycle/reuse practices. In order to assist in encouraging greater use of these aquaculture systems for wastewater treatment, we need to make sure that the results of past and ongoing research efforts are effectively applied to innovative/alternative technology projects funded through the EPA Construction Grants Program. (Author)
W86-02049

USE OF AQUATIC PLANTS AND ANIMALS FOR THE TREATMENT OF WASTEWATER: AN OVERVIEW,

California Univ., Davis. Dept. of Civil Engineering.
G. Tchobanoglous, R. Stowell, R. Ludwig, J. Colt, and A. Knight.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 35-55, 3 fig, 6 tab, 16 ref.

Descriptors: *Wastewater treatment, *Aquaculture, Aquatic plants, Fish, Biological wastewater treatment, Algae, Zooplankton, Shellfish, Crustaceans, Design criteria.

Aquatic systems employing plants and animals have been proposed as alternatives to conventional wastewater treatment systems. The fundamental difference between conventional and aquatic systems is that in the former, wastewater is treated rapidly in highly managed environments, whereas in the latter, treatment occurs at a comparatively slow rate in essentially unmanaged natural environments. The consequences of this difference are (1) conventional systems require more construction and mechanization but less land than aquatic systems, and (2) conventional processes are subject to greater operational control and less environmental influence than aquatic processes. The major stimulus for further research into the fundamentals, design, and management of aquatic systems is the potential for reducing the construction and operation and maintenance costs for wastewater treatment. The general concept involved in the design and use of aquatic systems are presented and the implications are discussed in this overview. (Author)
W86-02050

WETLANDS CREATION FOR HABITAT AND TREATMENT - AT MT. VIEW SANITARY DISTRICT, CA.,

Mountain View Sanitary District, Martinez, CA.
F. C. Demgen.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 61-73, 4 fig, 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Wetlands, Aquatic habitats, Nutrient removal, Nitrogen, Phosphorus, Mt. View, California, Habitats, Aquatic plants, Vegetation, Algae, Animals, Invertebrates.

The Mt. View (California) Sanitary District's wetlands creation project on low lying reclaimed tidal lands, uses treated sewage effluent as a freshwater source. The wetlands system covers 20.3 acres and consists of five interconnected areas with tributary edge habitat. Detention time is 5 days at design capacity. The ecosystem has been balanced and healthy. The habitat supports 72 species of plants, 21 species of animals, 90 species of birds, and 34 species of aquatic invertebrates. Natural predators control mosquito breeding. No avian botulism or odors are evident because good water circulation is maintained. Redwood bark floats have been added to provide supplementary habitat for aquatic invertebrates. Water quality parameters are as follows: (1) dissolved oxygen, 1 mg/liter to supersaturation, normally above 5 mg/liter, (2) BOD, varies seasonally, usually less than loading levels and consists of algae and other organisms, (3) suspended solids, usually reduced in winter but not in summer, (4) nitrates, >90% removal consistently, (5) ammonia and organic nitrogen, about 60% removal, and (6) phosphates, 37-53% removal.

W86-02051

CYPRESS WETLANDS FOR TERTIARY TREATMENT,

Boyle Engineering Corp., Orlando, FL.
W. R. Fritz, and S. C. Helle.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 75-81, 7 fig. ENV76-23276.

Descriptors: *Wastewater treatment, *Wetlands, *Cypress, Florida, Nutrient removal, Biological wastewater treatment, Tertiary wastewater treatment, Swamps.

Cypress domes (shallow, saucer-shaped depressions receiving drainage water) are technically feasible as a tertiary wastewater treatment method. Three concepts are possible. (1) The natural dome needs little modification. Treated wastewater, applied to the center of the dome percolates to the groundwater, losing contaminants on the way. (2) The isolated dome needs an earth dike around the perimeter to keep out storm runoff and retain wastewater. (3) The flow through system operates as a sheet flow through the cypress strand with purification en route to a downstream waterway. Tests show 98% total nitrogen removal and 97% total phosphorus removal. Cypress strands have economic advantages over the other methods because they can process a larger volume than the domes. Bacterial and viral contamination of the groundwater do not appear to be a problem if effluent is sufficiently chlorinated and if all short-circuits to the groundwater are avoided. Areas suitable for municipal treatment must have the following: sufficient capacity, low failure rates, flood and natural disaster resistance, adequate sunshine, electricity for pumps, and a sufficient safety factor. (Cassar-PTT)
W86-02052

DRUMMOND PROJECT - APPLYING LAGOON SEWAGE EFFLUENT TO A BOG: AN OPERATIONAL TRIAL,

Geological Survey, Ithaca, NY.
W. M. Kappel.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Poceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430-/9-80-006, September 1979. MCD-67. p 83-90.

Descriptors: *Wastewater treatment, *Wetlands, *Bogs, Shagnum, Drummond, Wisconsin, Biological wastewater treatment, Lagoons.

The Drummond Project (Wisconsin) is a multiresource continuing study of a sphagnum bog and its response to the application of sewage effluent. The intent of the project is to understand the dynamics of this type of wetland as well as determining whether this type of wetland can be used to effectively treat and assimilate residential sewage effluent. Up to this time, little was known of the dynamics or treatment capabilities of sphaghnum peat wetland. (Author)
W86-02053

EFFECTIVENESS OF A WETLAND IN EASTERN MASSACHUSETTS IN IMPROVEMENT OF MUNICIPAL WASTEWATER,

IEP, Inc., Wayland, MA.
D. A. Yonika.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 91-100, 4 fig, 3 tab.

Descriptors: *Wastewater treatment, *Wetlands, Biological wastewater treatment, Tertiary wastewater treatment, Concord, Massachusetts, Marshes, Nutrient removal, Nitrogen removal, Phosphorus removal.

The Concord, Massachusetts, sewage treatment plant discharges secondary effluent to a 48-acre deep marsh. The wetlands functions as two units: a 6-acre shallow marsh/shrub swamp and the deep marsh. Retention time is 57 days. Final discharge is into the Concord River. Concentrations of substances (in mg/liter) in effluent and in discharge to the river, respectively, were as follows: ammonia N, 8.0 and 0.15; nitrate-N, 3.1 and 0.47; nitrite nitrogen, 0.019 and 0.010; Kjeldahl N, 10.0 and 0.77; total phosphorus, 2.1 and 0.17; orthophosphate, 1.6 and 0.10; and BOD, 38.2 and 2.3. Average annual removal efficiencies ranged from 20% for nitrate-N to 67% for BOD. Nitrite-N was released from the system. Removal efficiency varied seasonally. The BOD uptake was higher on an annual basis in the shallow area (20.8 pounds per acre per day). The shallow area was also more efficient than the deep marsh in removing phosphorus. Ammonia-N removal rates were higher in the deep marsh; nitrate-N removal rates were higher in the shallow area. (Cassar-PTT)
W86-02054

WETLAND TERTIARY TREATMENT AT HOUGHTON LAKE, MICHIGAN,

Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
R. H. Kadlec.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 101-139, 13 fig, 11 tab, 43 ref.

Descriptors: *Wastewater treatment, *Wetlands, Biological wastewater treatment, Nutrient removal, Nitrogen removal, Phosphorus removal, Tertiary wastewater treatment, Environmental effects, Aquatic habitats, Habitats, Plants, Animals, Houghton, Michigan.

Secondary wastewater effluent was discharged to a 7 sq km peatland near Houghton, Michigan, for five consecutive summers. All nitrogen and phosphorus was stored or removed within a 5-acre area at a discharge rate of 100,000 gal/day and within a 50-acre area at a discharge rate of 1 million gal/day. Chloride and other inactive dissolved ions moved through the wetland with very little change. pH, higher in the discharge, dropped rapidly to background levels (slightly acid) as the discharge traveled across the wetland. Conductivity also dropped to background levels. Suspended solids were deposited close to the discharge area. Erosion, plant mortality, odor, and effects on animals and birds were nonexistent. The only visual effects were greener plants and slightly deeper water near the discharge. Coliforms and viruses appeared at equal levels in the discharge and the wetland. (Cassar-PTT)
W86-02055

ENGINEERING, ENERGY AND EFFECTIVENESS FEATURES OF MICHIGAN WETLAND TERTIARY WASTEWATER TREATMENT SYSTEMS,

Williams and Works, Grand Rapids, MI.
T. C. Williams, and J. C. Sutherland.
IN: Acquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 141-173, 12 fig, 3 tab, 15 ref.

Descriptors: *Wastewater treatment, *Wetlands, Biological wastewater treatment, Irrigation, Wastewater irrigation, Tertiary wastewater treatment, Houghton, Vermontville, Michigan, Phosphorus removal, Nitrogen removal, Spray irrigation, Energy, Capital costs.

Two markedly different Michigan wetlands are receiving pond stabilized secondary treated nonchlorinated wastewater. Both operations result in removal of 98%-100% of phosphorus through contact with reactive soils. At Vermontville, flood irrigation fields (11.5 acres) overgrown with volunteer wetland vegetation (mainly cattail) treat and dispose of wastewater princpally by slow seepage (4 inches-week) through phosphorus-absorbing clayey-silty glacial till. Occasional uncontrolled runoff of wetland surface waters releases phosphorus, BOD, and uspended solids in concentrations slightly above permitted limits. Seepage wetlands offer potential advantages compared to upland spray irrigation for small communities. Savings of 25% or greater on capital plus land costs can be expected for flow below 0.1 MGD average flows. Field maintenance may not be needed, and irrigation energy costs need be no higher than those for surface irrigation of uplands. At Houghton Lake natural state-owned wetlands (600 acres) treat and dispose of wastewater by overland flow across a reactive peat substrate. Construction and maintenance in 1978 involved negligible ecological impact. Construction was done in the dormant months between March and June. The wetland transmission and irrigation pipelines are strapped to a wooden walkway suspended 2.5 ft above the wetland on pole pilings anchored in clay. The cost of the wetland wastewater distribution system was $21.00/ft (1979 dollars). Irrigation electrical energy costs were approximately $7.21 in 1979. The wetland capital and land costs represent savings of approximately $1 million compared to upland irrigation (Author)
W86-02056

ENGINEERING DESIGN DATA FOR SMALL VASCULAR AQUATIC PLANT WASTEWATER TREATMENT SYSTEMS,

National Space Technology Labs., NSTL Station, MS.
B. C. Wolverton.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 179-192, 3 fig, 4 tab, 12 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, Lagoons, Wastewater lagoons, Water hyacinth, Duckweed, Phenol, Biological wastewater treatment, Secondary wastewater.

A general background of the research findings of the National Aeronautics and Space Administration's Vascular Aquatic Plant Program using higher plants such as the water hyacinth (Eichhornia crassipes) and duckweed (Lemna sp. and Spirodela sp.) to treat domestic wastewater is presented. New data on a small two-cell lagoon system using only duckweed is included. Further laboratory experiments were conducted to correlate BOD removal with known wet masses of water hyacinths. The data from these experiments with domestic wastewater indicates that an average total BOD removal rate of 4.0 mg BOD/gram wet weight could be achieved with a seven day retention time. When a phenol solution is substituted for the wastewater, the average total BOD removal is 3.5 mg BOD/gram wet weight in seven days. This data along with the results of the previous field experiments, is used to develop design criteria for small domestic wastewater treatment systems servicing a maximum of 3000 people. The criteria for these systems addresses the problems of BOD reduction, and suspended solids reduction, odor control, and sludge accumulation. (Author)
W86-02057

DEVELOPMENT OF HYACINTH WASTEWATER TREATMENT SYSTEMS IN TEXAS,

Texas State Dept. of Health, Austin.
R. Dinges.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 193-231, 16 fig, 4 tab, 15 ref, 1 append.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Water hyacinth, Biological wastewater treatment, Nutrient removal, Nitrogen removal, Phosphorus removal, Algae, Texas, Hydraulic loading.

Plant-scale wastewater treatment by water hyacinth culture has been implemented in several Texas locations. Some general conclusions can be

drawn from these experiences. Sufficient design data is presently available for constructing hyacinth tretment facilities in warm climates. However, optimal design is necessary to minimize areas and costs for using this treatment system in greenhouses in temperate climates. The most critical consideration in culture basin design is hydraulic loading. A triangle-shaped basin is an ideal shape; two of these may be combined to form a rectangle for better land use. The primary pollutant removal mechanism in hyacinth treatment is removal of suspended particulates. Since hyacinth harvesting disrupts treatment, multiple culture basins should be used for alternate operation. Nitrogen management is a key factor in utilizing hyacinths for wastewater treatment or for biomass production. Stablilization ponds can be designed for effective nitrogen reduction. Hyacinth removes most remaining nitrogen in pond effluent, especially that in organic form such as algae. Effluent from a hyacinth treatment system can produce effluents with less than 10 mg/liter BOD and total suspended solids. (Cassar-PTT)
W86-02058

WATER HYACINTH ADVANCED WASTEWATER TREATMENT SYSTEM,

Coral Ridge Properties, FL.
D. Swett.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. p 233-255, 2 fig, 7 tab.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Water hyacinth, Advanced wastewater treatment, Lagoons, Coral Springs, Florida, Biological wastewater treatment.

A one-year field experiment at the 378,530 liters/day (100,000 gpd) level has demonstrated that a system of 5035 sq m (54,200 sq ft) of water hyacinth (Eichhornia crassipes) lagoons can provide advanced treatment to effluent from an activated sludge plant by achieving removal rates of 67% for total suspended solids, 98% for biochemical oxygen demand, 97% for total nitrogen and 79% for total phosphorus. Biomass produced by the system offers a potential for energy, fertilizer or fodder production. (Author)
W86-02059

WATER HYACINTH WASTEWATER TREATMENT SYSTEM AT WALT DISNEY WORLD,

Reedy Creek Utilities Co., Inc., Lake Buena Vista, FL.
A. P. Kruzic.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis, EPA 430/9-80-006, September 1979. MCD-67, p 257-271, 2 fig, 3 tab, 5 ref.

Descriptors: *Wastewater treatment, *Aquatic plants, Water hyacinth, Biological wastewater treatment, Walt Disney World, Florida.

A water hyacinth wastewater treatment system is being tested at Walt Disney World, Florida. Consisting of three 1/4-acre channels with piping, hydraulic control devices, and pumping equipment, it is designed to handle flows up to 200,000 gpd with a probable minimum of 50,000 gpd. The completely mobile harvesting system includes a front end loader, conveyor-chopper, and forage wagon. Although most components of the project are operating as planned, some problems have developed. For example, in using a backhoe to seed the hyacinths into the channels, much grass and dollarweed was also brought in. The unwanted plant species had to be removed. In treating primary effluent, dissolved oxygen concentrations are very low. Floating sludge and fly larvae exist in ponds which once supported a mosquitofish population. Testing of the system continues. (Cassar-PTT)
W86-02060

UTILIZATION OF WATER HYACINTHS FOR CONTROL OF NUTRIENTS IN DOMESTIC WASTEWATER – LAKELAND, FLORIDA,

Dawkins and Associates, Inc., Orlando, FL.
E. A. Stewart.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 273-293, 8 fig, 1 tab, 8 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, Fish, Water hyacinth, Lakeland, Florida, Nutrient removal, Nitrogen removal, Phosphorus removal, Invertebrates, Mosquitoes, Biological wastewater treatment, Lagoons, Wastewater lagoons, Ponds.

A large (up to 13 mgd) water hyacinth treatment demonstration project in Lakeland, Florida, was based on nutrient removal requirements of 1.5 mg/liter total N and 0.4 mg/liter total P. The system consisted of three one-acre lagoons in series. Plant health and chlorophyll content declined from Pond 1 to Pond 3, with iron the limiting nutrient. Oxygen levels in the water were adequate to above saturated, rarely falling below 2 mg/liter in Pond 1, which was expected to have the lowest levels. pH changed from neutral to slightly alkaline. BOD and suspended solids were reduced somewhat. Nitrogen and phosphorus uptake were greater than expected for the crop density of 99 metric tons/ha. Water color and turbidity were noticeably reduced throughout the system. Dissolved solids decreased due to selective uptake of certain ions such as ferrous ion, calcium, and chloride. Coliform reduction was dramatic. The biological nature changed throughout the system. In Pond 1 hyacinths were large; macroinvertebrates were restricted to chironomid larvae, mosquito larvae, and a snail; two fish species were surviving well. In Pond 2 the hyacinths were smaller and suffered from chlorosis; the invertebrate and fish populations were diverse and numerous. In Pond 3 hyacinths were very chloratic; fish and invertebrates were even more diverse than in Pond 2. Designing the system for plant growth kinetics in cool weather allows for a safety margin. (Cassar-PTT)
W86-02061

SOME ECOLOGICAL LIMITS TO THE USE OF ALTERNATIVE SYSTEMS FOR WASTEWATER MANAGEMENT,

Michigan State Univ., East Lansing. Inst. of Water Research.
D. L. King.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 299-307, 14 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Lagoons, Ponds, Biological wastewater treatment, Algae, Cyanophyta, Fish, Nitrogen removal, Phosphorus removal, Standards, Effluent standards, Ecosystems.

Biological, chemical, and physical factors interact to place limitations on the use of natural ecosystems for wastewater treatment. An understanding of these limits allows better design of treatment systems to fit individual environmental and wastewater conditions. At the Michigan State University Water Quality Management Facility expansion of the lagoon system was based on effluent tests which showed excellent BOD and coliform removal. However, BOD was underestimated by the 5-day test. Algae, spilling into the effluent, did not decompose within 5 days but became part of the BOD load further downstream. When suspended solid limits were placed on lagoon effluents, lagoon systems required revision to meet standards. Other natural factors to consider are seasonal variations and the lack of a natural mechanism to remove phosphorus on a long-term basis. The nutrient balance in wastewater is not suitable for pond biota, favoring growth of undesirable blue-green algae. The presence of fish which eat zooplankton also favors eventual dominance of blue-green algae and supression of macrophytes. Another limiting factor, toxic to fish, is the ammonia and high pH common in wastewater ponds. The strict water quality standards with respect to pathogens and other contaminants discourages use of wastewater aquaculture food products at this time. (Cassar-PTT)
W86-02062

UTILIZATION OF SILVER AND BIGHEAD CARP FOR WATER IMPROVEMENT,

Arkansas Game and Fish Commission, Lonoke.
S. Henderson.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 309-350, 5 append.

Descriptors: *Wastewater treatment, *Aquaculture, *Fish, Benton, Arkansas, Water quality, Silver carp, Bighead carp, Carp, Lagoons, Wastewater lagoons, Biological wastewater treatment.

Filter feeding fish, the silver and bighead carp, were stocked in an existing lagoon treatment system in 1975-76 for a preliminary evaluation of the effect of the fish on water quality and the potential of this nutrient source for fish production. In a full-scale 6-cell, 24-acre facility at Benton, Arkansas, BOD removal was 96.4% and suspended solids removal was 86% during the first 8 months of the study. Detailed water quality monitoring results are given in the appendixes. With three months remaining in the growing season, the standing crop of fish in the four ponds containing fish was >22,777 kg, a total average production of 3344 kg/ha. Fish tissue and water samples were regularly analyzed for particular pathogens, metals, and pesticides. Only Staphylococcus bacteria, copper and mercury levels were above detection limits. Using the fish as fish meal would yield a gross return of $430-$575/ha/year; for direct human consumption, $3600-$4525/ha. (Cassar-PTT)
W86-02063

TREATED SEWAGE EFFLUENT AS A NUTRIENT SOURCE FOR MARINE POLYCULTURE,

Woods Hole Oceanographic Institution, MA.
J. H. Ryther.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 351-375, 7 fig, 5 tab, 5 ref.

Descriptors: *Wastewater treatment, *Aquaculture, Fish, Shellfish, Oysters, Clams, Flounder, Lobsters, Biological wastewater treatment, Tertiary wastewater treatment, Seaweed, Algae, Nitrogren removal, Nutrients.

A biological tertiary sewage treatment-marine aquaculture system was developed and studied at the Woods Hole Oceanographic Institution. Secondary sewage effluent mixed with sea water was used to grow phytoplankton in continuous flow-through cultures. This product was fed to several varieties of shellfish in stacked trays. Uneaten food and wastes from the shellfish supported small invertebrates, in turn eaten by lobster and flounder stocked in the shellfish areas. Effluent from the shellfish tanks was passed through red algae grown in suspended culture to reduce nutrients further. Total nitrogen removal efficiency was 93.6%. (Cassar-PTT)
W86-02064

SOLAR AQUACELL SYSTEM FOR PRIMARY, SECONDARY OR ADVANCED TREATMENT OF WASTEWATERS,

Solar AquaSystems, Inc., Encinitas, CA.
W. C. Stewart, and S. A. Serfling.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1969. MCD-67. p 377-412, 6 fig, 3 tab, 44 ref.

Descriptors: *Wastewater treatment, *Solar energy, Solar AquaCell system, Biological wastewater treatment, Nutrient removal, Aquatic plants, Hercules, California, Lagoons, Wastewater lagoons, Advanced wastewater treatment, Tertiary wastewater treatment, BioWeb substrates, Aeration, Anaerobic conditions, Primary wastewater treatment.

The Solar AquaCell process consists of a series of multicell lagoons, a diffused aeration system, high surface area fixed-film substrates as a biofilm habitat, aquatic macrophytes, greenhouse pond cover, and a solar heat exchange system to heat the water phase. Three AquaCell pond systems (anaerobic, facultative, and aerobic) each with high surface area biofilm devices, can be used in series to achieve primary, secondary and/or advanced treatment, respectively. The system designed for the city of Hercules, California, 1325 cu m per day of raw wastewater, is described. (Cassar-PTT)
W86-02065

RESOURCE RECOVERY FROM WASTEWATER AQUACULTURE,

Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
L. O. Bagnall.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979, MCD-67. p 421-439, 11 fig.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, Biological wastewater treatment.

Removal and recycling of the nutrients and other components in the wastewater aquaculture system are completed by harvesting, processing and utilizing the aquatic organisms in which the nutrients are collected. Aquatic species grown in wastewater have been experimentally used for food, feed, fiber, fertilizer, and energy. Some of the processes and products appear to be technologically and economically feasible on an operational scale. (Author)
W86-02066

ENERGY FROM WASTEWATER AQUACULTURE SYSTEMS,

Ecoenergetics, Inc., Vacaville, CA.
J. R. Benemann.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 441-458, 4 tab, 39 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Anaerobic digestion, *Aquatic plants, Energy, Biological wastewater treatment, Digestion, Methane, Biomass, Ponds.

Aquatic biomass produced in wastewater treatment ponds can be an energy source. The high moisture, high nutrient, and low lignocellulose content of most aquatic plants makes them ideal substrates for anaerobic digestion. Although little specific data is available, this reaction can be expected to proceed without significant difficulties and at rates comparable to those seen with sewage sludge. Studies are being conducted on two-phase reactors which separate the acid and methane baterial cultures. Other technologies are gas recovery from landfills or anaerobic ponds and the anaerobic filter process using an expanded bed reactor. The possible fuel outputs for a secondary wastewater aquaculture system of 15 mgd are 6.0 MBTU/MG with energy conservation of 6.0 MBTU/MG. A tertiary treatment system would produce about 37.5 MBTU/MG of net fuel output and have an energy conservation potential of 13.5 MBTU/MG. (Cassar-PTT)
W86-02067

OVERVIEW OF THE LEGAL, POLITICAL, AND SOCIAL IMPLICATIONS OF WASTEWATER TREATMENT THROUGH AQUACULTURE,

Denver Research Inst., CO.
L. C. Lohman.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 459-474, 13 ref.

Descriptors: *Wastewater treatment, *Water law, *Aquaculture, *Political aspects, *Social aspects, Legal aspects, Public participation, California, Regulations, Federal jurisdiction, State jurisdiction, Legislation, Standards, Water rights, Water reuse, Attitudes.

The legal, political, and social elements involved in full-scale aquaculture for wastewater treatment are highlighted. Emphasis is on California, where several aquaculture projects are under development. On the Federal level many statutes, regulations, and agencies are concerned with wastewater aquaculture. The National Water Pollution Control Act and its amendments exert the most direct control over wastewater discharges. State law regarding water quality is largely derived from Federal law. The power of particular interest to proponents of wastewater aquaculture is the state control over rights to use water and obligations to protect all water users. Wastewater aquaculture can change the quantity and quality of water for downstream users. States generally exercise control over all aspects of wastewater treatment with special concern about effects on public health. Legal and political elements are closely entwined. Influences and policies affect decisions on new wastewater facilities. Many conflicts are possible. Society reacts to proposed projects as different interest groups, from individuals to large organizations. Acceptance of wastewater aquaculture by the public is easier if effluent meets standards and no nuisances are created. (Cassar-PTT)
W86-02068

ECONOMICS OF AQUATIC TREATMENT SYSTEMS,

Metcalf and Eddy, Inc., Sacramento, CA.
R. W. Crites.
IN: Aquaculture Systems for Wastewater Treatment: Seminar Proceedings and Engineering Assessment, September 11-12, 1979, University of California-Davis. EPA 430/9-80-006, September 1979. MCD-67. p 475-485, 11 tab, 20 ref.

Descriptors: *Wastewater treatment, *Aquaculture, *Aquatic plants, *Fish, Biological wastewater treatment, Tertiary wastewater treatment, Lagoons, Wastewater lagoons, Wetlands, Water hyacinth, Nutrient removal, Advanced wastewater treatment, Oxidation ponds, Economic aspects, Wetlands, Energy, Land disposal.

Aquatic treatment systems, although still in the development stage in most areas, offer low-cost, low-energy solutions for wastewater treatment. For advanced secondary treatment (BOD and suspended solids, 10 mg/liter; no nutrient removal), combinations of oxidation ponds with water hyacinths or wetlands are cost effective compared at 1 mgd with land treatment or conventional treatment. For the lowest cost flowsheet examined, the land cost can reach $115,000/acre before the conventional activated sludge system becomes economically competitive. For advanced wastewater treatment (nitrogen, 3 mg/liter; phosphorus, 1 mg/liter), aquatic systems alone have not been developed technically to achieve the same standards. The aquatic processes can, however, be integrated with land treatment and oxidation ponds to achieve this high quality of effluent. In the cases studied, the combined equatic-land treatment systems were less expensive than land or conventional treatment at 1 and 10 mgd. As aquatic systems become further developed and demonstrated, the costs will become more firmly established. In addition, the economic benefits (such as from compost, fertilizer, soil conditioners, or biogas) may offset some of the costs of wastewater treatment in the future. (Author)
W86-02069

TOXIC AND HAZARDOUS WASTES,

Proceedings of the Sixteenth Mid-Atlantic Industrial Waste Conference, June 24-26, 1984. Technomic Publishing Co., Inc., Lancaster, PA. 1984. Edited by Michael D. LaGrega and David A. Long. 587 p.

Descriptors: *Hazardous materials, *Industrial wastes, *Groundwater pollution, *Waste-water treatment, *Waste disposal, Sludge disposal, Conferences, Groundwater management, Land disposal, Activated sludge, Heavy metals, Incineration, Recycling, Industrial wastewater, Landfills, Symposium.

This book is an outgrowth of the proceedings of the sixteenth Mid-Atlantic Industrial Waste Conference. The conferences are designed to provide a forum for interchange of new technical and nontechnical solutions for industrial pollution control problems of the region by allowing regulatory agencies, industrial agencies, universities, and consulting engineers to exchange information regarding their various activities. The sessions of the conference included: biological wastewater treatment, waste incineration and energy recovery, international research topics, regulatory compliance, recycle/reuse, heavy metal control, physical-chemical processes, sludge management, hazardous waste-site clean-up, and groundwater protection. This book is intended to provide a state-of-the-art synopsis of contemporary practice in the control of industrial, toxic, and hazardous wastes. (Geiger-PTT)
W86-02094

BIODETOXIFICATION OF HAZARDOUS WASTEWATERS WITH ACTIVATED ROTATING BIOLOGICAL CONTACTORS,

Memphis State Univ., TN. Dept. of Civil Engineering.
J. W. Smith, and L. W. Moore.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 15-28, 13 fig, 3 tab, 2 ref.

Descriptors: *Hazardous materials, *Organic wastes, *Biological wastewater treatment, *Wastewater treatment, *Organic pesticides, Chlorinated hydrocarbons, Halogenated pesticides, Copper, Leachates, Industrial wastewater, Industrial wastes, Activated sludge process, Aeration, Pesticides, Color, Hydrogen ion concentration.

A bench-scale rotating biological contactor (RBC) that was modified to include an aeration basin and final clarifier with sludge recycle to the fixed film media (ARBC) was tested on several hazardous organic wastes. The ARBC system was compared to a completely mixed activated sludge system with respect to treatability of pesticide formulation wastewater, and wastewaters containing dog food or Cu and synthetic leachates containing heptachlor, chlordane and endrin, or organic wastewaters high in color or pH. Results showed that ARBC systems achieved higher organic removal efficiencies than did activated sludge systems, and generally removed greater quantities of hazardous pollutants such as Cu and pesticides. About 95% of the heptachlor, chlordane and endrin were removed from wastewater by two ARBC systems operating in series. The ARBC system tolerated as high as 5 milligrams/liter soluble Cu, but long term exposure to such concentrations would probably interfere with treatment efficiency. The ARBC system exhibited greater removal efficiencies in the treatment of a strong, organic industrial waste than did a completely mixed activated sludge system. (Geiger-PTT)
W86-02095

APPLICATION OF THE TOTAL BARRIER OXIDATION DITCH ACTIVATED SLUDGE PROCESS FOR SINGLE STAGE NITRIFICATION-DENITRIFICATION OF HIGH STRENGTH WASTEWATER,

Reid Engineering Co., Fredericksburg, VA.
J. H. Reid.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 29-41, 2 fig, 1 tab.

Descriptors: *Denitrification, *Nitrification, *Activated sludge process, *Wastewater treatment, *Food-processing wastes, Aeration, Aerators, Ammonia, Food processing industry, Industrial wastes, Biological wastewater treatment, Suspended solids, Biological oxygen demand, Activated sludge, Oxidation.

In January 1981, the first Total Barrier Oxidation Ditch activated sludge system in the U.S. began operation at a poultry processing plant to provide nitrification for ammonia removal, denitrification for nitrate removal, and enhance secondary BOD and suspended solids treatment. The barrier oxidation ditch basin is preceded by an anaerobic flow equalization pretreatment basin. The oxidation ditch operates at an average volume of 700,000 gal. Three activated sludge clarifiers are operated in parallel with a total effective settling area of 1350 sq ft. One chlorine contact basin is used for combined effluent disinfection and post aeration. The single stage, low load, continuous loop reactor extended aeration activated sludge process was selected for this treatment system upgrade, based on design loadings and performance capability. Performance data shows that the Total barrier Oxidation Ditch can be utilized as a single activated sludge treatment process, to provide very high removals of carbonaceous and nitrogenous oxygen demand and total N during the warm season months between April and October. During these months nitrification efficiency was 99%, and total N removal efficiency was 92%. During the winter season months, nitrification efficiency was reduced to 97% and total N removal efficiency was reduced to 84%. The automation of aerator oxygen transfer rate to maintain a looped reactor intake zone dissolved oxygen concentration less than or equal to .2 milligrams/liter would stabilize denitrification efficiency in the warm season months and greatly improve the denitrification efficiency attainable during the winter season. (Geiger-PTT)
W86-02096

DEVELOPMENT OF ENERGY EFFICIENT ACTIVATED SLUDGE SYSTEMS THROUGH UTILIZATION OF NUTRIENT REMOVAL PROCESSES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. W. Randall.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 52-63, 2 fig, 4 tab, 8 ref.

Descriptors: *Nutrient removal, *Denitrification, *Biological wastewater treatment, *Wastewater treatment, *Cost analysis, Nutrients, Phosphorus removal, Oxidation, Activated sludge process, Energy, Aeration, Oxidation, Chemical oxygen demand.

Biological nutrient removal wastewater treatment processes have been adequately demonstrated under full-scale conditions to warrant general application. Due to their decreased oxygen requirements, these processes have the potential to substantially reduce the amount of energy that must be expended to treat a given wastewater. The energy saving aspects of denitrification have been thoroughly demonstrated by widespread application. The potential energy savings of biological P removal systems have far less documentation. Research using biological P removal has shown promise for high COD reduction, when truly anaerobic conditions prior to highly aerobic conditions are maintained. The oxidation ditch modification of the activated sludge process appears to be ideally suited for economic, energy efficient biological nutrient removal operation. Nutrient removal oxidation ditch design can be readily achieved using widely accepted techniques, such as Monod type equations. (Geiger-PTT)
W86-02097

MICROBIOLOGY OF FILAMENTOUS BULKING OF INDUSTRIAL AND DOMESTIC ACTIVATED SLUDGE,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
T. M. Williams, R. F. Unz, and K. Beard.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 64-77, 1 fig, 4 tab, 12 ref. CME-79189191.

Descriptors: *Activated sludge, *Microbiological studies, *Bacteria, *Biological wastewater treatment, *Culturing techniques, Wastewater treatment, Activated sludge process, Mixed liquor solids, Microorganisms, Separation techniques, Industrial wastewater, Municipal wastewater.

The distribution of filamentous microorganisms in bulking activated sludge obtained from several industrial and domestic wastewater treatment plants was investigated along with isolation procedures suitable for the recovery of filamentous microorganisms. Microscopic examination of mixed liquor specimens from treatment plants experiencing poorly settling solids, revealed the presence of one or more types of filamentous microorganisms. In general, treatment plants operated at low to medium organic loading rates produced activated sludge solids populated by Haliscomenobacter hydrossis, and Eikelboom types 0041, 0675, and 0803. Aeration basins with higher organic loading rates produced activated sludge solids populated by Sphaerotilus natans, Thiothrix spp., and types 1701 and 021 N. Pretreatment of samples from industrial and domestic sources prior to innoculation of culture media facilitated isolation of filamentous bacteria. A total of 42 axenic strains of bacteria, representing seven distinct groups of filamentous organisms, were isolated. The morphological and cytological features of the isolated bacteria are discussed. (Geiger-PTT)
W86-02098

UTILIZATION OF AN INDUSTRIAL WASTE OIL AS AN ALTERNATIVE FUEL FOR A MUNICIPAL SLUDGE INCINERATOR,

Tennessee Univ., Knoxville.
D. W. Weeter.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 99-107, 2 fig, 2 tab, 4 ref.

Descriptors: *Sludge disposal, *Oil recovery, *Oil wastes, *Recycling, *Sludge utilization, Wastewater treatment, Incineration, Wastewater reclamation, Cost analysis, Municipal wastewater, Waste recovery, Waste disposal, Industrial wastes.

A project to provide fuel beneficiation for a municipal sludge multiple hearth furnace incinerator at the Maryville Regional Wastewater Treatment Plant (MRWTP) is described. Waste oil sludge from the Aluminum Company of America (ALCOA) Tennessee operations was treated with alum and sulfuric acid to reclaim rolling oils. The MRWTP was modified to utilize the reclaimed oil. Fuel switching between natural gas and oil sludge was adopted along with plans to keep the incinerator temperature up when not burning sewage sludge. The new system had no major effects on water quality. The additional ash that was added by the oil was not hazardous and could be legally spread on nearby corn fields. A 50 inch induced draft fan was installed to meet New Source Performance Standards for air quality. The above ground oil storage vessel was diked to comply with EPA oil spill prevention regulations. Since the project was implemented, natural gas costs have decreased from $144 thousand to $1,000 per year. A waste exchange contract was developed between ALCOA and MRWTP.
W86-02099

BIOLOGICAL TREATMENT OF INDUSTRIAL WASTEWATERS IN THE USSR,

American Standards Testing Bureau, Inc., New York.
L. Shmidt.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 121-139, 4 fig, 4 tab, 4 ref.

Descriptors: *Biological wastewater treatment, *Industrial wastewater, *Sludge disposal, *Activated sludge process, *Wastewater treatment, Industrial wastes, Aeration, Chemical treatment, Sludge drying, Sludge disposal, Solid waste disposal, Pulp wastes, Waste disposal, Activated sludge.

Biological treatment is widely used for industrial wastewater treatment in the chemical, petrochemical, and pulp and paper industries in the USSR. The most widely used biological treatment process is the activated biological sludge process and its modifications. The classical plug-flow-recycle system or its modifications such as tapered or step aeration systems are most often used. The standard unit for the biological wastewater treatment facility includes an equalizer, a primary clarifier, an aeration tank and a secondary clarifier. Multi-stage systems for biological wastewater treatment have been designed over the last few years. Five categories of multi-stage systems are identified. To reduce the cost of industrial wastewater treatment, an increase in the loading of aeration tanks and biofilters is needed. The Baikal Pulp Mill wastewater treatment plant includes a biological wastewater treatment system, a chemical wastewater treatment system, lagoons for polishing and aerating wastewaters and sludge thickening, filtering, drying and combustion units. (Geiger-PTT)
W86-02100

FACILITY UPGRADES DUE TO HAZARDOUS MATERIALS REGULATIONS,

GTE Government Systems Corp., Mountain View, CA. Sylvania Systems Group-Western Div.
S. M. Hochstadt.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 158-172, 3 fig, 2 tab, 10 ref.

Descriptors: *Wastewater treatment, *Cost analysis, *Hazardous materials, *Waste storage, *Wastewater facilities, Maintenance costs, Operating costs, Waste disposal, Metal-finishing wastes, Wastewater management, Industrial wastes, Industrial wastewater.

Industry faces a multitude of government regulations dealing with the storage, use, and disposal of hazardous materials in order to protect the health and safety of employees, the public, and the environment. Environmental regulations are handled under the federally legislated Clean Water, Clean Air, and Resources Conservation and Recovery Acts. The discharge of industrial process wastewaters is usually regulated by a local water district or municipal public works department. Most recently, attempts have been made to regulate the storage of hazardous materials in underground tanks. GTE Government Systems Corporation uses four separate chemical and two waste storage facilities which are being upgraded after twenty years of operation. The waste treatment system of the plating shop will feature a package treatment system for cyanide destruction, Cr reduction, pH neutralization, flocculation, clarification, sludge thickening, water recycle and sodium hydroxide. Four waste storage and four reagent storage tanks will be included. A trend of decreasing capital expenses with sharp increases in operating and maintenance initially (but leveling off after 1984) is depicted with <10% annual increase for upgrading costs. (Geiger-PTT)
W86-02101

INDUSTRIAL WASTEWATER TREATABILITY STUDY ACHIEVING BCT/BAT TREATMENT,

Koppers Co., Inc., Pittsburgh, PA.
A. C. Middleton, J. R. Smith, M. R. Urbassik, R. E. Keffer, and P. W. Sawchuck.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 173-185, 3 fig, 4 tab, 5 ref.

Descriptors: *Organic compounds, *Chemical coagulation, *Bioassay, *Wastewater treatment, *Activated sludge process, Organic wastes, Flocculation, Suspended solids, Toxicity, Pilot plants, Separation techniques, Chemical treatment, Biological wastewater treatment.

The Federal EPA in March 1983 issued proposed effluent guidelines for the organic chemicals, plastics and synthetic fibers industry. The guidelines require conventional pollutant parameters to be regulated by best conventional technology (BCT) and the 129 priority pollutants by best available technology (BAT). To determine the degree of treatment required to meet these limits, Koppers

Company, Inc. conducted a complete on-site wastewater treatability study at its Oil City, Pennsylvania plant. A pilot plant study simulated wastewater pretreatment for oil/water separation, activated sludge treatment, and toxicity testing of the treated effluent. Results showed that pretreatment of wastewater by FEC13 coagulation/flocculation/settling was very effective for removal of suspended matter and emulsified organic material. GC/MS analysis for organic priority pollutants in one effluent sample showed below detectable limit concentrations for all priority pollutant parameters except phenol and 2,6-dinitroluene. Results from both static and continuous flow-through fish bioassays showed the final treated effluent to be nontoxic. (Geiger-PTT)
W86-02102

RATIONAL PROCEDURE FOR ESTABLISHING DISCHARGE CONCENTRATION LIMITS IN MUNICIPAL SEWER USE ORDINANCES,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
J. K. Farmer, S. J. Spiegel, and S. R. Garver.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 186-199, 10 tab, 10 ref.

Descriptors: *Wastewater treatment, *Effluent limitations, *Water quality standards, *Sludge disposal, *Industrial wastewater, Monitoring, Landfills, Wastewater facilities, Waste disposal, Municipal wastewater, Biological wastewater treatment, Water pollution sources, Sewer systems.

The General Pretreatment Regulations require that municipalities throughout the United States develop programs to monitor and control industrial wastewater discharges to their municipal sewer systems. Discharges to publically owned treatment works (POTW) are comprised of controllable and uncontrollable sources. The allocatable loading to the POTW for any particular substance would be derived by subtracting the uncontrollable source contribution from the total allowable POTW loading. The performance criteria to be considered in developing discharge standards includes influent and effluent effects, biological and sludge treatment, and sludge disposal. Limiting concentrations identified at specific points in the treatment system need to be translated back to the treatment plant influent. Since POTW sludges are subject to RCRA regulations if disposal is by landfilling, mathematical equations exist for calculating the maximum concentration of treatment plant influent which will prevent the sludge from being classified as hazardous. The controllable loading for each substance must then be translated to maximum industrial discharge limitations. (Geiger-PTT)
W86-02103

ELECTROLYTIC RECOVERY OF ZINC FROM METAL FINISHING RINSE WATERS,

Maryland Univ., College Park. Dept. of Civil Engineering.
R. W. Walters, and D. M. Vitagliano.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 251-264, 5 fig, 3 tab, 10 ref.

Descriptors: *Metal-finishing wastes, *Zinc, *Industrial wastes, *Waste recovery, *Electroplating, Heavy metals, Electrodes, Electrochemistry, Recycling, Wastewater treatment, Corrosion, Metals, Industrial wastewaters.

In an effort to meet Zn discharge limits at an electroplating firm, a review of the literature regarding electrolytic recovery of metals from dilute wastewater, an effluent characterization study to identify sources of Zn within the plant, and a preliminary bench-scale evaluation of the feasibility of electrolytic recovery of Zn, were undertaken. Results showed that the Zn automatic line accounted for 88% of the Zn discharged. An optimum strategy requiring less frequent dumping of rinse tanks would be to stagger tank dumps so that a plant discharge of 4 milligrams/liter (the discharge limit for Zn) would not be exceeded. A bench-scale, electrolytic recovery reactor was constructed and tested to study the technical feasibility of Zn removal from the plating bath rinse stream using this technique. Results showed that the reactor configuration was effective at removing Zn from the complexed, Zn cyanide wastewater. Agitation was important for achieving high rates of Zn deposition. Although corrosion had no noticeable effect on Zn removal rates, it could be a limiting factor economically for this type of wastewater. Use of lower NaCl doses resulted in comparable Zn removal with less electrode corrosion. (Geiger-PTT)
W86-02104

SOLUBLE-SULFIDE PRECIPITATION TREATMENT OF METAL FINISHING WASTEWATER,

Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
J. J. Resta, M. Daly, and M. Pressman.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 265-278, 5 fig, 4 tab, 10 ref.

Descriptors: *Chemical precipitation, *Sludge thickening, *Sulfides, *Industrial wastes, *Metal-finishing wastes, Chromium, Metals, Sludge drying, Cost analysis, Sludge disposal, Performance evaluation, Wastewater treatment, Industrial wastewater, Hazardous materials, Electroplating, Metals, Heavy metals.

The performance and operation of the soluble-sulfide precipitation treatment system (SSP) for the removal of metal from finishing wastewater was evaluated at the U.S. Army Belvoir Research and Development Center in Virginia. The SSP system can reduce hexavalent Cr under neutral conditions. A sodium metabisulfite reduction system was included to minimize the amount of sodium sulfide required. Several safety features were included to reduce generation of toxic hydrogen sulfide gas. Total effluent metal concentrations in the SSP system averaged 1 milligram/liter. Sludge generation averaged 0.3 gallons of sludge/1000 gallons of wastewater treated. The sludge thickening and dewatering process performed adequately without the use of sludge conditioners. Chemical costs averaged $0.30/1000 gallons treated waste. The reactivity of the SSP system sludge could not be determined because the EPA has not promulgated a method for evaluating sulfide sludges. If the SSP sludge is determined to be a reactive hazardous waste, sludge disposal costs could limit the use of SSP treatment technology. (Geiger-PTT)
W86-02105

CO-PRECIPITATION OF HEAVY METALS WITH SOLUBLE SULFIDES USING STATISTICS FOR PROCESS CONTROL,

Talbot (Richard S.) and Associates, Inc., Media, PA.
R. S. Talbot.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 279-288, 8 tab, 3 ref.

Descriptors: *Industrial wastewater, *Heavy metals, *Chemical precipitation, *Wastewater treatment, *Metal-finishing wastes, *Heavy metals, Chemical treatment, Sulfides, Industrial wastes, Flocculation, Metals, Electroplating, Statistical methods.

The Talbot Process of sulfide co-precipitation was developed to help electroplating industries meet discharge pretreatment standards. The patented Talbot Process, owned by Richard S. Talbot and Associates, Inc., is used for the removal of metals that are difficult to precipitate as a metal hydroxide. The process can be used in both batch and continuous flow treatment operations, and is easily controlled through the use of statistics. The Talbot Process of sulfide co-precipitation produces a lower dissolved heavy metal content for the metals to be precipitated than conventional hydroxide precipitation alone. Sulfide co-precipitation produces a higher solids settling rate, and enhanced flocculation with anionic, organic polymers. A smaller quantity of sludge is produced as compared with conventional hydroxide precipitation leading to lower sludge disposal costs. The Talbot Process can easily be added to existing conventional systems to protect against future, more stringent heavy metals discharge standards. (Geiger-PTT)
W86-02106

EFFECT OF CHELATING AGENTS ON THE REMOVAL OF HEAVY METALS BY SULFIDE PRECIPITATION,

Purdue Univ., Lafayette, IN. Dept. of Civil Engineering.
R. W. Peters, and D. Bhattacharyya.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 289-317, 17 fig, 10 tab, 16 ref. CR-807760.

Descriptors: *Chemical precipitation, *Sulfides, *Heavy metals, *Chelating agents, Metal complexes, Chemical treatment, Chemical coagulation, Metals, Wastewater treatment, Copper, Zinc, Cadmium, Flocculation, Hydrogen ion concentration, Chelation.

The precipitation of metal sulfides was studied under both batch and MSMPR precipitation conditions for various metals, pH conditions, and EDTA concentrations. EDTA forms very strong metal chelates which interfere with the precipitation of ZnS. Weak chelating agents form weak metal chelates; formation of metal sulfide precipitates predominates. Removal of Cu is nearly complete even in the presence of EDTA. The Zn system shows that a phase transformation from an initial amorphous kinetically favored precipitate to a more crystalline form occurs. The Cu-Zn, Cu-Cd, and Cd-Zn systems behave like a single metal. After CuS precipitation is nearly complete, the ZnS reaction becomes significant. For more complex multi-metal systems, removal of Cu is nearly complete, the ZnS reaction becomes significant. For more complex multi-metal systems, removal of Cu is nearly complete, while removal of Zn and Ni were poor. For the continuous precipitation of ZnS, particle size distributions were poor. Although removal of Zn is hindered by EDTA, increased growth rates and larger dominant particle sizes are observed with increasing EDTA concentrations. The observed larger particle sizes were attributed to flocculation and formation of metal hydroxide precipitates. (Geiger-PTT)
W86-02107

REMOVAL OF HEAVY METALS IN POTW USING ALUM OR SODIUM ALUMINATE FOR PHOSPHORUS REMOVAL,

Rensselaer Polytechnic Inst., Troy, NY.
D. B. Aulenbach, N. L. Clesceri, M. A. Meyer, C. Vasudevan, and E. Beckwith.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 318-330, 3 tab, 6 ref.

Descriptors: *Chemical treatment, *Heavy metals, *Alum, *Aluminum, *Sodium compounds, Metals, Chromium, Cadmium, Industrial wastes, Copper, Lead, Antimony, Nickel, Beryllium, Mercury, Zinc, Thallium, Phosphorus removal, Wastewater treatment, Industrial wastewater.

The removal of heavy metals by alum or sodium aluminate used for P removal was studied in three publically owned treatment works in Massachusetts - the Pittsfield, Medfield and the Fitchburg. By measuring the heavy metals concentrations at the plants during late summer when the Al salt is added and continuing measurement after the discontinuance of Al salt addition, any difference in heavy metals removal may be attributed to the discontinuance of the Al salt addition. Results showed that the addition of alum or sodium aluminate at dosages which effectively remove phosphorus can remove Cu, Cr and Pb in wastewaters. Of the remaining metals analyzed, no difference was observed with and without Al salt addition for Cd or Sb, nor was there any difference in TOC removal. Hg was effectively removed to below the detection limit by primary sedimentation, so no further removal was achieved during secondary treatment when the alum/aluminate was added. The remaining metals analyzed (Ni, Be, Tl) were not present above the detection limits in the plant influents, and hence their removal could not be evaluated. (Geiger-PTT)

W86-02108

EXPERIMENTAL STUDY OF THE EFFECTIVENESS OF ALUMINUM CHLORIDE FOR CLARIFYING WASTEWATER,

Villanova Univ., PA. Dept. of Chemical Engineering.
J. M. Courtney, and D. D. Joye.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 343-350, 3 tab, 5 ref.

Descriptors: *Aluminum chloride, *Clarification, *Cost analysis, *Food-processing wastes, *Flocculation, Aluminum, Ferric chloride, Alum, Industrial wastewater, Chemical precipitation, Wastewater treatment, Turbidity, Chemical coagulation, Cost analysis, Industrial wastes.

The effectiveness of aluminum chloride for clarifying wastewater was determined relative to two widely used inorganic coagulating/flocculating agents, alum and ferric chloride. Actual wastewater samples, prior to treatment, were obtained from a municipal treatment plant and several industrial food processing plants. The performance of the flocculating agents was evaluated on the basis of turbidity reduction and sludge volume in standard jar tests and settling cones. The results of this study showed aluminum chloride to be in most cases as effective as alum or ferric chloride at optimum dosage. When economics are considered, aluminum chloride may be an attractive replacement for currently used inorganic flocculating agents in the treatment of industrial wastewater. (Author)
W86-02109

SOLVENT INTERACTIONS WITH COMPLEX, CONCENTRATED INDUSTRIAL WASTEWATERS,

Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
W. M. Ollinger, and R. C. Ahlert.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 384-394, 5 fig, 2 tab, 4 ref.

Descriptors: *Leachates, *Phenols, *Chemical reactions, *Industrial wastewater, *Organic solvents, Industrial wastes, Landfills, Wastewater treatment, Solubility, Solvents, Separation techniques, Anions.

The presence of components of a landfill leachate solute matrix alters the distribution of phenol and o-chlorophenol between organic and wastewater phases. The alteration is more pronounced with phenol than with o-chlorophenol due to solute-salt interactions in the aqueous phase which is favored by phenol. The components in the leachate solute matrix that contribute to the salting out of phenol, to the greatest extent, appear to be the large inorganic anions (carbonate and sulfate ions). High concentrations of these anions in the leachate stem from the pretreatment process. High levels of acetic, propionic, and butyric acids also contribute to the observed change in the phenol distribution. Solubility studies are needed to determine in which phase salt effects are more pronounced. (Geiger-PTT)
W86-02111

INVESTIGATION INTO THE WATER QUALITY BENEFITS OF CHLORINATING PAPERMILL EFFLUENTS,

Pennsylvania Dept. of Environmental Resources, Harrisburg.
R. H. Shertzer, and R. F. Frey.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 395-410, 4 fig, 6 tab, 15 ref.

Descriptors: *Chlorination, *Coliforms, *Wastewater treatment, *Pulp wastes, *Water quality, Chlorine, Biological properties, Water pollution effects, Macroinvertebrates, Industrial wastes, Aquatic bacteria, Industrial wastewater, Chemical properties, Escherichia coli, Klebsiella, Metals.

The effectiveness of chlorine addition in the control of coliform bacteria in two treated papermill wastewater discharges, and in the east branch of Brandywine Creek, Pennsylvania, was examined along with chemical and biological changes in the creek due to chlorination. Eleven sampling stations were established to assess water chemistry, bacteriology, and aquatic biology from July to October 1982. Results showed that significant reductions in bacteria density during chlorination occurred only at Station 3. The densities of both Klebsiella and E. coli in the effluents of both papermills were reduced after the application of chlorine. No significant improvement in water quality is documented as a result of chlorination of the papermill effluents. Neither metals discharged from the mills, nor total residual chlorine exerted a toxic influence on aquatic macroinvertebrates. Under such conditions, the instream biological community is already somewhat limited by other discharge components making any impact attributable to chlorine difficult to detect. (Geiger-PTT)
W86-02112

CASE HISTORY - OPTIMIZATION OF DISSOLVED AIR FLOTATION SLUDGE THICKENER REDUCES SLUDGE TREATMENT COSTS BY ELIMINATING ADDITIONAL DEWATERING PROCESS,

J. Wozniak, and T. L. Collett.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 411-417, 3 fig.

Descriptors: *Biological wastewater treatment, *Sludge drying, *Cost analysis, *Polymers, *Oil refineries, Operating costs, Maintenance costs, Wastewater treatment, Industrial wastes, Dewatering, Sludge thickening.

In 1983, a program was initiated to reduce the costs of biological sludge treatment at a Northeast crude oil refinery and chemical plant known as the Conservation Area. The biological sludge was thickened by an optimized Dissolved Air Flotation unit (DAF). A Gravity Belt Filter Presses (GBFP's) dewatering step was eliminated, reducing overall treatment costs by $900 thousand per year. The DAF thickening performance was increased about 50%. Mechanical and polymer changes allowed for easier process start-up and a 25% capacity increase. After optimization, the final sludge concentration was consistently 10-12% total solids. The optimized in-line dilution of polymer significantly reduced costly equipment, maintenance and operator time. About one-third of the total cost savings realized represents the polymers no longer used in the GBFP's. The maintenance cost savings was about one-third of the total savings and the remaining savings were attributed to the energy costs required by the GBFP's, the polymer dilution system and the building where everything was located. (Geiger-PTT)
W86-02113

BELT FILTER PRESS SELECTION FOR CHEMICAL PROCESS WASTE BIOSLUDGES,

Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
K. N. Wood, and E. L. Mongan.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 418-432, 7 fig, 3 tab, 20 ref.

Descriptors: *Sludge drying, *Sludge, *Flocculation, *Sludge conditioning, *Sludge filters, Dewatering, Wastewater treatment, Sludge solids, Drying.

The design features and unique concepts employed by the various belt filter presses (BFP) used for sludge dewatering at the DuPont facilities are described. The belt press consists of a three-stage process: sludge flocculation, gravity drainage of free water, and belt pressing of dewatered sludge. Some presses offer an extra high pressure zone which is advantageous with fibrous or inorganic sludges. The Flocpress accomplishes flocculation in a rotary drum. An earlier version of the Unimat has V-shaped pockets for gravity drainage. The R. B. Carter Company BFP uses a rotating drum for flocculation and a screen-lined drum for thickening. The Klampress flocculates sludge by passing it through a vortex mixer. Testing methods of BFP's should involve selection of effective polyelectrolytes for sludge conditioning, determining mixing time and energy requirements for flocculation, recording rate and quantity of filtrate release by gravity drainage and by compression dewatering, and calculating filter cake dryness. It is suggested that more than one press manufacturer's equipment be evaluated on-site, and ample startup time be allowed for finetuning of the polymer addition system, belt tracking and other potentially tempermental aspects of the belt filter press installation. (Geiger-PTT)
W86-02114

MODELING OF REACTIONS BETWEEN AQUEOUS CHLORINE AND NITROGENOUS COMPOUNDS,

Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
R. A. Isaac, and J. C. Morris.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 63-75, 5 fig, 5 tab, 9 ref. DAMD 17-77-C-7051.

Descriptors: *Wastewater treatment, *Chlorination, Fate of pollutants, Model studies, Chloramines, Nitrogen compounds, Amino acids, Organic compounds, Decomposition, Chemical reactions.

A computer model is used to predict the relative amounts of selected chloramines in wastewaters. Common organic nitrogen compounds in wastewater are methylamine, di- and trimethylamine, and the amino acids. The ratio of organic N to total N in wastewaters is 0.45-1.00, median 0.92. Results show that the nature of the organic nitrogen is an important factor in the chlofamine/organic-NC1 distribution. In the case of glycylglycine it is likely that the amine-N and not the amide-N is being chlorinated. Decomposition of chloramines was studied by pouring a solution of HOC1 into a rapidly stirred solution of the nitrogenous compound and monitoring disappearance by titrimentry or spectrometry. Half-lives (in min) of chloramines (with varying pH and temperatures) of the following compounds were as follows: alanine, 76-96; glycine, 1300-9000; histidine, 34-79; leucine, 66-79; phenylalanine, 52; serine, 33-72; tryptophan, too fast to measure; creatinine, 3300; glycine-N-acetyl ester, 19,000; glycine ethyl ester, 53-945; glycylglycine, 930-14,000; sarcosine, 192-257; and sarcosine anhydride, 2,900-12,900. Calculations show that low concentrations of dichloramine enhance disinfection but organic chloramines have no practical value in disinfection. (Cassar-PTT)
W86-02137

NATURAL DECHLORINATION KINETICS OF SECONDARY MUNICIPAL EFFLUENTS,

Beak Consultants Ltd., Mississauga (Ontario).
M. P. Shaw, and W. J. Snodgrass.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 113-123, 3 fig, 2 tab, 20 ref.

Descriptors: *Wastewater treatment, *Fate of pollutants, *Chlorination, *Kinetics, Ponds, Design criteria, Wastewater ponds, Ultraviolet radiation, Organic matter.

The chemical kinetics of dechlorination in a natural wastewater dechlorination pond were investigated, considering temperature, ultraviolet radiation, and organic concentration. The kinetic constants delta = 0.00056 per min and gamma = 3270 degrees K should be used in the modified Arrehenius equation to predict the first-order rate constants describing natural dechlorination kinetics. Chlorine concentration should be computed in molar values. Dechlorination pond design should be based on the slowest expected kinetics, which occur in winter with ice cover. Atmospheric levels of ultraviolet radiation roughly double the first-order rate constant. (Cassar-PTT)

W86-02142

CHLORINE DEMAND: STUDIES CONCERNING ITS CHEMICAL BASIS,
Maryland Univ., College Park. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W86-02147

FORMATION OF ORGANOHALOGEN COMPOUNDS IN CHLORINATED SECONDARY WASTEWATER EFFLUENT,
Florida International Univ., Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5B.
W86-02169

NONVOLATILE ORGANICS IN DISINFECTED WASTEWATER EFFLUENTS: CHEMICAL CHARACTERIZATION,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-02170

FORMATION OF VOLATILE HALOORGANIC COMPOUNDS IN THE CHLORINATION OF MUNICIPAL LANDFILL LEACHATES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02171

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 5F.
W86-02324

REGIONALIZATION OF WATER SUPPLY AND SANITATION SERVICES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02326

SEWERAGE: THE DEVELOPING COUNTRY DILEMMA,
Cole and Co. Ltd., Ottawa (Ontario).
M. G. McGarry.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 125-141, 1 fig, 3 ref.

Descriptors: *Sewer systems, *Wastewater treatment, *Cost-benefit analysis, *Developing countries, *Sanitation, Sewers, Maintenance costs, Cost analysis, Public health, Project planning, Wastewater disposal, Waste management, Economic aspects.

In the mid-nineteenth century many American and European cities had to construct sewers to handle problems of wastewater disposal. Whereas sewerage and treatment plants are being designed today to overcome environmental pollution problems of the industrialized states, the problems facing the large low-income populations of developing countries are human health-related. Usually consultants to planning projects in developing countries come from already developed nations, and these consultants have little experience with alternatives to sewerage. A cost-benefit analysis of projects to provide sewerage to Taipei, Taiwan is given to illustrate the difficulties involved in making such an assessment. Three costs of sewerage that are often overlooked are the cost of flush water, loss of the reuse potential of excreta, and increased costs for treatment of receiving waters for sewage. The necessary health education programs needed to improve hygiene in the home rarely accompany the introduction of sewerage. Community support in the education of people in sanitary practices is essential. Although technical alternatives to sewerage are now available, it will take many more years before effective delivery mechanisms are in place and operating. Plans for sewering a city center do not usually address the health problems of peripheral squatter settlements. (Geiger-PTT)
W86-02332

WET METHOD FOR EXCRETA DISPOSAL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 157-176, 6 fig, 1 tab, 34 ref.

Descriptors: *Septic tanks, *Wastewater disposal, *Seepage pits, *Developing countries, *Sludge disposal, Waste disposal, Sewer systems, Septic sludge, Septic wastewater, Seepage, Evapotranspiration, Leaching, Economic aspects, Public health, Sanitation, Social aspects.

Financial and economic costs of wet methods for excreta disposal are less than those of a full sewerage system. The aqua-privy (AP) can handle feces and urine, with an input of water. The AP consists of a drop pipe from the toilet and a nonbaffled container discharging to a soakaway. The tank is mainly sized on the basis of the long-term buildup of solids. Since the failure to maintain the water seal is often the reason for AP failure, the addition of sullage is recommended as a design standard. Sludge levels in the AP should be checked annually. The septic tank system also relies on the on-site disposal of wastes. Estimation of the quantity of wastewater flow is the critical factor in the sizing of septic tanks. The most common means of effluent disposal is in seepage or leaching fields. The most important characteristic of the disposal field is its hydraulic conductivity. Septic tanks, AP and their leaching fields must be located away from wells, streams, and buildings. If impermeable rock or soils of low permeability exist, the evapotranspiration bed appears to be a feasible alternative. Communal toilets are often unacceptable due to inconvenience and lack of proper cleaning. Health problems may arise if sludge cleaning is not performed, water seals are not maintained, or seepage fields become clogged. The success of any system relies its acceptance by its users. (Geiger-PTT)
W86-02333

LOW-COST ALTERNATIVES TO SEWERAGE,
Cole and Co. Ltd., Ottawa (Ontario).
M. G. McGarry.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 143-156, 7 fig, 13 ref.

Descriptors: *Latrines, *Septic tanks, *Wastewater disposal, *Developing countries, *Sludge disposal, Waste disposal, Solid waste disposal, Economic aspects, Public health, Sanitation, Social aspects, Design criteria.

The main cause of failure of latrinization programs in the past are social and educational failure. The conventional pit latrine has been advocated by aid programs and colonial governments as part of health care projects. In dense squatter settlements, redigging of the pits after several years may cause problems in areas where there is already limited space. The vented improved pit latrine has its pit offset and a vent pipe rising from the pit's concrete cover slab. Pit desludging is done by the municipality. The revised earth closet has alternating pits to increase the capacity for storage and lengthen the time between desludging. Once filled, the first pit is closed and its contents left to digest while the superstructure is placed above the second pit. The Reed's odorless earth closet has the pit offset from the superstructure by using a straight or curved chute. This latrine is not recommended because the chute often becomes clogged. The Mozambiquan latrine is made of cement and is designed as a circular slab located over a circular pit. This type of latrine is well suited to areas where raw materials are scarce and the subsoil is unstable. The principal elements of the pour-flush latrine are the bowl, trap, and pipe. The bowl is designed to be flushed with 1-2 liters of water poured by hand. The pour-flush latrine provides a water seal between the household and the excreta storage pit. The vacuum truck and vault system collects excreta and stores it beneath the toilet for regular collection by the municipality. (Geiger-PTT)
W86-02334

EXCRETA REUSE OPTIONS: COMPOSTING AND BIOGAS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 177-200, 5 fig, 5 tab, 39 ref.

Descriptors: *Recycling, *Waste disposal, *Composting, *Biogas, *Sludge digestion, Anaerobic digestion, Sludge disposal, Economic aspects, Aerobic digestion, Social aspects, Methane, Waste management, Digestion, Fertilizers, Sludge utilization.

Reuse options for excreta disposal help solve problems of waste disposal while turning a waste into a resource. Compost latrines have not met with widespread success, due to improper user attitudes. Compost units can be designed for continuous or batch operation. The aerobic processes are usually continuous and centered around the Swedish design known as the Clivus Multrum. Outside of the Swedish experience with multrums, the batch type anaerobic composters have achieved the most significant success, especially in developing countries. Certain sociocultural factors have to be considered for composting to be successful. User education and care are needed. The users must be willing to handle the composted humus, and there must be a market or local use for the product. Lime or ash addition is preferable in double-vault latrines because of their odor-absorption capabilities. Definitive health studies on pathogen survival in composted wastes are lacking. Most data point to the survival of viruses and helminths, especially Ascaris. A minimum one-year retention time is recommended for essentially complete kill. Anaerobic digestion under suitable conditions for biogas production does not render an effluent slurry sufficiently low in pathogen content for use as fertilizer. A brief review of the theory and principles of anaerobic sludge digestion confirms the limits of the process. Use of biogas energy is considered along with operation and design of digesters. (Geiger-PTT)
W86-02335

OXIDATION PONDS AND FISH CULTURE,
Cole and Co. Ltd., Ottawa (Ontario).
M. G. McGarry.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 201-218, 4 fig, 19 ref.

Descriptors: *Fish farming, *Aquaculture, *Oxidation ponds, *Public health, *Waste disposal, Sludge utilization, Anaerobic digestion, Aerobic digestion, Wastewater treatment, Carp, Oxidation process, Wastewater disposal, Viruses, Pathogenic bacteria, Parasites, Pathogens, Coliforms, Developing countries.

The oxidation pond has become widely recognized as the most efficient, least costly method of primary and secondary treatment of wastewaters. Conventional oxidation ponds are classified into three types: anaerobic, facultative and maturation. The advantages of using anaerobic, facultative and maturation ponds in tropical developing countries are numerous. Untreated wastewater can be fed directly into facultative ponds, where wastes are treated both anaerobically and aerobically. Maturation ponds are placed after a series of facultative ponds and usually recieve effluents below 75 milligrams/liter BOD. Land requirement for totally facultative and maturation pond systems can be considerably reduced by placing anaerobic ponds in front of the first facultative pond. To maximize algae production for use as animal feed, oxidation ponds can be operated at detention periods of 3-4 days and depths of 20-40 cm as high-rate algae ponds. In East Asia, the practice of raising fish on nightsoil (domestic excreta) is common. The introduction of fish to sewage-fed oxidation ponds reportedly increases the quality of the final effluent. Well designed and operated oxidation and maturation ponds can achieve significant viral removals. Fish resist penetration of viruses into their muscle

tissue while shellfish do not. Pathogenic bacteria may penetrate the meat of fish and cause health problems in improperly cooked fish. Series oxidation ponds are capable of efficient removal of many human parasites. (Geiger-PTT)
W86-02336

COST-EFFECTIVE WATER SUPPLY AND SANITATION PROJECTS FOR DEVELOPING COUNTRIES,

International Bank for Reconstruction and Development, Washington, DC. Dept. of Transportation and Water.
For primary bibliographic entry see Field 6C.
W86-02337

SANITATION ASPECTS OF WATER SUPPLY AND EXCRETA DISPOSAL,

Ministry of Health, Lilongwe (Malawi).
For primary bibliographic entry see Field 5E.
W86-02340

OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS,

Walker and Partners Ltd., Ottawa (Ontari).
B. Grover.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 327-341, 8 fig, 1 ref.

Descriptors: *Maintenance, *Project planning, *Wastewater treatment, *Water supply development, *Sanitation, Evaluation, Management planning, Future planning, Maintenance costs, Developing countries, Manpower, Economic aspects, Water supply, Education.

In order to operate properly, water supply and sanitation systems must receive the proper maintenance. Planned maintenance attempts to anticipate and avoid interruptions of service. Breakdown maintenance, a form of crisis intervention, tries to restore service in malfunctioning systems as quickly as possible. In a survey conducted by the General Accounting Office which showed failure of the majority of wastewater treatment plants to meet their discharge standards, the lack of proper maintenance was cited as the second most frequent cause of failure. In developing countries, systems are frequently broken down. Local resources are usually all that is needed to keep a hand pump water supply system in operation. The United Nations Children's Fund conducted an educational program on the maintenance of water supplies. Piped water supplies that involve treatment and pumping are also very vulnerable to failure in rural areas. To keep water and wastewater systems operating properly, the agency responsible for maintenance must have reliable transport fleet. When planning, financing, construction and operation of a system are all undertaken locally, local personnel can handle any maintenance problems. Design criteria should consider local customs and the use of locally available materials. For the effective operation and maintenance of water and sanitation systems, motivation, good management, money and manpower must be present. In planning new water supply and sanitation projects, the planner should first evaluate what is wrong with the present system. (Geiger-PTT)
W86-02341

5E. Ultimate Disposal Of Wastes

PHYSICAL PROPERTIES AND LEACH TESTING OF SOLIDIFIED/STABILIZED INDUSTRIAL WASTES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-147983, Price codes: A07 in paper copy, A01 in microfiche. EPA-600/2-82-099, December 1982. 135 p, 21 fig, 33 tab, 15 ref, 3 append. EPA-IAG-D4-0569.

Descriptors: *Sludge treatment, *Waste disposal, *Industrial wastes, *Leaching, Landfills, Metals, Heavy metals, Waste treatment, Toxic wastes, *Waste stabilization, *Water pollution control.

Physical property and leaching tests were conducted to assess the engineering characteristics and pollution potential of five industrial wastes (sludges from electroplating, Ni-Cd battery manufacture, pigment production, chlorine production brine, and glass etching). Four solidification/stabilization processes were used to produce different types of treated-waste products: (1) one resembling low-strength concrete, (2) a rubber-like solid, (3) a solid plastic-encased block, and (4) a soil-like material. No correlation between the physical properties of the treated products and their ability to contain the sludge constituents in leach testing was found. The soil-like product had the highest permeability and lowest strength and durability, but it gave the best overall containment of all the treated-waste products except the polyethylene-jacketed waste. Although the rubber-like solid was strong and durable, it produced the leachate with the highest concentration of pollutants. Leach tests were conducted with carbon dioxide-saturated water at a flow rate of 0.00005 cm/sec for 1-2 years. In all cases leachates were higher in heavy metals and anions than drinking water standards. No treatment process other than plastic encapsulation uniformly reduced the concentration of all potential pollutants for all sludge types; however, the overall pollution potential was lowered. In some cases, additional leachable materials were added in the treatment process. Some treatment processes increased the solubility of certain constituents so that they were lost at higher rates than in untreated sludge. (Cassar-PTT)
W86-02001

HAZARDOUS AND TOXIC WASTES: TECHNOLOGY, MANAGEMENT AND HEALTH EFFECTS,

For primary bibliographic entry see Field 5B.
W86-02041

OPERATING EXPERIENCE IN HAZARDOUS WASTES DISPOSAL BY POZZOLANIC CEMENTATION,

Envirosafe Services, Inc., Horsham, PA.
C. L. Smith, and T. Longosky.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 64-76, 3 fig, 7 tab, 10 ref.

Descriptors: *Waste disposal, *Cement, Pozzolanic cementation, Landfills, Envirosafe process, Organic compounds, Sludge, Paper coating industry, Steel industry, Metal-finishing industry, Oil, Fly ash, Encapsulation.

A pozzolanic cementation process has been used for hazardous waste disposal by the Envirosafe Services facility, Honeybrook, Pa., since early 1980. Fly ash is blended with the waste, then lime is added. The basic chemistry is similar to that of portland cement hydration and hardening, producing a material of high compressive strength with permeability coefficients in the range of 10 to the minus 6 power cm/sec. The processed waste, with the consistency of damp soil, is trucked to a landfill, where it is spread, graded, and compacted. Essentially zero leachate is generated by the landfill, and no impact on monitoring wells has been detected. Some wastes are not suitable for this process, notably those with high sugar content. Specific details are given for several wastes: paper coating wastes (50% complex organics with inorganic pigments and clays), air pollution residue from steel production (zinc, iron, calcium), and rolling mill oil-bearing sludge (quartz, oil and grease, heavy metals). (Cassar-PTT)
W86-02042

GEOLOGICAL FACTORS IN DISPOSAL SITE SELECTION,

Pennsylvania State Univ., University Park. Dept. of Geosciences.
R. F. Schmalz.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 124-136, 52 ref.

Descriptors: *Waste disposal, *Water quality control, *Landfills, *Geology, Geohydrology, Soil properties, Groundwater movement.

Reinforced concrete vaults and other man-made containers for burial of hazardous waste have failed within 20 or 30 years in many instances. Therefore, proper selection of a suitable geological site is very important for long-term safe storage. Essential criteria for a successful shallow land burial site are as follows: (1) sufficient depth of soil or regolith to accomodate the burial cells, (2) a water table of sufficient depth to guarantee that the cells are above the zone of saturation at all times, (3) a surface water regimen which allows drainage away from the cells, (4) soil or regolith which is homogeneous and impermeable so that groundwater flows aways from the site, and (5) a stable geological environment. Guidelines are given for choosing or excluding a site for hazardous waste disposal. A four-level process is used to quickly eliminate unsuitable sites from consideration. The first level excludes sites on a regional basis (volcanic activity, flood plains, population centers, permeable bedrock, etc.). The second level considers site-specific problems (eliminating places subject to exceptional storms, landslides, local areas of fractured rock, steep slopes, mines, usable aquifers). Interactive site-specific criteria consider interrelationships between two or more factors, such as soil transmissivity and depth to water table. Factors which enhance the suitability of a site for waste disposal include transportation facilities, backfill sources, and absorbant or neutralizing soil. (Cassar-PTT)
W86-02043

TIME PERSPECTIVE IN THE SUBSURFACE MANAGEMENT OF WASTE,

Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 5B.
W86-02044

SITING HAZARDOUS WASTE MANAGEMENT FACILITIES: THEORY VERSUS REALITY,

Boston Univ., MA. Dept. of Urban Affairs and Planning.
For primary bibliographic entry see Field 5G.
W86-02045

COAL TAR WASTES: THEIR ENVIRONMENTAL FATE AND EFFECTS,

Pennsylvania Power and Light Co., Allentown.
For primary bibliographic entry see Field 5B.
W86-02046

TOXIC AND HAZARDOUS WASTES,

For primary bibliographic entry see Field 5D.
W86-02094

UTILIZATION OF AN INDUSTRIAL WASTE OIL AS AN ALTERNATIVE FUEL FOR A MUNICIPAL SLUDGE INCINERATOR,

Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 5D.
W86-02099

BIOLOGICAL TREATMENT OF INDUSTRIAL WASTEWATERS IN THE USSR,

American Standards Testing Bureau, Inc., New York.
For primary bibliographic entry see Field 5D.
W86-02100

FACILITY UPGRADES DUE TO HAZARDOUS MATERIALS REGULATIONS,

GTE Government Systems Corp., Mountain View, CA. Sylvania Systems Group-Western Div.
For primary bibliographic entry see Field 5D.
W86-02101

FIXATION OF SEWAGE SLUDGE AND FLY ASH; AN ALTERNATIVE METHOD FOR OCEAN DISPOSAL,

State Univ. of New York at Stony Brook.
C-S. Shieh, and F. J. Roethel.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 433-443, 5 fig, 3 tab, 15 ref.

Descriptors: *Solid waste disposal, *Ocean dumping, *Sludge disposal, *Fly ash, *Mine wastes, Waste disposal, Sludge drying, Sludge conditioning, Dewatering, Sludge thickening, Reefs, Chemical properties.

The Coal Waste Artificial Reef Program (C-WARP) has proven the environmental acceptability of waste stabilization and ocean dumping of dewatered sludge mixed with fly ash while forming an artificial reef for fishing. Test samples of solid cylinders (11.9 cm by 10.2 cm) or a fly ash-sewage sludge (FA-SS) mixture were tested for permeability, compressive strength, electron microscopic appearance, and chemical properties (elemental analysis). Results showed that the compressive strength of the FA-SS block was a function of curing time, temperature, moisture, and additive contents. Scanning electron micrographs of sewage sludge indicate that the sludge is composed of an irregular flaky material. Permeabilities ranged from 0.00001 to 0.000001 cm/sec over the periods of the experiment. Concentrations of Al, Cu, Zn and Pb in the exterior portions of the FA-SS blocks increased with time after exposure to seawater while a steady decrease of Cd was also observed. These findings show that blocks maintain their structural integrity and may provide an acceptable option for ocean dumping of solid wastes. (Geiger-PTT)
W86-02115

DEALING WITH LANDFILLED HAZARDOUS SLUDGE, OTHER ALTERNATIVES,

Maryland Dept. of Health and Mental Hygiene, Baltimore. Office of Environmental Programs.
G. Z. Francis.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 444-455, 4 fig, 3 tab.

Descriptors: *Groundwater pollution, *Landfills, *Leachates, *Sludge disposal, *Water pollution prevention, Leaching, Waste disposal, Solid waste disposal, Water quality, Industrial wastes, Calcium carbonate, Nickel, Boreholes, Acid rain, Cost analysis.

A study was conducted to test leachate and groundwater quality of a major industrial facility in Maryland. The landfilled sludge consists of a mixture of three types of wastes: electroplating sludges, paint residues, and industrial painting wastewater treatment sludges. Twelve boreholes were drilled in the vicinity of the disposal site and groundwater monitoring wells were installed in five of these boreholes. Groundwater was monitored continuously for three months. No evidence of groundwater quality deterioration was observed over a 4-yr period, although natural precipitation was suspected as a source of leachate for Ni. It was recommended that the site be closed and a 1-inch layer of calcium carbonate be applied to its surface to neutralize acid precipitation in the facility's area for more than 800 years. Total closure cost is estimated at $100,000 to $120,000 while digging out the waste and disposing of it by some other means would cost an estimated $900,000 to $1,000,000. (Geiger-PTT)
W86-02116

ENVIRONMENTAL AND ENGINEERING ASPECTS RELATED TO THE RESTORATION OF A FERROUS SULFATE (COPPERAS) WASTE DISPOSAL SITE,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. R. Knocke, J. T. Novak, G. L. Goodman, M. Morris, and J. Moslehi.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 487-496, 2 fig, 3 tab, 2 ref.

Descriptors: *Solid waste disposal, *Landfills, *Leachates, *Ferrous sulfate, *Groundwater pollution, Waste disposal, Acidic water, Land disposal, Sulfates, Linings, Leaching, Water pollution sources, Environmental effects, Water pollution effects, Cleanup, Clays.

An assessment of environmental damage associated with the burial of waste ferrous sulfate or copperas at an abandoned Ti processing facility in Nelson County, Virginia and related engineering improvements associated with the sites cleanup was made in the summer of 1983. Results showed extreme cracking of the top clay liner which allowed rainfall to percolate directly into the buried copperas. The extremely acidic surface seepage erradicated all vegetation with which it came in contact. Evaluations of soluble Al concentrations in roundwater showed a significant change in the mineralogical structure of contaminated soils which was hypothesized to be directly related to the release of Al during acidic decomposition of the soil matrix. An increase in permeability as a function of exposure time to copperas leachate could also occur. River water samples collected along the Piney River both upstream and downstream of all identified surface runoff locations at the plant site, showed significant decreases in pH due to groundwater contamination. Laboratory tests show increased permeabilities of clay lining materials due to copperas. Remedial action included regrading the surface, depositing a 2-ft clay cover and planting vegetative cover to aid in rainfall drainage and evapotranspiration. (Geiger-PTT)
W86-02117

CONSTRUCTION TECHNIQUES FOR REMEDIAL DESIGN AT A CONNECTICUT SUPERFUND SITE: A CASE STUDY,

Hart (Fred C.) Associates, Inc., New York.
For primary bibliographic entry see Field 5G.
W86-02118

PREDICTING LEACHATE GENERATION IN LANDFILLS: A NEW METHOD,

Anderson (James C.) Associates, Camden, NJ.
J. R. Gee.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 548-567, 4 fig 8 tab, 21 ref. C2521NASX.

Descriptors: *Landfills, *Lysimeters, *Leachates, *Percolation, *Mathematical equations, Models, Simulation analysis, Leaching, Soil water, Statistical analysis, Computer models, Model studies, Waste disposal.

A summary of part of a research effort to develop a more direct method of landfill percolation prediction based on the percolation process itself rather than on the processes surrounding it is presented. Factors were selected for measurement which could be easily measured in the field. They are: rainfall amount, initial soil moisture content, soil density, slope, and runoff. Using a specially designed rainfall simulator and lysimeters, laboratory testing of five different landfill cover soils were carried out. Rainfall simulator data was analyzed using the MINITAB statistical computer program. An extensive nuumber of linear equations were analyzed to find a good relationship between the variables selected. In addition to the equations generated, the Thornthwaite Water Balance, HELP and HSSWDS computer models were also used to predict leachate generation at Cell 1 of the Madison solid waste lysimeters from 1972 to 1975. Predicted values from both the physical and nonphysical rainfall simulator models and their laboratory determined coefficients showed better accuracy than existing water balance methods on a monthly and yearly basis. (Geiger-PTT)
W86-02122

HAZARDOUS WASTE MANAGEMENT FOR THE 80'S.

Ann Arbor Science, Ann Arbor, MI. 1982. Edited by T. L. Sweeney, H. G. Bhatt, R. M. Sykes, and O. J. Sproul. 553 p.

Descriptors: *Waste disposal, *Waste management, *Groundwater pollution, *Industrial wastes, *Waste identification, *Landfills, On-site investigations, Cleanup operations, Legal aspects, Field tests, Groundwater, Environment, Pollutants, Aerial photography, Water, Leachates, Mathematical models.

A series of papers reflecting current work on critical issues in hazardous waste management (including groundwater and seepage; treatment, storage and disposal; site cleanup; and safety and legal considerations) is presented. A variety of industrial contaminants are considered, and many practical problems involved in disposal (particularly land disposal) are addressed. Site assessment, containment and encapsulation of hazardous waste disposal sites, hazardous waste site cleanup, and remedial action for abandoned waste sites are among the topics covered. Groundwater monitoring, contamination and recovery are discussed. Several case histories are presented to illustrate the various topics. (Halterman-PTT)
W86-02219

CLASSIFICATION AND MANAGEMENT OF PROCESS WASTES FOR THE TENNESSEE SYNFUELS ASSOCIATES COAL-TO-GASOLINE FACILITY,

R. W. Rittmeyer, J. P. Fillo, D. P. Malik, A. J. Merritt, and J. P. Brennan.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 45-80, 4 fig, 7 tab, 9 ref.

Descriptors: *Industrial wastes, *Waste disposal, Waste identification, Solid wastes, Solid waste disposal, Land disposal, Landfills, Regulations.

A plant proposed by the Tennessee Synfuels Associates for the production of gasoline from locally available bituminous coal is described, and the development of an inventory, preliminary classifications, and management options for process wastes expected from the facility are reported. The features of the 1976 Resource Conservation and Recovery Act which apply to this plant are reviewed. For each plant operating area, the generated wastes, generation rate and schedule, potential hazard classification, and proposed management techniques for various wastes are presented in tabular form. A schematic for probable waste management techniques is included. The information represents best estimates base on current process design. The facility (50,000 barrels per day capacity) will generate approximately 4.6 million tons/year of raw wastes in five categories: coal-derived wastes (77%), organic wastes (4%), byproducts (4%), spent catalysts (0.06%), and other wastes (15%). In-process management will reduce the amount of wastes actually leaving process units to 2.4 million tons/year, 87% of which will be coal-derived. Hazardous wastes will be subjected to routine analysis and non-hazardous wastes will be analyzed at least annually. (Halterman-PTT)
W86-02220

DETERMINATION OF DISPOSAL SITES FOR PCB CONTAMINATED MATERIAL DREDGED FROM THE HUDSON RIVER BED,

Pirnie (Malcolm), Inc., Paramus, NJ.
J. S. Reed, and J. C. Henningson.
IN: Hazardous Waste Management for the 80's. Ann Arbor Science, Ann Arbor, MI, 1982. p 81-93, 2 fig, 2 tab, 6 ref.

Descriptors: *Dredging, *Spoil banks, *Waste disposal, Hudson River, Land disposal, Environment, Field tests, On-site investigations, Polychlorinated biphenyls.

The selection process used in locating a site for disposal of PCB-contaminated material obtained from two Hudson River dredging projects is described. The five steps in the approach are described in detail. The steps are: development of siting criteria; preparation of overlays using topographic maps as a base; delineation of specific sites within the environmentally acceptable 'windows'; conduction of preliminary field visits; and conduction of detailed field investigations. Public participation and response was also included in this study. The detailed field investigation of the preferred

site included soil borings, a resistivity survey, and test pit investigations. This approach resulted in a site which meets or exceeds both State and Federal standards. (Halterman-PTT)
W86-02221

ROLE OF THE ANALYTICAL LABORATORY IN HAZARDOUS WASTE MANAGEMENT,

Harmon Engineering and Testing, Auburn, AL.
V. K. Varma, B. B. Ferguson, and M. S. Shearon.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 115-141, 2 fig, 3 tab, 11 ref.

Descriptors: *Industrial wastes, *Waste disposal, *Waste identification, *Environment, Waste management, Groundwater, Laboratories, Regulations, Legal aspects.

Several aspects of the role of the analytical laboratory in hazardous waste management are addressed, including examination of selected analytical considerations, presentation of selected case studies, and guidelines for obtaining laboratory services. The functions of the analytical laboratory within the Hazardous Waste Management (HWM) system of the Resource Conservation and Recovery Act (RCRA) fall into three categories: waste identification; waste and waste constituent monitoring; and treatment, clean-up and other certifications. Programs which have been developed specifically for meeting the compliance objectives of the HWM system are described in detail. These programs include waste identification, delisting of waste sources and specific wastes, groundwater monitoring plans, and waste analysis plans. The analytical chemistry considerations discussed include sample collection and preservation, analytical interferences, instrumentation, and quality control. Three case studies illustrate the role of the analytical laboratory in the HWM system decision-making process. (Halterman-PTT)
W86-02222

REMEDIAL ACTION ALTERNATIVES FOR ABANDONED HAZARDOUS WASTE SITES,

For primary bibliographic entry see Field 5G.
W86-02225

SLURRY TRENCH CUTOFF WALLS FOR HAZARDOUS WASTE ISOLATION,

For primary bibliographic entry see Field 5G.
W86-02226

CLAY LINER PERMEABILITY - A PROBABILISTIC DESCRIPTION,

Carnegie-Mellon Univ., Pittsburgh, PA.
K. O. Harrop-Williams.
IN: Hazardous Waste Management fr the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 307-314, 2 fig, 13 ref.

Descriptors: *Landfills, *Waste disposal, *Permeability coefficients, *Mathematical models, Model studies, Liquid wastes, Solid wastes, Environment.

The primary criterion used in evaluating the suitability of hazardous waste landfills for containing hazardous waste is permeability, and many regulatory agencies have adopted regulations requiring clay-lined hazardous waste landfills to have a coefficient of permeability no greater than a fixed value. However, permeability is one of the most variable of engineering properties and its behavior is best described using probability theory. A model is developed to predict the uncertainty associated with specified permeability values. Using this model, it is possible to establish confidence levels associated with possible ranges of the coefficients of permeability of clay-lined hazardous waste landfills. The probability density function of the coefficient of permeability is derived from a microscope view of flow through soils. In developing this model, the permeant was assumed to be a neutral agent (e.g., water). However, as is usually done in clay-liner design, this model can be modified to include the effect of chemicals on the clay. (Halterman-PTT)
W86-02227

CONTAINMENT AND ENCAPSULATION OF HAZARDOUS WASTE DISPOSAL SITES,

A. A. Metry.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 315-342, 7 fig, 5 tab, 10 ref.

Descriptors: *Waste disposal, *Landfills, *Environmental engineering, Radioactive wastes, Solid wastes, Environmental effects, Computer models, Environment, Wastes.

State-of-the-art techniques for containment and encapsulation of hazardous waste disposal sites are discussed. Such techniques have been applied as remedial action for inactive hazardous waste disposal sites containing chemical, toxic and low-level radioactive materials. The use of computer simulation for optimization of design features is discussed, and techniques for evaluation of cover, liner and barriers are presented and illustrated. The case history presented is for a large site containing low-level radioactive waste, but can be applied to other types of hazardous waste. Components of the cover system are considered, with 18 cover types being evaluated based on 20 performance criteria. In a discussion of the function of the liner system, 12 materials are evaluated. It is concluded that it is preferred to utilize passive rather than active techniques for encapsulating waste-disposal sites. Multilayer cover systems, soil/clay liners, bentonite slurry walls and ion-exchange barriers represent the basic elements of remedial action that do not require perpetual postclosure operations. (Halterman-PTT)
W86-02228

ESTIMATES OF SEEPAGE THROUGH CLAY COVERS ON HAZARDOUS WASTE LANDFILLS,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. J. Wright, and C. P. Miller.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 343-356, 4 fig, 2 tab, 13 ref.

Descriptors: *Waste disposal, *Landfills, *Linings, *Leachate, Model studies, Mathematical models, Wastes, Industrial wastes, Environment.

The importance of estimating the amount of leachate generated in a hazardous waste landfill is stressed, and several methods available for the estimate of leachate rates are described, along with their shortcomings. An alternative method, based on a numerical model and using a more mechanistic approach, is presented. The example is based on a hypothetical landfill, but with meteorological information from a specific location. Three conclusions can be reached. First, the leakage rates through the clay layer are greater than the saturated hydraulic conductivity which is often stated to be the case for fully saturated flow. Leakage rates of four or five times this value can be computed. Second, if the total potential leakage into the clay is of the same order of magnitude as the saturated hydraulic conductivity or less, the liner will accept all downward flow. And third, the thickness of the clay liner only affects the time that it takes for a significant amount of leakage to begin to enter the landfill and has little effect upon the seepage rates. (Halterman-PTT)
W86-02229

MUNICIPAL SOLID WASTE MANAGEMENT FACILITY LOCATION MAPPING: SUPPORT ACTIVITIES REPORT,

Texas Natural Resources Information System, Austin.
Report TNRIS-031, January 1983. 22 p, 5 fig, 2 tab, 2 ref, append.

Descriptors: *Texas, *Waste disposal, *Computer programs, *Waste management, *Solid waste disposal, *Waste dumps, Automation, Municipal wastes, Landfills, Composting, Permits, Maps, *Mapping.

The Texas Department of Health (TDH) was designated by the 'Solid Waste Disposal Act,' Article 4477-7, Vernon's Texas Civil Statutes, as the Texas agency responsible for providing standards for managing the collection, handling, storage, and disposal of municipal solid waste. TDH is empowered by the Act to require and issue permits authorizing and governing the operation and maintenance of sites used for the management (including disposal) of solid waste. The Department has for some time maintained automated records associated with each permit application and each permitted site. Although the geographic coordinates of each existing or proposed site were on the file, no systematic means was available for displaying the site locations by geographic coordinates as computer-generated maps. By including site location data in the TNRIS Geographic Information System (GIS), TDH can display the data along with a variety of other geographic information already included in the GIS. Data can be reproduced at any scale in any of eight available geographic projections. TNRIS System Central staff provided computer software to establish a GIS file which included the type, location, and status of each proposed or existing municipal solid waste management site. Plots of the data have been used by TDH for a variety of purposes including scheduling of public hearings and (in conjunction with maps showing physical and geological features and population) to identify areas of potential concern related to each site. (Author)
W86-02320

WET METHOD FOR EXCRETA DISPOSAL,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02333

LOW-COST ALTERNATIVES TO SEWERAGE,

Cole and Co. Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W86-02334

EXCRETA REUSE OPTIONS: COMPOSTING AND BIOGAS,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02335

OXIDATION PONDS AND FISH CULTURE,

Cole and Co. Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W86-02336

SANITATION ASPECTS OF WATER SUPPLY AND EXCRETA DISPOSAL,

Ministry of Health, Lilongwe (Malawi).
W. G. Bomba.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 311-325, 5 fig, 2 tab, 9 ref.

Descriptors: *Sanitation, *Public health, *Waste disposal, *Water supply, *Developing countries, Water quality, Drinking water, Case studies, Water supply development, Water quality control, Water quality management, Pathogens, Infection, Human diseases, Social aspects.

The improvement of public health in developing countries can only arise through satisfactory systems of water supply, sanitation and health education. The role of health education in sanitation programs is highlighted using two case studies - a water study in Lesotho and latrinization program in Malawi. The principal human diseases that can be transmitted by water and their causative agents (bacteria, protozoa, viruses, and helminths) are reviewed. Many water-related diseases have more than one route of transmission. The ingestion of food or drink contaminated with feces, infection from contact with water, transmission from contact with soil, infection via insect vectors, and infection via meat are considered. Education programs had to be adopted in Malawi to encourage people to use latrines. Water contamination may take place when water is drawn from unprotected

sources, when drawn from taps into contaminated containers, or when storage containers inside the home are left uncovered. Coliform bacteria is usually used as an indicator of drinking water quality. The decision to condemn a certain water supply should be left to those who know the local circumstances and who are responsible for safeguarding the health of the community. (Geiger-PTT)
W86-02340

5F. Water Treatment and Quality Alteration

ZETA POTENTIAL STUDY OF THE WATER TREATMENT OF GEOTHERMAL BRINES,
Idaho National Engineering Lab., Idaho Falls.
P. M. Wikoff, and D. F. Suciu.
Available from the National Technical Information Service, Springfield, VA 22161 as DE-005910, Price codes: A03 in paper copy, A01 in microfiche. Report EGG-GTH-5673, November 1981. 27 p, 15 fig, 3 tab, 7 ref. DE-AC07-761D01570.

Descriptors: *Water treatment, *Cooling water, *Flocculation, Corrosion control, Geothermal studies, Zeta potential, Silica, Phosphates, Ferrous sulfate, Polymers, Adsorption, Magnesium oxide, Lime, Brines.

Zeta potential studies on geothermal cooling water were performed on the silica reduction system and the phosphate reduction system. In the silica reduction system, data suggested that adsorption occurred between the magnesium hydroxide formed in solution and the silica. Addition of calcium ion caused a bridging type of adsorption between the silica-magnesium hydroxide particles. The optimum magnesium oxide concentration, added as magnesium chloride, was 150-200 ppm MgO. Optimum pH, adjusted with lime, was 10.2. The best polymer was Betz 1125L at a dose of 1 ppm. An excess of polymer (8 ppm or greater) left more silica in solution. In the phosphate reduction system the optimum iron concentration was 20-30 ppm added as ferrous sulfate. Optimum pH, adjusted with lime, was 9.2 Betz 1195, a cationic polymer, produced the largest, best-selling flocs at an optimum concentration of 2-4 ppm. Since the phosphate studies were done on domestic water, further research is needed to account for the zinc sulfate or dispersants normally present in blowdown water. (Cassar-PTT)
W86-01987

RATIONAL PROCEDURE FOR ESTABLISHING DISCHARGE CONCENTRATION LIMITS IN MUNICIPAL SEWER USE ORDINANCES,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5D.
W86-02103

TREATMENT ALTERNATIVES FOR GROUNDWATER CONTAMINATION,
Montgomery (James M.), Inc., Reston, VA.
A. R. Appleton, and M. Kavannaugh.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 351-383, 6 fig, 10 tab, 33 ref.

Descriptors: *Aeration, *Groundwater pollution, *Activated carbon, *Design criteria, *Case studies, Water treatment, Adsorption, Organic compounds, Water quality control, Odor, Taste, Water pollution sources, Cost analysis.

Several options are available for the removal or reduction of carcinogenic compounds from groundwater. These include: source control, blending with uncontaminated sources, development of new sources, treatment of contaminated sources, and point-of-use treatment. Physicochemical parameters of organic compounds are useful in predicting their behavior in the environment and removal efficiencies in treatment processes. Aeration processes, particularly packed tower air stripping, may be effective in treating contaminated groundwaters. Similarly, the octanol:water partition coefficient is useful in predicting the effectiveness of granular activated carbon adsorption for removal of specific compounds. More accurate cost estimates for CAC adsorption, as well as aeration, require full-scale design criteria obtained through site specific pilot-scale studies. Two case studies from Southern California are presented to illustrate full-scale applications of treatment processes for the removal of organic compounds from groundwaters. The Valley County Water District used an air stripping system for the removal of trichloroethane and the City of La Habra used a packed tower to alleviate taste and odor problems. (Geiger-PTT)
W86-02110

WATER CHLORINATION: ENVIRONMENTAL IMPACT AND HEALTH EFFECTS; VOLUME 4, BOOK 1: CHEMISTRY AND WATER TREATMENT,
Proceedings of the Fourth Conference on Water Chlorination: Environmental Impact and Health Effects, Pacific Grove, California, October 18-23, 1981. Ann Arbor Science, Ann Arbor, MI. 1983. 2 v. (1491 p.) Edited by Robert L. Jolley, Wiliam A. Brungs, Joseph A. Cotruvo, Robert B. Cumming, and Jack S. Mattice.

Descriptors: Fate of pollutants, *Water treatment, *Chlorination, *Pollutant identification, *Water analysis, Chloramines, Bromination, Organic compounds, Trihalomethanes, Chlorinated hydrocarbons, Chlorine demand, Residual chlorine, Wastewater treatment, Wastewater analysis, Kinetics, Chemical reactions, Activated carbon, Humic acids, Fulvic acids, Oxidation, Organic matter, Cooling water, Seawater, Disinfection, Chromatography, Trace levels.

This volume concerns the chemistry of water treatment, emphasizing the fate and effects of chlorine. Section I describes the chemistry of nitrogenous and other compounds, including the products of halogens with ammonia, amino acids, proteins, polynuclear aromatic hydrocarbons, and lipids. Section II, the chemistry of chlorine demand, considers the products formed when chlorine and bromine react with aquatic humic materials and other organic matter to form trihalomethanes and other halogenated compounds. Section III discusses the fate of chlorine and the formation of halogenated organic compounds in cooling water, drinking water, wastewater, and municipal landfill leachates. The alternative disinfectants, hydrogen peroxide and ozone, are evaluated. Analytical methods are presented in Section IV and V. They include methods for analyzing halogenated organic mixtures as well as for determing chloramines, residual chlorine, and residual oxidants attrace levels. Several systems for continuous monitoring are described. (Cassar-PTT)
W86-02135

REVIEW OF THE CHEMISTRY AND ENVIRONMENTAL FATE OF REACTIVE OXIDANT SPECIES IN CHLORINATED WATER,
Oak Ridge National Lab., TN.
R. L. Jolley, and J. H. Carpenter.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 3-47, 4 fig, 7 tab, 118 ref. EPA079-D-X0789.

Descriptors: *Water treatment, *Literature reviews, *Chlorination, *Bromination, *Oxidation, Chemical reactions, Organic compounds, Chloramines, Bromamines, Trihalomethanes, Wastewater treatment, Hypochlorous acid, Hypobromous acid, Iodine, Chlorine demand, Fate of pollutants, Ammonia, Nitrogen compounds.

This review concerns the chemistry of chlorine in wastewaters and in natural waters as it pertains to the formation, degradation, and reaction products of free and combined oxidants. Chlorine hydrolyzes very rapidly in water to form hypochlorous acid, which upon dissociation forms hypochlorite ion. As pH increases, the hypochlorite ion becomes more dominant than the undissociated acid. Chlorine added to water containing bromide yields hypobromous acid and chloride ion. Dissociation of hypobromous acid forms hypobromite ion, which is dominant at higher pH. Chlorination of iodine-containing water produces molecular iodine and chloride. Ammonia combines with hypohalous acids to form mono- and dihalamines as well as nitrogen tribromide and trichloride. Monochloramine and dibromamine are common constituents of chlorinated and brominated wastewaters. Although monochloramine is a less effective chlorinating agent than hypochlorous acid, it minimizes formation of trihalomethanes during water treatment. Chlorine or bromine plus amino acids or other nitrogen-containing organics yields organic chloramines or bromamines. Knowledge of the organic halamines and their reaction products in natural water is limited. Bromochloramines can form in salt water systems. Chlorine demand, the difference between chlorine dosage applied to water and the measured available chlorine, is a result of inorganic oxidation and reactions with organic matter. Disproportionation of hypohalous acids (e.g., formation of chlorate and chloride) takes place at basic pH. Photochemical or catalytic influence cause hypohalous acids to decompose, yielding oxygen. Free available chlorine also reacts with organic matter to form a complex mixture of organohalides. (Cassar-PTT)
W86-02136

MODELING OF REACTIONS BETWEEN AQUEOUS CHLORINE AND NITROGENOUS COMPOUNDS,
Massachusetts Dept. of Environmental Quality Engineering, Westborough. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5D.
W86-02137

CRITICAL REVIEW OF KINETIC AND THERMODYNAMIC CONSTANTS FOR THE AQUEOUS CHLORINE-AMMONIA SYSTEM,
Harvard Univ., Cambridge, MA. Dept. of Applied Science.
J. C. Morris, and R. A. Isaac.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 49-62, 4 fig. 2 tab, 19 ref. DAMD 17-77-C-7051.

Descriptors: *Water treatment, *Chlorination, *Chemical reactions, *Nitrogen compounds, Chloramines, Hydrolysis, Kinetics, Thermodynamics.

Tables list a complete summary of the kinetic and equilibrium constants and the derived thermodynamic quantities for reactions of the aqueous chlorine-ammonia system. Reaction systems considered are (1) monochloramine + water yield ammonia + hypochlorous acid, (2) dichloramine + water yield monochloramine + hypochlorous acid, (3) nitrogren trichloride + water yield dichloramine + hypochlorous acid, and (4) disproportionation of monochloramine to yield ammonia and dichloramine. Some of the values are less accurate than desired; some are based on relatively insecure assumptions. However, trends are seen in reactivity, degree of phydrolysis, and endothermicity. (Cassar-PTT)
W86-02138

ULTRAVIOLET ABSORPTION SPECTRA OF BROMOCHLORAMINE AND DIBROMOCHLORAMINE IN ETHER,
Tennessee Univ., Knoxville. Dept. of Chemistry.
W. R. Haag, and R. L. Jolley.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 77-83, 2 fig, 10 ref.

Descriptors: *Water treatment, *Chlorination, Chloramines, Bromochloramines, Spectrometry.

Ultraviolet absorption spectra were determined for bromochloramine and dibromochloramine in ether. These compounds were prepared by mixing hypobromite solution with monochloramine. At an HOBr/NH2C1 molar ratio <0.4 two new peaks at 220 and 333 nm were always observed on top of

the monochloramine spectrum, and the increase in absorbance between successive experiments was proportional to the difference in the amount of bromine added, suggesting that a single new compound (NHBrC1) had been formed. Increasing the HOBr/NH2C1 molar ratio above 0.5 produced spectra which indicated the formation of NBr2C1. Based on the other spectra, the NBrC12 peak in water, at 230 nm with maximum extinction coefficient of about 7000. Possible reasons that these compounds have not been detected in chlorinated saline water are (1) overlapping absorption bands caused by mixtures of halamines and (2) rapid decomposition of the bromochloramines. (Cassar-PTT)
W86-02139

DIHALOACETONITRILES IN CHLORINATED NATURAL WATERS,

Florida Atlantic Univ., Boca Raton. Dept. of Chemistry.
T. I. Bieber, and M. L. Trehy.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 85-96, 3 tab, 30 ref.

Descriptors: *Water treatment, *Chlorination, Dihaloacetonitriles, Chlorinated hydrocarbons, Nitrogen compounds, Amino acids, Dichloroacetonitrile, Dibromoacetonitrile, Proteins, Trihalomethanes, Activated carbon, Absorption, Chloramine.

Dichloroacetonitrile, dibromoacetonitrile, and bromochloroacetonitrile were identified in chlorinated natural waters in south Floriday. Thes result from chlorination of proteinaceous materials such as certain amino acids and polypeptides. Aspartic acid and aspartyl residues are especially prolific dihaloacetonitrile (DHAN) producers. Chlorination of lake water at 6 and 20 mg/liter chlorine for 15 min showed that increasing concentrations of DHANs were formed with increasing contact time. Levels of DHANs were also higher at the 20 mg/liter level. For example, at 20 mg/liter and 15 min contact time concentrations in ppb were as follows: dichloroacetonitrile, 5.2, and bromochloroacetonitrile, 0.4. Likewise, the concentrations of trihalomethanes (THMs) increased with dose and contact time. Levels of total THMs produced in lake water samples at 20 mg/liter chlorine and 15 min contact time were 182 ppb. Activated carbon can be used to remove DHAN precursors, but the process is energy-intensive, costly, and has many variables. Lime treatment increases water pH, shortens the half-lives of the DHANs, but increases the levels of THMs formed. Use of chloramine as a disinfectant maintains low levels of DHAN. (Cassar-PTT)
W86-02140

PRODUCT DISTRIBUTION AND RELATIVE RATES OF REACTION OF AQUEOUS CHLORINE AND CHLORINE DIOXIDE WITH POLYNUCLEAR AROMATIC HYDROCARBONS,

Minnesota Univ.-Duluth. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-02145

CHLORINE DEMAND: STUDIES CONCERNING ITS CHEMICAL BASIS,

Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, D. A. Dotson, and A. C. Sigleo.
IN: Water Chlorination: Environmental Impact and Health Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983, p 181-190, 2 fig, 2 tab, 15 ref.

Descriptors: Fate of pollutants, *Water treatment, *Chlorination, *Organic matter, *Oxidation, Proteins, Amino acids, Chlorine demand, *Wastewater treatment, Waste treatment.

The oxidizing agents assayed by standard chlorine analyses are known to disappear on time scales ranging from minutes to days, depending on treatment conditions and water quality but the reactions responsible for this disappearance are poorly known. An assortment of evidence points to reactions involving organic matter as major chlorine consumers, but it is generally agreed that formation of halocarbons is minor. Experiments in which river water was treated with about 150 microM of NaOC1 (about 10 ppm C12) produced about 35 microM of carbon dioxide. However, oxidation of organic matter to carbon dioxide in these experiments definitely cannot account for all the chlorine decay and probably accounts for only about half of it. Investigation of the effect of chlorination on protein macromolecules showed a general loss of protein amino acids after chlorination, as well as a more pronounced loss of the specific amino acids that possess reactive side groups (lysine, histidine, arginine, methionine, and tyrosine). Because only two reaction products were observed during amino acid analysis by liquid chromatography and gas chromatography, it is concluded that most off the reactive amino acids are substantially altered or totally oxidized by chlorination. The general loss of protein could be caused by scission of the protein chain at sites occupied by reactive amino acids, yielding polymer fragments too small in some cases to be recovered by ultrafiltration. (Author)
W86-02147

CHLORINATION PRODUCTS FROM AQUATIC HUMIC MATERIAL AT NEUTRAL PH,

North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5B.
W86-02148

FULVIC ACID AND CHLORINATED FULVIC ACID IN WATER AND SEDIMENT: HPLC FRACTIONATION AND SPECTROSCOPIC CHARACTERIZATION,

North Texas State Univ., Denton. Inst. of Applied Sciences.
For primary bibliographic entry see Field 5B.
W86-02149

ORGANIC REACTION PRODUCTS OF CHLORINE DIOXIDE AND NATURAL AQUATIC FULVIC ACIDS,

North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5B.
W86-02150

INFLUENCE OF AQUATIC HUMIC SUBSTANCE PROPERTIES ON TRIHALOMETHANE POTENTIAL,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W86-02151

EMPIRICAL MODEL FOR PREDICTING CHLOROFORM FORMATION FROM HUMIC AND FULVIC ACIDS,

For primary bibliographic entry see Field 5B.
W86-02152

FORMATION OF TRIHALOMETHANES FROM THE HALOGENATION OF 1,3-DIHYDROXYBENZENES IN DILUTE AQUEOUS SOLUTION: SYNTHESIS OF 2-13 C-RESORCINOL AND ITS REACTION WITH CHLORINE AND BROMINE,

California Inst. of Tech., Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W86-02153

KINETICS AND MECHANISM OF HALOFORM FORMATION: CHLOROFORM FORMATION FROM TRICHLOROACETONE,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W86-02154

QUANTITATIVE EFFECTS OF BROMINE ON THE FORMATION AND DISTRIBUTION OF

TRIHALOMETHANES IN GROUNDWATER WITH A HIGH ORGANIC CONTENT,

Florida International Univ., Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5B.
W86-02155

FORMATION OF BROMINATED TRIHALOMETHANES: EXTENT AND KINETICS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02156

BROMOFORM PRODUCTION IN TROPICAL OPEN-OCEAN WATERS: OCEAN THERMAL ENERGY CONVERSION CHLORINATION,

California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5B.
W86-02157

DISPERSION OF CHLORINE AT SEVEN SOUTHERN CALIFORNIA COASTAL GENERATING STATIONS,

Southern California Edison Co., Rosemead.
For primary bibliographic entry see Field 5B.
W86-02158

MODEL FOR PREDICTING CHLORINE CONCENTRATION WITHIN MARINE COOLING CIRCUITS AND ITS DISSIPATION AT OUTFALLS,

Central Electricity Generating Board, Fawley (England). Marine Biological Unit.
For primary bibliographic entry see Field 5B.
W86-02159

HALOGENATED ORGANIC STUDY AT SELECTED TENNESSEE VALLEY AUTHORITY FOSSIL-FUELED POWER PLANTS,

Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5B.
W86-02161

ORGANOHALOGENS IN CHLORINATED COOLING WATERS DISCHARGED FROM NUCLEAR POWER STATIONS,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-02162

ATMOSPHERIC EMISSIONS FROM ELECTRIC POWER PLANT COOLING SYSTEMS,

SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W86-02163

HYDROGEN PEROXIDE - A REAL ALTERNATIVE TO CHLORINE IN WATER TREATMENT,

North Surrey Water Co., Staines (England).
For primary bibliographic entry see Field 5B.
W86-02164

EVALUATION OF OZONE PRETREATMENT OF SURFACE WATERS PRIOR TO CHLORINATION FOR REDUCTION IN TRIHALOMETHANE FORMATION,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
J. N. Veenstra, J. B. Barber, and P. A. Khan.
IN: Water Chlorination: Environmental Impact and Helath Effects; Volume 4, Book 1: Chemistry and Water Treatment, Ann Arbor Science, Ann Arbor, MI. 1983. p 455-465, 7 fig, 1 tab, 10 ref.

Descriptors: *Water treatment, *Ozonation, Chlorination, Trihalomethanes, Organic carbon, Chlorinated hydrocarbons, Kaw Lake, Oklahoma, Disinfection.

Ozone pretreatment of Kaw Lake (Oklahoma) water before chlorination affected reductions in

the total organic carbon (TOC) and trihalomethane(THM)-forming potential. With mean absorbed ozone dosage of 2.9 +- 1.1 mg/liter (+-1 SD), the mean TOC reduction was 10.3 + 23.0% (+-1 SD). The TOC chromatgrams for all samples showed the predominance of one peak for the TOC in the molecular weight fraction of 1000 to 5000. Seasonal shifts in TOC patterns occurred as illustrated by the change in percentage of TOC in the <4000 apparent molecular weight group was found in the ozonated samples than in the raw water samples. This difference which varied from 5 to 8%, reflected the effect of ozonation. A seasonal shift toward bromoform in the total trihalomethane production was observed, and ozonation accentuated the shift toward bromoform. Ozonation caused a decrease in the yields of allfour trihalomethanes. For Kaw Lake, water ozonation caused a greater reduction in total trihalomethanes than in TOC. Possible alteration of the precursors by ozonation could make them less amendable to trihalomethane formation. Preliminary results of this study have shown preozonation to have a limited effect in reducing the concentration of the more brominated trihalomethanes. The study is continuing because the potential overall effects of preozonation have not been fully evaluated. (Author)
W86-02167

INFLUENCE OF PRECHLORINATION ON THE AMOUNT AND TOXICITY OF MICRO-POLLUTANTS EXTRACTED FROM WATER AT THE MORSANG PLANT,

Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
For primary bibliographic entry see Field 5B.
W86-02168

WATER TREATMENT PLANT DESIGN FOR THE PRACTICING ENGINEER.

Ann Arbor Science, Ann Arbor, MI. 1982. Edited by Robert L. Sanks. 845 p.

Descriptors: *Water treatment, *Water treatment facilities, *Chemical treatment, Drinking water, Potable water, Coagulation, Flocculation, Filtration, Sedimentation, Water analysis.

Various aspects of water treatment plant design are presented to assist consulting engineers. Specific areas of discussion include effects of federal regulations on water treatment design, public health aspects of water supplies, treatment processes (coagulation, sedimentation, flocculation, filtration, suspended solids removal, softening, ion exchange, sludge removal), chemical handling and feeding, equipment design, package water treatment plants, corrosion control, automated operation, pump station design, instrumentation, cost estimation techniques, operation and maintenance manuals, and operator training. (Halterman-PTT)
W86-02188

EFFECTS OF FEDERAL REGULATIONS ON WATER TREATMENT PLANT DESIGN,

Environmental Protection Agency, Denver, CO. Region VIII.
P. E. Hoffbuhr, and D. R. Chaussee.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 1-15, 8 tab, 8 ref.

Descriptors: *Water treatment, *Chemical treatment, Water treatment facilities, Legal aspects, Regulations, Drinking water, Potable water.

Various aspects of the Safe Drinking Water Act are discussed, with emphasis on maximum contaminant levels, and design consideration, including water source treatment selection. The focus of the treatment selection discussion is inorganic and organic chemical removal, turbidity, microbiological contaminants and radiological chemicals. The greatest difficulty will be for small communities to meet the requirements of the new law. Since cost effective water treatment processes for small water systems have never been fully developed, research in this area is badly needed. (Halterman-PTT)
W86-02189

PUBLIC HEALTH ASPECTS OF WATER SUPPLIES,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
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W86-02190

PREDESIGN STUDIES,

Montgomery (James M.), Inc., Pasadena, CA.
R. R. Trussell.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 37-64, 13 fig, 4 tab, 36 ref.

Descriptors: *Water treatment, *Drinking water, Potable water, Water analysis, Treated water, Filtration, Flocculation, Water treatment facilities, Turbidity.

Methods for establishing treatment requirements for specific water supplies, prior to the designing of a treatment plant, are detailed. The treatment processes of major concern are removal of turbidity, iron, manganese, color and H2S; treatment for tastes and odors; softening; and disinfection. To assist the design engineer, applicable water quality standards and their meaning are discussed. Methods for evaluating water sources are reviewed, with special emphasis on meaningful methods of data analysis. Appropriate bench-scale tests are discussed, emphasizing evaluation of jar test data (turbidity topogram) and direct filtration studies. Pilot studies are discussed in detail, including comments on flocculation, sedimentation and filtration. (Halterman-PTT)
W86-02191

COAGULATION,

North Carolina Univ. at Charlotte. Dept. of Environmental Sciences and Engineering.
C. R. O'Melia.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 65-81, 4 fig, 19 ref.

Descriptors: *Water treatment, *Coagulation, Flocculation, Water treatment facilities, Aluminum sulfate, Color removal, Turbidity, Pollutants.

Coagulation, the process for combining small particles into larger aggregates, is an essential component of accepted water treatment practice in which coagulation, sedimentation and filtration processes are combined in a series to remove particulates from water. The coagulation process, including destabilization and mixing, is outlined. The materials used for destabilization are described. They include hydrolyzing metal ions (primarily aluminum), synthetic polymers, and coagulant aids (such as activated silic). Some guidelines for proper selection of these materials are provided. Finally, rapid mix and flocculation tanks are discussed. Guidelines for their proper use are provided. (Halterman-PTT)
W86-02192

SLUDGE DISPOSAL AND THE A.P. BLACK PROCESS,

Gainesville-Alachua County Regional Electric Water and Sewer Utilities Board, FL.
A. T. DuBose.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 83-103, 2 fig, 6 tab, 10 ref.

Descriptors: *Water treatment, *Chemical treatment, *Sludge utilization, Water treatment facilities, Turbidity, Flocculation, Water analysis, Sludge disposal, Sludge thickening.

The A.P. Black process for sludge removal entails pumping thickened sludge, produced from the lime-softening of hard, turbid or colored water, to a series of sludge carbonation cells where it is mixed with scrubbed kiln gas containing 20% CO2. The magnesium hydroxide is dissolved from calcium carbonate and turbidity factors. This slurry passes to a thickener from which clear supernatant containing soluble magnesium bicarbonate overflows and passes to a heat exchange unit and is warmed to 40 degrees C. After stirring, the precipitation of magnesium carbonate as the trihydrate is rapid and complete in 90 seconds. The turbidity factors are then removed by froth flotation, and the purified CaCO3 is calcinated to a high quality quicklime. The economics of this process are discussed and the application of this method under varying conditions is described. (Halterman-PTT)
W86-02193

FLOTATION PROCESS USED FOR CALCIUM CARBONATE RECOVERY FROM WATER TREATMENT SLUDGES,

Dawson Metallurgical Labs., Inc., Murray, UT.
H. A. Dawson.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 105-124, 6 fig, 6 tab, 9 ref.

Descriptors: *Water treatment, *Chemical treatment, *Froth flotation, Flotation, Treated water, Flocculation, Turbidity, Coagulation, Chemical coagulation, Calcium carbonate.

Froth flotation is a physico-chemical method for separating types of minerals or compounds present as discrete particles in an aqueous slurry. The history, mechanics of action, and the process are described. Results from tests conducted at several plants indicate that this process is relatively simple, easily controlled, and practical for the recovery of magnesium carbonate in large water treatment plants. The magnesium carbonate process is applicable for coagulation in the smallest plants. The recovery of magnesium carbonate, however, should be limited to plants that require at lest 0.9 ton of coagulant per day. (Halterman-PTT)
W86-02194

DESIGN OF RAPID MIX UNITS,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 131-147, 3 fig, 3 tab, 23 ref.

Descriptors: *Water treatment, *Chemical treatment, Flocculation, Treated water, Turbidity, Coagulation, Aluminum sulfate, Alum.

The rapid mix unit is often the first step in a water treatment process train, and provides the hardware necessary for the initial stages of the coagulation process. Some theoretical considerations for the rapid mixing operation are outlined, and summaries of the available alternatives in design are presented. Data needed for optimal design include analysis of best and worst raw water conditions, minimum and maximum flow rates, and typical jar test results of all water samples. The location of the rapid mix units must be close to the coagulant feed tanks to minimize clogging. Furthermore, the alum solution lines should be able to feed 5% or less into the raw water. (Halterman-PTT)
W86-02195

SEDIMENTATION,

Walker Engineer, Aurora, IL.
J. D. Walker.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 149–182, 9 fig, 4 tab, 8 ref.

Descriptors: *Water treatment, *Chemical treatment, Flocculation, Treated water, Turbidity, Coagulation, Aluminum sulfate, Alum, Sludge, Sludge disposal.

Sedimentation of flocculent solids to produce a clear effluent can be accomplished in several ways. The most economical and easily operated unit for this process is a well-designed clarifier basin, equipped with a sludge scraper and underflow control system. Solids contact systems, with a combination of solids return, high-rate mixing, floc aggregation, and circumferential vertical rise clarification, are also important considerations. Floc preparation before sedimentation should consist of

instant blending, rapid mixing floc aggregation. The newer high-rate settlers such as inclined tube or plate modules also warrant consideration, especially for small flows. Furthermore, conservative surface-loading rate parameters work well for small flow systems. (Halterman-PTT)
W86-02196

SLUDGE DISPOSAL,

Alvord, Burdick and Howson, Chicago, IL.
L. R. Howson.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 183-193, 2 fig, 8 ref.

Descriptors: *Sludge, *Sludge disposal, *Water treatment, *Sludge lagoons, Flocculation, Coagulation, Aluminum sulfate, Alum, Sludge thickening, Sludge solids.

Waterworks sludge is the suspended solid material (sand, silt, clay and algae) present in raw water plus the precipitated chemicals added to facilitate separation of suspended solids. Sludge is usually removed by a variety of methods, including backwashing, followed by deposition in lagoons. The use of lagoons is the most economical means of sludge removal, especially in small treatment plants. The costs of such methods as pressing and centrifugation usually exceeds the costs of lagoons. (Halterman-PTT)
W86-02197

DESIGN OF FLOCCULATION SYSTEMS,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 195-229, 8 fig, 3 tab, 38 ref.

Descriptors: *Water treatment, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

The flocculation stage in water treatment is the aggregation or growth of the destabilized colloidal suspension. Two major mechanisms are identified: perikinesis (aggregation resulting from random thermal motion and significant for particles less than 2 microns); and orthokinesis (induced by velocity gradients in the fluid). The available kinetic models of the flocculation process are described, and the design of mechanical flocculators and sludge blanket clarifiers are discussed. (Halterman-PTT)
W86-02198

GRANULAR-MEDIA DEEP-BED FILTRATION,

Iowa State Univ., Ames. Dept. of Civil Engineering.
E. R. Baumann.
In: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 231-281, 25 fig, 6 tab, 42 ref.

Descriptors: *Water treatment, *Filtration, Drinking water, Potable water, Trace metals, Bacterial analysis, Metals, Treated water.

Deep-bed granular-media filters find widespread use in potable water treatment for the removal of suspended solids in a variety of applications, including iron and manganese precipitates removed from ground water supplies; removal of softening precipitate carry-over from lime-soda ash softening of ground or surface water supplies; removal of floc carry-over resulting from coagulation-flocculation-sedimentation of surface waters; and removal of microorganisms. Currently accepted technology, the hudraulics of flow in filters, filtered water quality considerations, filter control methods, and filter media are discussed in detail. (Halterman-PTT)
W86-02199

SUSPENDED SOLIDS REMOVAL,

Permutit Co., Inc., Paramus, NJ.
R. T. O'Connell.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 283-298, 4 fig, 1 tab, 9 ref.

Descriptors: *Water treatment, *Suspended solids, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

Ideally, a water treatment plant effluent should contain less than one turbidity unit. To attain this quality, a water treatment plant must be equipped with the proper unit process to remove suspended solids. The various compounds used for chemical coagulation are reviewed. Alum is the most widely used material. Ferrous sulfate and ferric sulfate are commonly used when a wide range of pH exists. The use of Bentonite clay, powdered activated carbon and polymers for aiding coagulation are described. Solids contact-sludge blanket units and filtration are also discussed. The estimated costs for capital equipment, including solids contact units, gravity filters, chemical feeds and controls are provided. (Halterman-PTT)
W86-02200

ADVANCED TECHNIQUES FOR SUSPENDED SOLIDS REMOVAL,

Neptune Microfloc, Inc., Corvallis, OR.
W. R. Conley, and S. P. Hansen.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 299-312, 9 fig, 2 tab, 10 ref.

Descriptors: *Water treatment, *Suspended solids, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

Improved suspended solids removal, at a low cost, can best be achieved by precisely controlling coagulation. Advanced technology for doing so includes the use of a coagulant control center which continuously monitors coagulation conditions and alerts the operator to any changes. High-rate treatments (tube settlers, and mixed media filters) also help improve the system by reducing costs. The combination of these two modifications provides superior suspended solids removal at capitol costs lower than those of conventional water treatment plants. (Halterman-PTT)
W86-02201

PRECOAT FILTRATION,

Iowa State Univ., Ames. Dept. of Civil Engineering.
E. R. Baumann.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 313-370, 34 fig, 11 tab, 18 ref.

Descriptors: *Water treatment, *Suspended solids, Flocculation, Chemical treatment, Turbidity, Chemical coagulation, Treated water, Aluminum sulfate, Clarifiers, Filtration.

Precoat filtration, employing thin layer (3-5 mm) of filter media, requires three steps: a precoating operation, a filtering step, and a backwashing operation. This effective filtering procedure results in the loss of filter media after each run because it is quite difficult to separate the filter media from the solids that were removed. The entire operation is described, along with guidelines for selection of filter types, filter media, and filter media coatings. Various applications for precoat filtering are provided, including budgetary constraints, large seasonal variation in demand, and systems needing emergency or standby service. Optimal plant designs for precoat filtering are discussed. (Halterman-PTT)
W86-02202

DESIGN AND APPLICATION OF POTABLE WATER CHLORINATION SYSTEMS,

G. C. White.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 371-395, 1 fig, 10 ref.

Descriptors: *Water treatment, *Drinking water, *Chlorination, *Chlorine, Potable water, Bacterial analysis, Wastewater treatment, Residual chlorine.

The information necessary for the design of a chlorination system is provided, and the objectives of chlorination and its many uses in water treatment are outlined, and the means of achieving these objectives are discussed. Chlorination has historically been a method of choice for disinfection, taste and odor control, algal growth prevention, slime prevention, removal of iron and manganese, and organic color bleaching. The benefits of chlorination with hypochlorinators and gas chlorinators are compared. Injector systems, diffusers, mixing devices and safety equipment are discussed. (Halterman-PTT)
W86-02203

PUMP STATIONS,

Black and Veatch, Kansas City, MO.
J. R. Wright.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 397-414, 7 fig, 1 tab, 2 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Pumping, Pumping plants, Pumping tests, Pumps, Drinking water, Potable water.

Since water must be pumped either from the source of supply to the treatment works, or from the treatment works into the delivery system, or both, the pumping facilities must be consistent with the treatment plant design concepts. General considerations to be made are structural, architectural, and the layout of the equipment. Pump selection is based on a variety of factors, including pump design, pump control systems, drive systems (gasoline, gas, diesel, electric), cavitation tendency, sump design, piping, and valves. The important specification criteria for pumping stations and some data on costs of pumping stations are provided. (Halterman-PTT)
W86-02204

PACKAGE WATER TREATMENT PLANTS,

Culp/Wesner/Culp, Shingle Springs, CA.
S. P. Hansen, and W. R. Conley.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 415-434, 7 fig, 4 tab, 6 ref.

Descriptors: *Water treatment, *Drinking water, *Water treatment facilities, Potable water, Coagulation, Flocculation, Filtration, Settling tanks, Sedimentation.

The package water treatment plant has become established as a practical and economic solution for providing treated water for small communities. The historical problems associated with these systems have been overcome with recent developments in flocculation, clarification, and filtration. Features that are available to continuously monitor filtered water turbidity and to prevent the introduction of poor quality water into the distribution system are discussed. Because of the economics of their construction, ease of operation and maintenance, and reliability, package plants should be carefully considered for flows of less than 5 mgd. (Halterman-PTT)
W86-02205

PACKAGE WATER TREATMENT EQUIPMENT,

Permutit Co., Inc., Paramus, NJ.
R. T. O'Connell.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 435-445, 5 fig, 2 tab.

Descriptors: *Water treatment, *Drinking water, *Water treatment facilities, Potable water, Coagultion, Flocculation, Filtration, Settling tanks, Sedimentation.

Package-type water treatment equipment (preassembled, modular treatment units) for removal of suspended solids are discussed, and examples of

treatment systems are detailed. The sludge blanket clarifiers, with horizontally mounted agitators, are well suited for the package-type unit concept because they are small, the internal parts can be readily fabricated, and the units require no welding. Steel-shell cylindrical gravity filters can be shipped partially preassembled. The two major types in use are the automatic valveless gravity filter and the steel shell, conventional style gravity filters. Two examples of system development are diagramed, showing raw water intake, chemical dosing for coagulation, agitation, and sludge filtration. Differences in the systems, with regard to filtration, are discussed. (Halterman-PTT)
W86-02206

INSTRUMENTATION FOR AUTOMATIC OPERATION,

R. H. Babcock.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 447-459, 2 fig, 3 tab, 9 ref.

Descriptors: *Water treatment, *Chemical treatment, *Water treatment facilities, Drinking water, Potablewater, Water analysis, Turbidity, Pollutants, Hydrogen ion concentration, Residual chlorine.

Automatic treatment systems have instrumentation that must control critical tasks, minimize tedious repetitive tasks, and provide a tool for process supervision. Critical areas are measurement of flow and level; analytical measurement and control (pH, turbidity, chlorine residual, fluoride and hardness); alarm systems; and the modulation of controls. The automatic control of treatment systems is becoming a major factor in the design of modern systems. (Halterman-PTT)
W86-02207

POTASSIUM PERMANGANATE FOR IRON AND MANGANESE REMOVAL AND TASTE AND ODOR CONTROL,

Carus Chemical Co., La Salle, IL.
K. J. Ficek.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 461-479, 10 fig, 2 tab, 20 ref.

Descriptors: *Water treatment, *Chemical treatment, *Drinking water, Potable water, Taste, Odor Control, Odors, Potassium permanganate, Chlorine.

Potassium permanganate can be used effectively and economically to reduce taste and odors and to oxidize iron and manganese. Because it is an oxidizing agent, potassium permanganate application prior to chlorination reduces the chlorine requirement. It can be used with other water treatment chemicals, such as carbon, to improve water quality. The normal dosage levels of potassium permanganate range from 0.5 to 2.5 mg/l, but higher dosages may be required for more highly contaminated waters. Finally, potassium permanganate is safe and easy to handle. (Halterman-PTT)
W86-02208

ACTIVATED CARBON FOR TASTE AND ODOR CONTROL,

Westvaco Corp., Covington, VA. Carbon Dept.
B. H. Kornegay.
IN: Water Treatment Plant Designfor the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 481-496, 12 fig, 9 ref.

Descriptors: *Activated carbon, *Water treatment, *Chemical treatment, *Drinking water, Potable water, Taste odors, Odor control, Filtration, Adsorbants, Carbon.

The history of the use of activated carbon is discussed, including its early use in the 1920s in the chemistry industry. Since that time, powdered activated carbon has become the most widely used method of taste and odor control. Comparative laboratory testing is the most effective method for evaluating the cost-effectiveness of various carbons, but, in the absence of these data, the iodine number should be used as the basis of selection. Granular activated carbon systems are increasing in number and may be more cost-effective for severe taste and odor problems. The carbon also serves as a filter medium when applied in conventional systems. Therefore, adsorption, filtration and backwash must be considered in design. (Halterman-PTT)
W86-02209

CHEMICAL CONDITIONING FOR WATER SOFTENING AND CORROSION CONTROL,

Brown and Caldwell, Walnut Creek, CA.
D. T. Merrill.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 497-565, 21 fig, 9 tab, 18 ref.

Descriptors: *Water treatment, *Chemical treatment, Drinking water, Potable water, Corrosion, *Corrosion control, Water softening, Water treatment facilities.

The use of Caldwell-Lawrence diagrams to analyze and solve corrosion control problems is described. The diagrams provide a means to assess rapidly and accurately the condition of raw and finished waters, the type and amount of chemicals required to produce the finished water, and the amount of chemical precipitates formed. Insights that are not generally available through the inspection of gross analytical parameters are obtained by the use of these diagrams. Examples of the use of these diagrams in rational analyses of water processing alternatives are provided. (Halterman-PTT)
W86-02210

LIME-SODA SOFTENING PROCESSES,

Greeley and Hansen, Chicago, IL.
C. W. Reh.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 567-596, 10 fig, 7 tab, 21 ref.

Descriptors: *Water treatment, *Chemical treatment, *Water softening, Drinking water, Potable water, Water treatment facilities, Water analysis.

The design of lime softening facilities for municipal plants involves the application of basic water chemistry to continuous, uninterrupted flow regimens to produce a finished water with desirable, consistent and predictable characteristics and properties. Lime-soda ash-caustic softening includes a number of flow patterns, a wide variety of equipment components, and accessory equipment for process control and sludge dispreal. Alternate processes and bases for selection, process elements, specialized equipment and bases for selection, process elements, specialized equipment and tankage for the softening operations, and overall softening process control are discussed in detail. (Halterman-PTT)
W86-02211

ION EXCHANGE,

Montana State Univ., Bozeman.
R. L. Sanks.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 597-622, 13 fig, 5 tab, 10 ref.

Descriptors: *Water treatment, *Ion exchange, Chemical treatment, Drinking water, Potable water, Anion exchange, Cation exchange, Resins.

Background information on ion exchange is provided to enable engineers to make preliminary designs, evaluate costs, optimize capital and operating costs, and to guide the manufacturer toward a final design that approaches the optimum. The properties of strong acid, weak acid, strong base, weak base, and intermediate (difunctional) base exchangers are discussed. The design procedure is outlined as follows: select the resin to be used, determine pretreatment requirements, select regenerant level, select the regeneration contact time, recheck the capacity of the resin as a function of the raw water analysis, recheck the capacity vs. the service flow rate, check the leakage of hardness cations, calculate backflow rate, determine pressure drop within the resin beds, and finally, compute the operating cycle by determining the time required for all operations and compute the amount of water treated. Methods of making these determinations and for making estimates on the costs of operating this system, are provided. (Halterman-PTT)
W86-02212

WATER QUALITY IMPROVEMENT BY REVERSE OSMOSIS,

I. Nusbaum, and A. B. Riedinger.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 623-652, 8 fig, 4 tab, 16 ref.

Descriptors: *Water treatment, *Drinking water, *Reverse osmosis, *Ultrafiltration, Potable water, Membrane processes, Filtration, Bacteria, Viruses, Radioactive wastes.

Reverse osmosis and ultrafiltration, two types of pressure-driven membrane systems, are processes that are capable of water quality enhancement above and beyond that of conventional water treatment. The term reverse osmosis usually applies to the separation of ionic or low molecular weight species from a solvent, usually water, by a process involving osmosis. The molecular dimensions of the solute are within one order of magnitude of that of the solvent. Operating pressures for reverse osmosis, as applied to dissolved solids concentrations of up to 10,000 mg/l, are usually in the range of 300 to 600 psi. Ultrafiltration, on the other hand, is a filtration process, utilizing a porous membrane, which is used on bacteria, viruses and colloidal and high molecular weight dissolved organic substances. Several characteristics of reverse osmosis are described to provide engineers with an understanding of the operational requirements and performance of these systems. Included in the discussion are concentration polarization; specific ion and compound rejection; effects of temperature, compaction, pH and total dissolved solids. Applications to removal of organic compounds, bacteria, viruses, pyrogens, radioactive substances and gases are detailed. (Halterman-PTT)
W86-02213

TECHNIQUES AND MATERIALS FOR PREVENTING CORROSION,

American Paint Journal Co., New York.
A. Banov, and H. J. Schmidt.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 653-674, 6 tab, 6 ref.

Descriptors: *Water treatment, *Water treatment, *Coatings, *Linings, Sealants, Epoxy resins, Rubber, Elastomers, Zinc.

Because chemicals involved in water treatment put a severe burden on surface materials, selection of proper coating for surfaces is critical. Guidance for selecting the proper coating for surfaces under mild service conditions are provided. Selection of materials, surface preparation, application and inspection techniques are outlined. A variety of coatings and linings are discussed, including acrylics, epoxies, fluorocarbons, chlorinated rubber, phenol resins, polyesters, silicones, vinyls, urethanes, elastomeric urethanes, metalizing sealers, neoprene, chlorinated polyether, inorganic zinc, chlorosulfonated polyethylene, asphalt, rubber linings, coal tar epoxy, and furane resins. Two highly rated combinations of coatings are (1) a urethane moisture-cure primer, a two-component aromatic urethane intermediate coat, and a two-component aliphatic urethane topcoat, and (2) an inorganic zinc primer, a two-component epoxy/polymide intermediate coat and a high-build urethane topcoat. (Halterman-PTT)
W86-02214

DESIGN OF GRANULAR-MEDIA FILTER UNITS,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.

IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 675-737, 14 fig, 10 tab, 48 ref.

Descriptors: *Water treatment, *Water treatment facilities, *Filtration, *Filter media, Drinking water, Potable water, Backwash, Pretreatment of water, Filter rate, Filters.

Granular-media filtration, the final solid-liquid separation process in water treatment, is described. The major filtration principles that effect design of a filtration system include pretreatment, filtration rate, water quality, filter media, run length, backwashing, and the influence of polyelectrolytes. The use of these principles is illustrated with typical process design calculations, including data on design flow, filtration rate, filter media, underdrain system, filter dimensions, filter operational data, backwash system and the conduit system. A plan and section view of the filter block design are provided. (Halterman-PTT)
W86-02215

ESTIMATING WATER SYSTEM COSTS,

Montgomery (James M.), Inc., Pasadena, CA.
R. D. Dickson.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982, p 763-799, 8 fig, 8 tab, 5 ref.

Descriptors: *Drinking water, *Water treatment, *Water treatment facilities, *Costs, Potable water, Cost analysis, Economic aspects, Construction costs, Estimated costs, Maintenance costs, Operating costs.

The need to estimate the costs of the various components of a water treatment system, prior to making a final selection, has resulted in the development of two systems of indices which are normally used within the water works industry. These are referred to as the 'Engineering News-Record' and the 'Handy-Whitman' indices. The history of cost indices, the development of cost curves, the use of cost curves, the operation and maintenance cost-estimating procedures, reservoir costs, pumping station costs, pipeline costs, and water treatment plant costs are discussed. A comparison of cost curves is provided to illustrate different indices and variations in cost projections for different types of facilities. (Halterman-PTT)
W86-02216

O & M MANUALS AND OPERATOR TRAINING,

Regan (T.M.), Inc., Lexington, KY.
T. M. Regan.
IN: Water Treatment Plant Design for the Practicing Engineer, Ann Arbor Science, Ann Arbor, MI, 1982. p 805-814.

Descriptors: *Water treatment, *Water treatment facility, *Training, Drinking water, Potable water, Operation policies, Administration, Maintenance.

Various aspects of operation and maintenance (O to M) manuals, and operator training programs are discussed. The O and M manuals are effective design tools if started during the early stages of the design process, focusing attention on the physical operational problems of the facility. The need for proper operator training is also discussed. Of primary importance is the use of the O and M manual as a training text. If properly prepared and understood by operating personnel, the O and M manual can be the greatest single factor affecting the efficient operation of the facility. (Halterman-PTT)
W86-02217

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES,

Ann Arbor Science, Ann Arbor, MI. 1982. Edited by Eric J. Schiller and Ronald L. Droste. 368 p.

Descriptors: *Water supply development, Developing countries, *Sanitation, *Water treatment, *Wastewater treatment, Water supply, Public health, Water resources development, Water management, Training, Economic aspects, Social aspects, Waste disposal, Project planning.

This book is a revised and improved version of the material from a course given at the University of Ottawa during June 1981. Planning for this course evolved from an International Development Research Center (IDRC)/Canadian International Development Agency (CIDA) man-power training project and workshops that were conducted in East and Southern Africa during 1978-1980. As a result of extensive cooperation with overseas personnel, the dual emphases of renewable energy technologies and social, management and economic aspects emerged. These two foci provide the main outline for this book. This book gives a comprehensive coverage of the technical and management aspects of implementing water supply and sanitation systems in developing countries. It should prove valuable for both technical and nontechnical personnel who want to orient themselves to these activities. The text is divided into four sections. Section 1 deals with water supply technologies. Section 2 considers low-cost sanitation options. Section 3 deals with management aspects, and Section 4 discusses interfacing programs with developing countries. (Geiger-PTT)
W86-02324

WATER SUPPLY AROUND THE WORLD--APPROPRIATE TECHNOLOGY,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Okun.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 9-21, 11 fig.

Descriptors: *Water supply development, *Developing countries, *Sanitation, *Water treatment, *Wastewater treatment, Water supply, Water resources development, Water management, Economic aspects, Waste disposal, Project planning, Automation, Capital costs, Labor.

While it is not likely that a community will opt for improved sanitation ahead of water supply, the commitment should be made to both at the same time. In developing countries, water supply and sanitation facilities are often not yet available to people in rural areas, villages and many urban areas. The principles on which water supply and sanitation facility design and operation are based are the same in developed and developing countries. The only difference is that in developing countries, the facilities may be more labor-intensive than capital intensive. Since water supply and wastewater collection and treatment facilities are often among the most expensive and prominant of all investments made by communities in developing countries, the most modern technologies are usually opted for, over less costly and usually more adequate conventional technologies. Not only does the use of excessive technology detract funds from higher-priority needs, but investment in this technology becomes a heavy liability. Examples of the use of inappropriate technology for water treatment in Africa and Asia are given. (Geiger-PTT)
W86-02325

REGIONALIZATION OF WATER SUPPLY AND SANITATION SERVICES,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Okun.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 23-35, 1 fig, 6 ref.

Descriptors: *Regional development, *Water supply development, *Developing countries, *Sanitation, *Water management, Water supply, Water resources development, Training, Economic aspects, Social aspects, Political aspects, Wastewater facilities, Wastewater treatment, Waste disposal, Project planning, Wastewater disposal.

In 1945, the British initiated a program of regionalization of water supplies to optimize investments in water supply, wastewater collection and disposal, river regulation, and the amenity uses of inland waters. The uniqueness of water projects in relation to climate, precipitation, topography, density and distribution of population, industrial development, land use, economic status, availability of human resources, and social structure and customs must be recognized. The need for pure water supplies is important in developing countries where infectious diseases are more likely to spread. Integration of wastewater collection and disposal with water supply is particularly appropriate in arid and semiarid areas of the world where reclaimed wastewaters are used for nonpotable purposes. Integration of these services can afford efficiencies and economies of scale similar to those obtained by regionalization. When adopting a regionalization approach in developing countries, certain guidelines should be followed. The region should encompass people of the same cultural background. The region should be close to regional headquarters, or be large enough to have its own headquarters. The region should conform to political boundaries and should have potential for education and training centers and be able to manage its own facilities. (Geiger-PTT)
W86-02326

HAND-PUMP TECHNOLOGY FOR THE DEVELOPMENT OF GROUNDWATER RESOURCES,

Agency for International Development, Washington, DC.
For primary bibliographic entry see Field 8C.
W86-02327

RENEWABLE ENERGY PUMPING FROM RIVERS AND STREAMS,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8C.
W86-02328

WIND-POWER PUMPING,

Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 8C.
W86-02329

ROOFTOP RAINWATER CATCHMENT SYSTEMS FOR DRINKING WATER SUPPLY,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3B.
W86-02330

SIMPLE WATER TREATMENT METHODS,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
R. L. Droste, and F. E. McJunkin.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor, MI, 1982. p 101-122, 10 fig, 2 tab, 18 ref.

Descriptors: *Water treatment, *Water quality, *Chlorination, *Developing countries, *Filtration, Sand filters, Water supply, Water supply development, Aeration, Flocculation, Coagulation, Disinfection, Heavy metals, Enteric bacteria, Coliforms, Public health.

In less developed countries, the general rule for water treatment is to provide the minimum treatment necessary. A good water source is the first protective barrier against waterborne disease. Microbiological quality is the major measure of the quality of water. Fecal coliform and streptococcus serve as indicator organisms of microbiological purity. In developing countries, nitrates can cause methemoglobinemia in infants under 3 months of age. Fluorides in moderate amounts are desirable to prevent dental caries. Other dissolved inorganic salts affect the taste of water and can cause a temporary laxative effect. Fe and Mn cause staining of fixtures and clothes and contribute taste and odors. In developing countries, operation and maintenance of water treatment plants is the responsibility of national or regional governments. Storage of water supplies offers additional protection against emergency water demands. Aeration, filtration and chlorination are common practices for the treatment of water. Sand filtration may be

incorporated into source protection by using an infiltration gallery. There are a number of simple chlorination devices that can be used if the supply of solid chlorine is assured. (Geiger-PTT)
W86-02331

COST-EFFECTIVE WATER SUPPLY AND SANITATION PROJECTS FOR DEVELOPING COUNTRIES,

International Bank for Reconstruction and Development, Washington, DC. Dept. of Transportation and Water.
For primary bibliographic entry see Field 6C.
W86-02337

FINANCING WATER SUPPLY SYSTEMS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 6C.
W86-02338

PROCESS OF PROJECT PREPARATION,

Walker and Partners Ltd., Ottawa (Ontari).
For primary bibliographic entry see Field 6B.
W86-02339

OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS,

Walker and Partners Ltd., Ottawa (Ontari).
For primary bibliographic entry see Field 5D.
W86-02341

TRAINING OF COUNTERPARTS,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 9A.
W86-02342

5G. Water Quality Control

ACID MINE DRAINAGE: CONTROL AND ABATEMENT RESEARCH,

Bureau of Mines, Pittsburgh, PA. Pittsburgh Research Center.
For primary bibliographic entry see Field 5D.
W86-01978

ASSESSMENT AND CONTROL OF WATER CONTAMINATION ASSOCIATED WITH SHALE OIL EXTRACTION AND PROCESSING,

Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.
W86-01979

MECHANISMS FOR GROUNDWATER CONTAMINATION BY UCG: PRELIMINARY CONCLUSIONS FROM THE HOE CREEK STUDY,

Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W86-01981

PHYSICAL PROPERTIES AND LEACH TESTING OF SOLIDIFIED/STABILIZED INDUSTRIAL WASTES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5E.
W86-02001

SITING HAZARDOUS WASTE MANAGEMENT FACILITIES: THEORY VERSUS REALITY,

Boston Univ., MA. Dept. of Urban Affairs and Planning.
R. F. Anderson, and M. R. Greenberg.
IN: Hazardous and Toxic Wastes: Technology, Management and Health Effects, The Pennsylvania Academy of Science, Easton, PA. 1984. p 170-186, 2 fig, 6 tab, 29 ref.

Descriptors: *Water quality control, *Waste disposal, *Landfills, New Jersey.

A site screening method is useful in making decisions for locating new hazardous waste sites. Applied to 46 known disposal sites in Lower Raritan/Middlesex County 208 Water Management Area, central New Jersey, the method shows that most of these sites are not acceptable according to criteria in the proposed method. The 272 cells of 2 x 2 kilometers each were evauated according to 22 criteria, grouped into 9 composite statistical factors. Each cell rated 1-4 (most suitable to least suitable) in each of the 9 categories. A composite rating (1-5) was developed, 1 having the largest number of most suitable ratings and 5 having more than one least suitable ranking. Of the 38 most suitable cells, only 4 contain existing landfills. The other 42 landfills in this region, including the Kin-Buc landfill in Edison, are situated in land unsuitable for this purpose. (Cassar-PTT)
W86-02045

ENVIRONMENTAL IMPACT OF POLLUTION CONTROLS ON THE THAMES ESTUARY, UNITED KINGDOM,

Thames Water Authority, Reading (England).
P. Casapieri.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 489-504, 4 fig, 4 tab, 11 ref.

Descriptors: *Water quality control, *Estuaries, *Management, *Thames River, *United Kingdom, Water pollution control, Water pollution sources, Dissolved oxygen, Oxygen, Legislation, Wastewater treatment, Aquatic habitats, Habitats, Fish, Salmon, Standards, Water quality standards, Rivers, Tidal rivers.

The Thames River Estuary, badly polluted with industrial and human waste since the 18 century, has been recovering in recent years. Dissolved oxygen levels started to improve about 1870, following pollution control legislation in 1857. However, starting about 1900, dissolved oxygen again decreased, reaching zero for the period 1940-1965. In 1973 the 1600 separate water authorities responsible for pollution control in England and Wales were reorganized into 10 regional water authorities. Environmental quality objectives were developed by the Pippard Committee. Beginning with dissolved oxygen goals (minimum of 1 mg/liter), the next step was a management strategy to establish dissolved oxyten levels suitable for a migratory fish habitat. Six classes of rivers were defined, each with water quality objectives and standards. Likewise, tidal waters were classified into five categories. One measure of water quality is the number of fish species recorded in the Key-Gravesend reach. This has increased from <5 in 1964 to 50 in the late 1960's to nearly 100 in 1980. A 17-year salmon introduction project started in 1979 has yielded salmon caught by rod and reel and by electrofishing. (Cassar-PTT)
W86-02093

TREATMENT ALTERNATIVES FOR GROUNDWATER CONTAMINATION,

Montgomery (James M.), Inc., Reston, VA.
For primary bibliographic entry see Field 5F.
W86-02110

INVESTIGATION INTO THE WATER QUALITY BENEFITS OF CHLORINATING PAPER-MILL EFFLUENTS,

Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 5D.
W86-02112

CONSTRUCTION TECHNIQUES FOR REMEDIAL DESIGN AT A CONNECTICUT SUPERFUND SITE: A CASE STUDY,

Hart (Fred C.) Associates, Inc., New York.
B. D. Gillen, and D. E. Webster.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co., Lancaster, PA. 1984. p 497-509, 6 fig, 1 tab, 3 ref.

Descriptors: *Water pollution control, *Trenches, *Design criteria, *Landfills, *Drains, *Sewers, Ditches, Leachates, Dewatering, Leaching, Cost analysis, Waste disposal, Land disposal, Waste dumps, Sanitary landfills, Case studies.

The methods of construction and some design considerations used during the installation of a leachate collection trench drain at a landfill in Connecticut is described. The problems related to nonuniform soil conditions were remedied by using finer till from other stockpiles onsite. Compaction was improved creating a temporary till dam across the trench to retain liquids long enough to allow till to be placed on the trench bottom. Permeability tests were lengthy and pre-testing of sites is recommended. Dynamite blasting at the site caused fissures through which leachate could travel. An epoxy sealant was applied to prevent leachate escape through fissures. The manholes at the bottom of downgradient barriers had to be surrounded with an impermeable barrier to prevent leakage from the system. The entire system, including a trunk line to connect the collection drain to the existing sanitary sewer, was installed for about $400,000. The sytem currently collects approximately 20,000 gpd, an amount which may decrease over time as the groundwater level drops. (Geiger-PTT)
W86-02118

HAZARDOUS WASTE MANAGEMENT FOR THE 80'S.

For primary bibliographic entry see Field 5E.
W86-02219

USE OF AERIAL PHOTOGRAPHY AND REMOTE SENSING IN THE MANAGEMENT OF HAZARDOUS WASTES,

Ohio State Univ., Columbus.
J. G. Lyon.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 163-171, 18 ref.

Descriptors: *Aerial photography, *Remote sensing, *Infrared imagery, *Landfills, *Waste disposal, Groundwater, Industrial wastes, Solid wastes, Liquid wastes, Site selection, Environment.

Aerial photographs and remote sensor data are useful in providing both current and historical information on sites of hazardous wastes, and it is demonstrated that these tools can save money and human resources and can reduce toxic waste exposure. Historical photographic data can determine presence or absence of landfills, subsequent land use on closed landfills, and historical vegetation, soil and hydrological conditions. Current data can assist in the monitoring of soil and water conditions, in defining the chacteristics of vegetation cover, and in helping to prioritize abatement activities. Both siting and closure of hazardous waste sites can be facilitated by use of these techniques. Color infrared photography is valuable for monitoring water characteristics, since very thin layers of water can be distinguished. This is useful in locating leachate movement, ponding of water, erosion and condition of diversions. Aerial photographs have been acquired in the United States on a consistent basis since 1936. Information on sources for obtaining these photographs is given. (Halterman-PTT)
W86-02224

REMEDIAL ACTION ALTERNATIVES FOR ABANDONED HAZARDOUS WASTE SITES,

P. B. Lederman.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 265-276, 4 fig, 3 tab.

Descriptors: *Wastes, *Waste disposal, *Environment, *Cleanup, On-site investigations, Solid wastes, Liquid wastes, Landfills, Industrial wastes.

Various alternatives available for remedial action (cleanup) of abandoned hazardous waste sites (which will generally be pits, barrel repositories or burial grounds) are considered. After a field inves-

tigation has revealed the extent and type of contamination and sources of material (inventory), a judgment is made on the appropriate action. The alternatives to be considered include no action, site management, stabilization and closure, encapsulation, fixation, on site treatment, off-site secure landfill, or off-site treatment. The use of field tests, pilot studies, financial considerations, and assessment of risk of failure, to determine the most appropriate courses of action are discussed. (Halterman-PTT)
W86-02225

SLURRY TRENCH CUTOFF WALLS FOR HAZARDOUS WASTE ISOLATION,

D. J. D'Appolonia.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 289-305, 12 fig, 2 tab, 2 ref.

Descriptors: *Trenches, *Waste management, *Design criteria, *Waste disposal, *Cutoffs, Solid wastes, Liquid wastes, Environment, Landfills, Leachates.

Soil-bentonite slurry trench cutoff walls are an effective tool for isolating chemical and industrial waste materials that are disposed of in landfills or ponds. They can provide a vertical barrier around a disposal site without uncovering or disturbing the waste. The geological conditions where slurry trench construction is most applicable are reviewed, as are the important elements of slurry trench design. Critical design considerations include the connection details between the cutoff and the underlying aquaclude and the blend of soils and bentonite used for the landfill. In order to obtain a low permeability , containment-resistant backfill, a high percentage of fine plastic material must be used. A clayey sand or sandy clay containing 30 to 60 percent fines blended with bentonite slurry is usually satisfactory for most waste isolation applications. (Halterman-PTT)
W86-02226

CLAY LINER PERMEABILITY - A PROBABILISTIC DESCRIPTION,

Carnegie-Mellon Univ., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W86-02227

CONTAINMENT AND ENCAPSULATION OF HAZARDOUS WASTE DISPOSAL SITES,

For primary bibliographic entry see Field 5E.
W86-02228

ESTIMATES OF SEEPAGE THROUGH CLAY COVERS ON HAZARDOUS WASTE LANDFILLS,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-02229

MONITORING, RECOVERY AND TREATMENT OF POLLUTED GROUNDWATER,

J. R. Quince, and G. L. Gardner.
IN: Hazardous Waste Management for the 80's, Ann Arbor Science, Ann Arbor, MI, 1982. p 357-388, 13 fig, 2 tab.

Descriptors: *Groundwater pollution, *Industrial wastes, *Water treatment, Environment, Groundwater recharge, Water quality, Biological treatment, Chemical treatment.

An overview of techniques currently applied to recover and treat polluted groundwater is presented. The process consists of several steps: A preliminary investigation of existing site conditions, selection of a method of recovery (usually gravity collection, suction lift or positive displacement), selection of a treatment system based on the contaminant(s) being recovered, use of treatment system effluent for aquifer recharge, and monitoring. Four case histories encompassing a variety of contaminants are presented to illustrate the process. Treatment steps can be divided into three primary classifications: physical, chemical and biological. Physical techniques employ phase or component separation. Chemical treatment techniques employ the addition of a reactive material to provide for a change in chemistry of the waste stream. Biological treatment uses enhanced mirobiological activity to convert contaminants to non-toxic by-products. In situ recovery and treatment techniques including biodegradation have proven more effective than excavation and disposal of contaminated material. (Halterman-PTT)
W86-02230

SALINITY IN WATERCOURSES AND RESERVOIRS,

For primary bibliographic entry see Field 5B.
W86-02264

EVOLUTION OF A COST SHARING POLICY FOR FEDERAL CHLORIDE PROJECTS,

Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 6C.
W86-02266

PROBLEM OF SALINITY AND ITS CONTROL, RIVER MURRAY, AUSTRALIA,

River Murray Commission, Canberra (Australia).
For primary bibliographic entry see Field 5B.
W86-02267

DRAINAGE AND SALINITY CONTROL PROGRAMS IN PAKISTAN,

International Bank for Reconstruction and Development, Washington, DC.
W. D. Fairchild.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 43-52.

Descriptors: *Saline water; *Salinity, Irrigation, Water requirements, Water supply, Water use, Water users, Economic aspects, Pakistan, Indus Basin, Groundwater.

Several salinity-related water sector programs in Pakistan are outlined and the similarities with the Colorado Basin situation are discussed. Pakistan has up to 1.6 megahectares underlaid with saline groundwater that fits their 'disaster' classification of having a continuous high water table of less than 1.5 meters. Recommendations concerning salinity control included: exploitation of fresh groundwater resources by the private sector; implantation of a program to transfer operation and maintenance of existing public tubewells in fresh groundwater zones to the private sector; and placing high priority on control of waterlogging in saline groundwater zones in future investment programs. (Halterman-PTT)
W86-02268

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,

Bureau of Reclamation, Provo, UT. Utah Projects Office
For primary bibliographic entry see Field 6E.
W86-02269

USDA PLANNING PROCESS FOR COLORADO RIVER BASIN SALINITY CONTROL,

Soil Conservation Service, Portland, OR. West National Technical Center.
H. D. Hedlund.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 63-77, 2 fig, 2 tab, 20 ref.

Descriptors: *Salinity, *Saline water, *Irrigation, *Irrigation procedures, Water requirements, Irrigation requirements, Water supply, Water use, Water users, Colorado River, Colorado River Basin.

Several aspects of the USDA program for salinity control in the Colorado River Basin are reviewed. The planning process consists of the following six major steps: define the problem (quantification of the salinity problem); inventory and analysis (inventory of on-farm practices and analytical procedures to evaluate conditions); formulate alternative plans (determination of possible treatment opportunities); prepare displays of effects and compare alternative plans (displays aid in identification of tradeoffs between alternatives); and select the recommended plan (includes consideration of acceptability by local farmers and ranchers and the obligation to meet national and international water conservation and interstate water quality goals). Several on-going programs, including the Wellton-Mohawk, Grand Valley and Vinta Basin, are discussed. (Halterman-PTT)
W86-02270

SALINITY BUBBLES AND OFFSETS: A CONCEPT PAPER,

Environmental Protection Agency, Denver, CO. Water Management Div.
G. R. Reetz.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 79-91, 30 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation procedures, Water requirements, Irrigation requirements, Water supply, Water use, Water users, Colorado River, Colorado River Basin, Legal aspects, Legislation.

The impacts of salinity and the principles of a bubble/offset policy for environmental protection are discussed and the specifics of the problem of salinity in the Colorado River are described. Impacts on land and water uses include reduced crop yield, additional municipal water treatment costs, and increased corrosion and wear at water treatment facilities. The bubble concept applies to the practice of a facility rearranging emission control requirements, decreasing controls where control costs are high in exchange for increased controls where costs are low. The offset policy permits a new facility to enter a non-attainment area, provided the firm offsets its emissions with emission reductions obtained from existing firms in the non-attainment area. As related to Colorado River salinity control, the state of California recommended a bubble (the salinity concentrations at a particular time) bounded by the outflow from the Upper Basin, and recommended a basinwide offset policy for maintaining the bubble. The flexibility of the bubble and offset concepts, and their appropriateness for controlling salinity in the Colorado River Basin are discussed.
W86-02271

PLANNING AND IMPLEMENTATION FRAMEWORK FOR SALINITY CONTROL IN THE INDUS RIVER BASIN,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
M. S. Shafique, and G. V. Skogerboe.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 93-102, 3 fig, 1 tab, 5 ref.

Descriptors: *Saline water, *Salinity, Irrigation, Water requirements, Water supply, Water use, Water users, Economic aspects, Pakistan, Indus River, Groundwater.

The planning phase of salinity control in the Indus River Basin, Pakistan, included several steps. First, evaluation of alternatives for each individually irrigated area leads to practices that can effectively control salinity resulting from the use of water for irrigation. The second step is to define the best management practices by optimizing the cost-effectiveness relationships from individual areas into a single strategy. The third step assigns the required level of salinity control that should be implemented in each subbasin or irrigated area. The role of farmer organizations, monitoring, and evaluation in assuring the effectiveness of ongoing programs are discussed. (Halterman-PTT)
W86-02272

SOUTHWESTERN SALINITY SITUATION: THE ROCKIES TO THE MISSISSIPPI,

Army Engineer Div. Southwestern, Dallas, TX.
For primary bibliographic entry see Field 5B.
W86-02274

NATURAL SALT POLLUTION CONTROL BRAZOS RIVER BASIN, TEXAS,

Army Engineer District, Fort Worth, TX.
For primary bibliographic entry see Field 5B.
W86-02276

IMPROVING WATER MANAGEMENT PRACTICES ON SURFACE IRRIGATED LANDS: THE ROLE OF MODELING,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
W. R. Walker.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston, 1984. p 203-211, 4 fig, 1 tab, 13 ref.

Descriptors: *Salinity, *Saline water, *Irrigation, *Water quality control, Model studies, Irrigation design, Irrigation efficiency, Irrigation practices, Irrigation return flow.

Some of the faulty modeling assumptions made about uniform application of irrigation water, and the resultant bias of the results which favor off-farm salinity control options, are discussed. The need for more realistic irrigation models is stressed, and state-of-the-art models are described. Hydrodynamic, zero-inertia, kinetic-wave and volume balance models are outlined. Several ways in which surface irrigation models can be helpful are discussed. For instance, after an on-farm salinity control measure has been implemented at a structural level, the model can be used in conjunction with other management tools to improve and maintain effective irrigation practices. The use of surface irrigation models to predict the use of surge flow, cablegation, cutback, or tailwater reuse systems is also discussed. (Halterman-PTT)
W86-02282

LONGITUDINAL-VERTICAL HYDRODYNAMICS AND TRANSPORT WITH CHEMICAL EQUILIBRIA FOR LAKE POWELL AND LAKE MEAD,

Edinger (J.E.) Associates, Inc., Wayne, PA.
For primary bibliographic entry see Field 5B.
W86-02283

SKIMMING WELL MODEL FOR SALINITY CONTROL,

California Univ., Davis. Dept. of Civil Engineering.
B. A. Chandio, and B. E. Larock.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 235-242, 3 fig, 7 ref.

Descriptors: *Salinity, *Saline water, *Groundwater, *Water quality control, Model studies, Irrigation practices, Well hydraulics, Well water, Shallow water, Skimming.

A three-dimensional miscible fluid model of transient unconfined flow toward a skimming well is described and the role of such a model in salinity control is discussed. The ability to predict or control the distribution of salinity with skimming wells depends on knowledge of the hydromechanics of flow near the well. Important geometric factors that effect the hydromechanics, and thus the well operation, are described. Various well-operation strategies, such as depth and duration of pumping, can be tested for a suitable set of geometric parameters. In this way, the optimum means of skimming water from the relatively thin band of fresh groundwater which overlies a thicker saline water layer in an unconfined aquifer, can be determined. However, owing to the use of linear elements in the model, computations employing a larger, finer mesh of elements is suggested. (Halterman-PTT)
W86-02285

SALINITY CONTROL THROUGH WATER CONSERVATION IN THE UPPER COLORADO RIVER BASIN,

Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 3F.
W86-02286

IRRIGATION WITH SALINE GROUNDWATER AS A STRATEGY FOR SALINITY CONTROL IN THE SHEPPARTON REGION OF NORTHERN VICTORIA,

Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3C.
W86-02287

CASE STUDY OF A SALINITY CONTROL PROGRAM, VINTA BASIN, UTAH,

Soil Conservation Service, Salt Lake City, UT.
H. T. Brown.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 275-284, 1 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Vinta Basin, Utah.

Poor irrigation practices and natural salt sources resulted in increased total dissolved solids entering streams near irrigated lands. Technical assistance from the Soil Conservation Service and the Agricultural Stabilization and Conservation Service was initiated, at a cost of about $0.5 million per year, to control the salinity problem. Pasture management, irrigation water management, wildlife habitat management, land leveling and reservoir regulation are included in the salinity control program. It is estimated that 69,475 metric tons of salt-loading from the irrigated area can be eliminated from the Colorado River system annually. On-site benefits, including lower operating costs and higher crop yields, are also discussed. (Halterman-PTT)
W86-02289

CASE STUDY OF A MAJOR AGRICULTURAL CONTROL PROGRAM - THE GRAND VALLEY EXPERIENCE,

Soil Conservation Service, Denver, CO.
For primary bibliographic entry see Field 3F.
W86-02290

GRAND VALLEY STATE ONE MONITORING PLAN AND IMPLEMENTATION,

Bureau of Reclamation, Grand Junction, CO.
D. L. King.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 295-304, 3 fig, 2 tab, 3 ref.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Colorado River.

In order to improve groundwater flows and reduce salt loading, a 6.8 mile length of the Government Highline Canal was lined with concrete, and cross-drainage facilities were installed. To assess the effectiveness of these improvements, a hydrologically-closed basin, known as the Reed Wash study area, has been equipped to monitor surface and groundwater inflows, outflows, and levels. A monitoring program, implemented to establish preconstruction hydrologic conditions and to observe the effects of canal lining and lateral piping on salt loading in the watershed, is discussed. The monitoring program indicates that the water system improvements have been effective in reducing seepage and salt loading from canals and laterals. This area will be monitored for a number of years to verify the effectiveness of the lining program. (Halterman-PTT)
W86-02291

MEASURES FOR REDUCING RETURN FLOWS FROM THE WELLTON-MOHAWK IRRIGATION AND DRAINAGE DISTRICT,

Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
R. J. Effertz, W. K. Sidebottom, and M. D. Turley.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 305-314, 1 tab.

Descriptors: *Salinity, *Saline water, Groundwater, Irrigation, Irrigation effects, Irrigation practices, Environmental effects, Economic aspects, Agricultural hydrology, Agriculture, Colorado River.

A variety of measures to reduce salt loading of the Colorado River are discussed. Acreage reduction, on-farm measures and technical assistance are stressed. Research projects that added to irrigation efficiencies and reduction in drainage water included monitoring soil salinity; preventing clogging of emitters in trickle irrigation systems; managing dead-level irrigation; automating surface irrigation, and evaluating economic aspects of alternative irrigation systems. Reduced irrigation acreage and on-farm improvements resulted in significant reductions in the drainage of saline waters into the Colorado River. (Halterman-PTT)
W86-02292

SALINITY CONTROL AND DRAINAGE IN NORTHERN VICTORIA (AUSTRALIA),

Victoria State Rivers and Water Supply Commission, Armadale (Australia).
For primary bibliographic entry see Field 3F.
W86-02293

CONTROLLING SALINITY IN THE COLORADO RIVER BASIN, THE ARID WEST,

Bureau of Reclamation, Denver, CO. Colorado River Water Quality Office.
A. R. Jonez.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 337-347, 3 fig, 5 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Irrigation, Water use, Irrigation effects, Irrigation practices, Environmental effects, Agriculture, Colorado River, Desalination.

The sources of salt in the Colorado River are discussed. The primary sources are natural (47%), irrigation (37%) and reservoir evaporation (12%). Several activities designed to reduce salt loading and salinity levels in the Colorado River are discussed. They include irrigation source control (land leveling and canal sealing), point source control (removal of salt from localized areas such as mineral springs, abandoned oil wells, and geysers), diffuse source control (watershed management, land treatment and the collection and disposal of irrigation return flows). Major issues and concerns pertaining to salinity control are discussed, and the need for further development in salinity control technology is stressed. (Halterman-PTT)
W86-02295

SALINITY CONTROL BY PUMPING AND DEEP WELL INJECTION - THE PARADOX VALLEY UNIT,

Bureau of Reclamation, Durango, CO.
E. G. Jensen, and R. W. Leach.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 349-358, 6 fig.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Colorado River, Colorado, Dolores River, Environmental effects, Well hydraulics, Economic aspects, Hydraulics.

A plan to reduce salinity inputs to the Dolores River, a tributary of the Colorado River, is discussed. The Dolores River picks up an estimated 205,000 tons of salt annually as it passes over a salt anticline in Paradox Valley, Colorado. A control plan which has been adopted involves pumping brine from wells paralleling the Dolores River and adjacent to brine inflow areas. The pumping will lower the freshwater-brine interface below the river channel, thus preventing the brine from entering the river. Brine disposal methods have not been selected; however, disposal in large evaporation ponds, or by deep-well injection, appear to be the most attractive alternatives. (Halterman-PTT)

W86-02296

MEEKER DOME SALINITY INVESTIGATION,

CH2M Hill Central, Inc., Denver, CO.
For primary bibliographic entry see Field 5B.
W86-02297

SALINITY CONTROL BENEFITS THROUGH REGULATION OF PRODUCED WATER,

Utah Bureau of Water Pollution Control, Salt Lake City.
J. R. Riding.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 367-375, 1 tab, 26 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Deep wells, Ponds, Water pollution, Groundwater pollution.

Methodologies are discussed by which 'produced' water (from oil and gas production) is disposed, and salinity loading is minimized. The use of evaporation ponds and injection wells have long been standard practices; however, the need has existed for more stringent regulations regarding these two methods. Regulations recently developed for pond disposal insure that with proper siting, design, construction, and monitoring, minimal ground water contamination will take place. Successful disposal by injection well can be attained if water is injected into formations that are below freshwater zones, and separated from them by impermeable layers to prevent the upward migration of the injected fluids. (Halterman-PTT)
W86-02298

ARKANSAS-RED RIVER BASINS CHLORIDE CONTROL PROJECT: TECHNICAL FEASIBILITY STUDIES FOR PLAN OF CONTROL,

Corps of Engineers, Tulsa, OK.
J. H. Roberts.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 377-387, 8 fig, 1 tab, 2 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Deep wells, Ponds, Water pollution, Groundwater pollution.

A summary of the chloride contamination problem in the Arkansas and Red River Basins is provided, and an overview of technical feasibility studies necessary to develop a control plan is presented. The source of the salt is thick deposits of halite under a large area of the southwestern United States. Salt loading into the Arkansas and Red River Basins has degraded the waters to such a degree that they are unusable for most purposes. Surface water investigations indicate that three separate salt emission areas exist in a study area along Jonah Creek, a tributary of the Red River. Groundwater pump tests have shown that they are also separate hydrologically. Brine collection and disposal methodologies are discussed. The most efficient techniques involve pumping brine to the surface and then disposing of it by means of deep well injection. (Halterman-PTT)
W86-02299

GLENWOOD-DOTSERO SPRINGS SALINITY CONTROL PROJECT,

URS Co., Denver, CO.
C. A. Macko.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 389-396, 1 fig, 1 tab.

Descriptors: *Saline water, *Salinity, *Water quality control, Groundwater, Water supply, Environmental effects, Well hydraulics, Economic aspects, Colorado River, Drainage wells.

Various aspects of a proposed salinity control project, including planning, field investigations, results, and the conclusions, are discussed. The results of the field investigation were used in the design and cost estimates for the components of the recommended plan. Data indicate that a well field could collect approximately 0.20 cu m saline water/sec from the subsurface without dilution from the Colorado River. A computer model was calibrated with aquifer test data and extensive modeling efforts were undertaken to design a well that would not impact upon several nearby commercial springs. Annual reductions in salinity and water depletion rates that would result from the implementation of the recommended plan are discussed. (Halterman-PTT)
W86-02300

SALINITY CONTROL ON THE SMOKY HILL RIVER IN CENTRAL KANSAS,

Kansas State Geological Survey, Lawrence.
C. D. McElwee, A. Fleming, M. Butt, and A. Severini.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 397-406, 7 fig, 2 tab, 5 ref.

Descriptors: *Saline water, *Salinity, *Water quality control, Model studies, Groundwater, Water supply, Well hydraulics, Drainage wells, Relief wells, Smoky Hill River, Kansas.

The possible use of relief wells to alleviate the problem of high salinity in the Smoky Hill River is discussed. Modeling methods are applied to evaluate the effectiveness of various systems. Results indicate that the volume of salt water leakage could be reduced by 20%. In some cases, regional flow can capture about 50% of the freshwater leakage induced by the relief wells, resulting in considerable dilution of the discharged water. The most efficient net effect of the relief-well systems modeled was a reduction of 77-85% in the salt load discharged to the alluvium. The model predicts, however, that most of the dilution effect will not be felt at the discharge area for 40-160 years. (Halterman-PTT)
W86-02301

PRICE/SAN RAFAEL RIVER BASINS SALINITY INVESTIGATION,

CH2M/Hill, Boise, ID.
For primary bibliographic entry see Field 5B.
W86-02302

LIVING WITH SALINITY: AN EVALUATION OF TWO POLICY MEASURES WITHIN A REGIONAL FRAMEWORK,

Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3C.
W86-02304

IRRIGATION AS A SOLUTION TO SALINITY PROBLEMS OF RIVER SYSTEMS,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 3C.
W86-02305

AQUATRAIN PIPELINE SYSTEM,

Bureau of Reclamation, Denver, CO. Office of Saline Water Transport and Use.
For primary bibliographic entry see Field 3C.
W86-02307

SALT GRADIENT SOLAR PONDS,

Department of Energy, Washington, DC.
For primary bibliographic entry see Field 3C.
W86-02308

FISH AND WILDLIFE MITIGATION PROGRAM FOR THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT - A CASE HISTORY,

Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
T. A. Burke, D. E. Busch, and W. E. Rinne.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 539-548, 1 tab, 2 ref.

Descriptors: *Saline water, *Salinity, Mitigation, Wildlife conservation, Fish conservation, Arizona, California.

Salinity control measures impact upon fish and wildlife in a variety of ways, including: loss of surface water and associated wetlands in and along the lined canals due to elimination of seepage; loss of vegetation for project rights-of-way; and loss of irrigated croplands in the Wellton-Mohawk area (retired from agricultural use). The development of mitigation strategies designed to offset these, and other losses, are outlined. General mitigation measures include: use of existing main outlet drains as a conveyance channel for salt water wastes; screening the feed water intake to the desalting plant to reduce fish loss; conducting fish salvage during canal dewatering works, and providing bridges, siphons, and escape ladders in and along the canals for both human and wildlife use. Specific mitigation projects for both Arizona and California are detailed. (Halterman-PTT)
W86-02312

TRIANGLE CONSERVATION DISTRICT - A CASE STUDY IN DRYLAND SALINE SEEP CONTROL,

Triangle Conservation District, Conrad, MT.
T. Dodge, J. Holzer, W. Adams, and J. Farkell.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 561-570, 2 fig, 1 tab, 6 ref.

Descriptors: *Salinity, *Saline water, *Seep water, Seepage control, Seeps, Percolation, Environmental effects, Wells, Montana.

Saline seeps, defined as recently developed saline soils in non-irrigated areas, that are wet some or all of the time, are discussed. Control of seeps is obtained by a variety of techniques, including selective crop growth, and pumping ground water out of localized seeps, thus lowering the water table. Farm-by-farm assistance for saline seep control is the quickest and best way to solve the problem. Developing a successful saline plan requires a combination of the 'ideal' solution and practical considerations--economics, land ownership, farm program participation, type of farm operation, etc. Effective saline seep control frequently alters the entire farm operation. The changes in management require technical assistance throughout the implementation stage by a team of agronomic and soil specialists. (Halterman-PTT)
W86-02314

SALINITY CONTROL PROBLEMS: NON-AGRICULTURAL,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 5B.
W86-02316

CRITIQUE - SALINITY CONTROL PROBLEMS: AGRICULTURAL,

Science and Education Administration, Fort Collins, CO. Agricultural Research.
For primary bibliographic entry see Field 5B.
W86-02317

REUSING SALINE DRAINAGE WATERS FOR IRRIGATION: A STRATEGY TO REDUCE SALT LOADING OF RIVERS,

Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3C.
W86-02318

DESALTING BY REVERSE OSMOSIS AT YUMA DESALTING PLANT,

Bureau of Reclamation, Yuma, AZ. Yuma Projects Office.
For primary bibliographic entry see Field 3A.
W86-02319

GEOLOGIC AND HYDROLOGIC DATA COLLECTED DURING 1976-1984 AT THE SHEFFIELD LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE AND ADJACENT AREAS, SHEFFIELE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02372

LITERATURE REVIEW OF SURFACE-WATER QUALITY IN THE CUYAHOGA VALLEY NATIONAL RECREATION AREA, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02388

SELECTED HYDROLOGIC DATA FOR THE SOUTH PLATTE RIVER THROUGH DENVER, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02391

HYDROLOGY OF YUCCA MOUNTAIN AND VICINITY, NEVADA-CALIFORNIA--INVESTIGATIVE RESULTS THROUGH MID-1983,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02413

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

USDA PLANNING PROCESS FOR COLORADO RIVER BASIN SALINITY CONTROL,
Soil Conservation Service, Portland, OR. West National Technical Center.
For primary bibliographic entry see Field 5G.
W86-02270

PLANNING AND IMPLEMENTATION FRAMEWORK FOR SALINITY CONTROL IN THE INDUS RIVER BASIN,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W86-02272

SALINITY CONTROL ON THE SMOKY HILL RIVER IN CENTRAL KANSAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5G.
W86-02301

6B. Evaluation Process

PROJECTING LAND USE CHANGES ASSOCIATED WITH SMALL WATERSHED DEVELOPMENT,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6G.
W86-01976

ECONOMIC EVALUATION OF SALINITY CONTROL,
Corps of Engineers, Tulsa, OK.
R. D. Brown.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 125-134, 2 fig. 2 ref.

Descriptors: *Saline water, *Salinity, *Desalination, Water requirements, Water users, Water use, *Red River, Economic aspects.

The methodology used to determine the economic merit of investment for removal of salt pollution in the Red River is described. The primary points of evaluation include: existing water uses, existing water sources, future municipal water demands, future industrial water demands, alternative water sources to meet future demands, and finally, the cost of Red River water. The results of these evaluations show that the Red River chloride control project should be constructed and that the estimated benefit-to-cost ratio is 1.6 to 1. (Halterman-PTT)
W86-02275

PROCESS OF PROJECT PREPARATION,
Walker and Partners Ltd., Ottawa (Ontari).
B. Grover.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 269-285, 2 fig, 6 ref.

Descriptors: *Project planning, *Sanitation, *Water supply development, *Decision making, *Feasibility studies, Future planning, Evaluation, Planning, Financing, Management planning, Financial feasibility, Water supply, Projections, Benefits.

The basic factors involved in the preinvestment planning of water supply and sanitation development projects are reviewed. A brief report suffices to identify a possible project and commence the preinvestment planning. The prefeasibility study aims to select a preferred project for near term implementation after considering longer-term needs, existing system deficiencies and alternative system development. International financing agencies normally require general data on how the water supply and sanitation sector is organized throughout the country, and on how effectively services are currently provided and on national goals concerning water supply and sanitation services. The rationale for proceeding to develop a project must be explained carefully. Separate plans should be prepared for the phased development of water supply and sanitation systems to meet projected needs in the project area throughout the planning period. The prefeasibility stage should reach certain conclusions and recommend future actions, including the preparation of selected projects in a comprehensive feasibility study. The feasibility stage is the last stage before a project is approved and funds are committed. The feasibility report should provide data on the proposed project, institutional and financial aspects, and project impacts and justification. Resources for project preparation are discussed. Project approval usually depends on the consensus of several interest groups. (Geiger-PTT)
W86-02339

OPERATION AND MAINTENANCE OF WATER SUPPLY AND SANITATION SYSTEMS,
Walker and Partners Ltd., Ottawa (Ontari).
For primary bibliographic entry see Field 5D.
W86-02341

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

EVOLUTION OF A COST SHARING POLICY FOR FEDERAL CHLORIDE PROJECTS,
Army Engineer Div. Southwestern, Dallas, TX.
H. G. Robinson, and R. R. De Bruin.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 23-32, 1 fig, 1 tab, 5 ref.

Descriptors: *Saline water, *Salinity, Irrigation, Water requirements, Water supply, Water use, Water users, Arkansas River, Kansas, Oklahoma, Arkansas, Red River, Texas, Brazos River Basin, Cost sharing, Economic aspects.

The 20-year evolution of the cost-sharing rationale of the control of chlorides from natural sources is discussed. The financing involves several levels of the Federal government and the particular states that are involved. The major factors that influence any cost-sharing rationale include precedents (similarity of project to others with established cost-sharing policies), national objectives, state of the economy, recent laws or policies, and the logic of the new cost apportionment proposal. Specific natural sources of salt that are discussed include the Arkansas and Red Rivers and the Brazos River basin. The general cost-sharing rationale is summarized as follows. From 1961-1963, 100% of chloride control was paid for by the Federal Interstate Water Quality Project. In following years, the federal government paid from zero to 75% of costs. In 1977-1980, 100% of costs were paid by non-federal government agencies. In recent years the federal government has provided substantial reimbursements to non-federal agencies. (Halterman-PTT)
W86-02266

WATER SUPPLY AROUND THE WORLD--APPROPRIATE TECHNOLOGY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02325

COST-EFFECTIVE WATER SUPPLY AND SANITATION PROJECTS FOR DEVELOPING COUNTRIES,
International Bank for Reconstruction and Development, Washington, DC. Dept. of Transportation and Water.
F. L. Golladay.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 221-249, 2 fig, 3 tab, 1 ref, 3 append.

Descriptors: *Cost analysis, *Cost-benefit analysis, *Water supply development, *Sanitation, *Developing countries, Economic aspects, Project planning, Water supply, Costs, Econometrics, Economic evaluation.

This chapter suggests how needs for water supply and waste disposal can be met as sharply reduced costs. The economist is charged with the responsibility of cost-effectiveness and cost-benefit analysis of development projects. The value of benefits is generally difficult to quantify. The accounting of costs is usually incomplete. The value attached to inputs frequently bears little relationship to their social opportunity costs. Where surface water is uncontaminated and continuous, it offers the least costly option for water supply. Groundwater supplies are inexpensive when they can be drawn by hand with rope and bucket. The major issue in urban water supply projects is the type of delivery system to be installed. Waterborne sewerage provides not only health and environmental benefits, but very high consumer convenience. Examples of least-cost analyses of water supply and sanitation systems are presented. The initial choice of technology to improve sanitation should also reflect the desire for future improvements. The purpose of determining economic costs is to provide the basis for meaningful least-cost comparisons among alternatives. Unless substantial subsidies are feasible, low income consumers can afford only the cheapest of the low-cost options. A government might attach top priority for sanitation development to areas where the burden of disease is greatest. Appendices dicuss the use of shadow pricing in cost analysis, costs of alternative water supply and sanitation service levels, and alternative service levels for urban water supply. (Geiger-PTT)
W86-02337

FINANCING WATER SUPPLY SYSTEMS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Okun.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 251-267, 6 fig, 10 ref.

Descriptors: *Economic aspects, *Water supply, *Financing, *Water costs, *User charges, Cost analysis, Water supply development, Sanitation, Developing countries, Project planning, Costs, Economic evaluation.

Financing of a system of water supply by the user is needed to provide the user with a sense of the value of the system and help assure its proper operation and maintenance. The income will help defray at least the cost of operation and maintenance and provide funds for expansion of the system as needed. If local participation in financing is needed to assure success of a water supply project, then local initiative and collaboration in the planning and implementing of the project should also be included. Methods of collection of fees for water include residential metering, and metering at roadside standpost water supplies. Another less costly option that may delay metering is the use of flow restrictors or Fordillas. Water vending by individuals or by the government is often practiced in cities and villages not served by piped systems. Financing affects the design of water supply systems in terms of facility size and the availability of funds for capital and manpower in the face of massive needs. If a long-term and continuing investment in water supply and sanitation systems is to be assured for those curently being served and for the large percentage of the population not yet being served, financing systems need to provide sufficient funds, not only for payment of current operation and maintenance costs, but for repayment of capital costs. (Geiger-PTT)
W86-02338

6D. Water Demand

WATER USE IN OHIO, 1980,
Geological Survey, Columbus, OH. Water Resources Div.
M. Eberle, and J. A. McClure.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4024, 1984. 35 p, 5 fig, 7 tab, 28 ref.

Descriptors: *Water use, Industrial water, Thermal powerplants, Municipal water, Livestock, Rural areas, *Ohio.

An estimated 13,389 million gallons of water per day were used in Ohio in 1980, in four major categories of water use. Of this total, 12,645 Mgal/d (million gallons per day) were taken from surface-water sources whereas 744 Mgal/d was ground water. Totals for each category (in Mgal/d) were: thermoelectric power generation, 10,417; self-supplied manufacturing, 1,399; public water supplies, 1,432; and rural domestic and livestock, 141. Additional miscellaneous uses (irrigation, rural commercial, and non-manufacturing industrial) probably totaled about 300 Mgal/d. The five counties that led the state in total water use were: Jefferson, 2,620 Mgal/d; Lucas, 1,150 Mgal/d; Gallia, 1.086 Mgal/d; Cuyahoga, 1,085 Mgal/d; and Lorain, 991 Mgal/d. These counties, in the same order, were the top five surface-water users. (USGS)
W86-01954

ESTIMATE OF SELF-SUPPLIED DOMESTIC WATER USE IN OKLAHOMA DURING 1980,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4223, 1984. 20 p, 7 fig, 4 tab, 7 ref.

Descriptors: Water supply, *Water utilization, Domestic water, *Oklahoma, *Water use.

Reported or measured water-use data for the domestic self-supplied user were not available for the state of Oklahoma; therefore, estimates of water use within this classification were derived. The total self-supplied population in Oklahoma during 1980 was estimated at 343,615, which was 11.4 percent of the total 1980 State population. The rate of water use by this group was estimated to be 56 gallons per capita per day. For 1980, the estimated annual domestic self-supplied water use by county ranged from 10 to 1,180 acre-feet, with a total statewide use of 21,610 acre-feet. (USGS)
W86-02380

6E. Water Law and Institutions

OVERVIEW OF THE LEGAL, POLITICAL, AND SOCIAL IMPLICATIONS OF WASTEWATER TREATMENT THROUGH AQUACULTURE,
Denver Research Inst., CO.
For primary bibliographic entry see Field 5D.
W86-02068

EFFECTS OF FEDERAL REGULATIONS ON WATER TREATMENT PLANT DESIGN,
Environmental Protection Agency, Denver, CO. Region VIII.
For primary bibliographic entry see Field 5F.
W86-02189

WHAT IS THE MOST EFFECTIVE WATER POLICY FOR THE UNITED STATES: NATIONAL DEBATE TOPIC FOR HIGH SCHOOLS, 1985-1986,
Library of Congress, Washington, DC. Congressional Research Service.
Pursuant to Public Law 88-246, Senate, 99th Congress: 1st Session, Document No. 99-2, 1985. 957 p, 169 ref.

Descriptors: *Planning, *Water law, *Water policy, *Water supply, *Water quality, Federal jurisdiction, Water resources development, Water management, Institutional constraints, Water rights, Legal aspects, Water transfer, Wastewater treatment, Potable water, Drinking water.

Resource material for a national debate topic for high schools (1985-1986) consists of published papers, a bibliography, and guide to information sources, including government publications. The book is divided into chapters on background materials and the three debate propositions: (1) Resolved: that the federal government should implement a national system of priorities to control the allocation of all water in the United States, (2) Resolved: that the federal government should establish a comprehensive national policy to protect the quality of water in the United States, and (3) Resolved: that the federal government should establish a national policy to insure each United States resident an adequate supply of potable water for personal use. (Cassar-PTT)
W86-02218

LEGAL AND INSTITUTIONAL CONSTRAINTS TO SALINITY CONTROL,
Bureau of Reclamation, Provo, UT. Utah Projects Office
J. Franson, and M. Lopez.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 55-61, 6 ref.

Descriptors: *Salinity, *Saline water, Irrigation, Irrigation procedures, Water requirements, Irrigation requirements, Water supply, Water use, Water users, Colorado River, Colorado River Basin.

A variety of constraints to salinity control in the Colorado River are reviewed. General constraints that are discussed include the local perception that salinity control benefits only the lower Colorado Basin at the expense of the upper Basin, and, the perception by the federal government that the problem is regional and should be solved by the Basin states. Further constraints that are discussed include a lack of urgency at both the local and national level, and a lack of coordination in funding between the Bureau of Reclamation and the Soil Conservation Service. Possible options for slowing down the projected increases of salinity concentrations are discussed. They fall into three categories: prevent saline waters from entering the River, reduce salt pickup of waters entering the River, and provide extra water for dilution of salinity.
W86-02269

SALINITY BUBBLES AND OFFSETS: A CONCEPT PAPER,
Environmental Protection Agency, Denver, CO. Water Management Div.
For primary bibliographic entry see Field 5G.
W86-02271

WATER SUPPLY AND SANITATION IN DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 5F.
W86-02324

WATER SUPPLY AROUND THE WORLD--APPROPRIATE TECHNOLOGY,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02325

REGIONALIZATION OF WATER SUPPLY AND SANITATION SERVICES,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-02326

6F. Nonstructural Alternatives

EVALUATION OF COMMUNITIES FOR THE APPLICATION OF LIMITED-DETAIL STUDY METHODS FOR FLOOD-INSURANCE STUDIES,
Geological Survey, Reston, VA. Water Resources Div.
E. D. Cobb.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4098, 1985. 54 p, 3 fig, 3 tab.

Descriptors: *Floods, *Flood discharge, Flood plain management, *Flood profiles, *Flood routing, Maps, Insurance, *Flood insurance, Data collections, *Data program design, *Limited-detail flood-insurance studies, Historical floods, Depth-frequency studies, Evaluations.

The U.S. Geological Survey evaluated 2,349 communities in 1984 for the application of limited-detail flood-insurance study methods, that is, methods with a reduced effort and cost compared to the detailed studies. Limited-detail study methods were found to be appropriate for 1,705 communities, while detailed studies were appropriate for 62 communities and no studies were appropriate for 582 communities. The total length of streams for which limited-detail studies are recommended is 9,327 miles with a corresponding cost of $23,007,000. This results in average estimated costs for conducting limited-detail studies of $2,500 per mile of studied stream length. The purpose of the report is to document the limited-detail study methods and the results of the evaluation. (USGS)
W86-02373

6G. Ecologic Impact Of Water Development

APPEARANCE AND WATER QUALITY OF TURBIDITY PLUMES PRODUCED BY DREDGING IN TAMPA BAY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
C. R. Goodwin, and D. M. Michaelis.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Supply Paper 2192, 1984. 66 p, 47 fig, 20 tab, 41 ref.

Descriptors: *Estuaries, *Dredging, *Water quality, *Aerial photography, *Florida, Turbidity, Nutrients, Metals, Pesticides, *Tampa Bay, *Turbidity plumes.

Turbidity plumes in Tampa Bay, Florida, were photographed and sampled during ship-channel dredging operations from February 1977 to August 1978 to document plume appearance and water

quality. Color photographs depict plumes ranging in length from tens of meters to several kilometers with turbidity levels from less than 10 to 200,000 Nephelometric Turbidity Units. Sediment composition varied from 85 percent sand and shell to 60 percent silt and clay. Plumes from one hopper dredge and three cutterhead-pipeline dredges were investigated. Disposal methods included beach nourishment, stationary submerged discharge, oscillating surface discharge, and creation of emergent dikes using turbidity barrier containment. Tidal velocities ranged from zero to 0.60 meters per second. Primary turbidity plumes were created directly by dredging and disposal operations and secondary plumes were created indirectly by resuspension of previously deposited material. The most visible turbidity plumes resulted from surface discharge to unconfined disposal areas of material having relatively high sand content discharging during times of strong tidal currents. Changes were not detected in nutrient, metal, and pesticide concentrations in Tampa Bay due to dredging. Few long-term turbidity characteristics of Tampa Bay could be directly attributed to dredging operations. (USGS)
W86-01929

CHEMICAL QUALITY OF WATER AT 14 SITES NEAR KESTERSON NATIONAL WILDLIFE REFUGE, FRESNO AND MERGED COUNTIES, CALIFORNIA,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-01959

PROJECTING LAND USE CHANGES ASSOCIATED WITH SMALL WATERSHED DEVELOPMENT,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
J. Kasal, and W. Crosswhite.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-149427, Price codes: A03 in paper copy, A01 in microfiche. ERS Staff Report No. AGES820330, April 1982. 47 p, 5 fig, 8 tab, append.

Descriptors: *Small watersheds, *Land use, *Projections, *Water resources development, *Statistical methods, Aerial photography, Markov process, Mathematical studies, Evaluation, Project planning.

This study determines if projected land use changes and their benefit estimates are biased in favor of project development. Both the base period land use estimates and the projected land use changes in a sample of 40 projects in two contrasting geographical regions were found to be reliable. When observed land use changes are measured from aerial photographs, the differences between projected and observed land use changes were not statistically significant. Four alternative land use projection techniques - aerial photography, trend analysis, cooperative river basin study procedures and the Markov process - did not improve upon the reliability of the U.S. Department of Agriculture Soil Conservation Service (SCS) land use projections. The SCS land use projection procedures for small watershed areas are set forth in the Economics Guide. Farm surveys are used to collect land use data for planning and evaluation of small watershed projects. The SCS land use projection procedures provide reliable measures of land use trends for estimating land use benefits due to project measures. (Geiger-PTT)
W86-01976

PATTERNS IN PREHISTORIC SETTLEMENT: EXAMINING THE DISTRIBUTION OF SITES IN A PORTION OF THE COLORADO RIVER VALLEY,

New World Research, Inc., Tucson, AZ.
Report of Investigations No.83-11, 1984. Compiled by John E. Keller, and L. Janice Campbell. Bureau of Reclamation, Amarillo, TX. 259 p, 64 fig, 23 tab, 6 app, 137 ref.

Descriptors: *Environmental effects, *Water resources development, *Archeology, Columbus Bend Dam, *Texas, Colorado River, Colorado Coastal Plains Project.

A cultural resources investigation of the proposed Columbus Bend Dam and Reservoir in Colorado and Fayette counties, Texas, revealed 96 sites. These were dominated by prehistoric lithic scatters. Lithic-ceramic scatters, stratified prehistoric sites, and historic sites were also identified. The work produced a predictive model of site location and interpretation of site data in light of cultural patterns and influences in settlement. (Cassar-PTT)
W86-01991

INDIAN LAND USE AND OCCUPANCY IN THE FRANKLIN D. ROOSEVELT LAKE AREA OF WASHINGTON STATE,

R. Bouchard, and D. Kennedy.
Colville Confederated Tribes, Nespelem, WA. June 1984. 456 p, 129 fig, 234 ref.

Descriptors: *Environmental effects, *History, *Land use, Indians, Franklin D. Roosevelt Lake, Washington, Columbia River.

Indian land use and occupancy were studied in Franklin D. Roosevelt Lake, Washington, the area along the Columia River between Grand Coulee Dam and the Canadian border. Elderly Indian informants and archives yielded 408 place names. For each place name are given the associated legends, meaning of the name, and activities. A comprehensive history of land utilization in Sanpoil, Spokane, Colville, and Lakes Indian territories traces events starting with the fur trading era. Information about hunting, fishing, plant food gathering, intergroup relations and territories is most abundant for the Sanpoil people. Little details are available for the Lakes and Colville peoples. However, some generalizations, common to all fishing-hunting-gathering people, can be made. (Cassar-PTT)
W86-01992

POTENTIAL CONSEQUENCES OF REJECT STREAM REPLACEMENT PROJECTS ON AQUATIC, TERRESTRIAL, AND RECREATION RESOURCES: VOLUME II, AQUATIC RESOURCES,

Engineering-Science, Inc., Arcadia, CA.
U.S. Bureau of Reclamation, Boulder City, NV. February 1980. 219 p, 33 fig, 21 tab, 4 append.

Descriptors: *Environmental effects, *Wildlife, *Fish, *Aquatic habitats, Yuma Desalting Plant, Butler Valley, Arizona, Imperial Valley, California, Alamo River, Salton Sea, All-American Canal, Santa Clara Slough, Aquatic plants, Aquatic animals, Aquatic life, Habitats, Marshes, Salt marshes, Canals, Rivers, Invertebrates, Streams, Brines, Desalination.

Effects on aquatic resources are discussed for several proposed projects for replacing the 44,000 acre-feet/year of brine flow rejected from the Yuma Desalting Plant. Proposed locations for these projects are the Imperial Valley, California, or Butler Valley, Arizona. Water systems affected by the projects include the All-American Canal, Alamo River, Salton Sea, Santa Clara Slough, and Butler Valley. For each system the following were determined: channel features, hydrology, water quality, substrates, underwater cover, and aquatic life (fish, algae, macrophytes, invertebrates, amphibians, and reptiles). The All-American Canal, impacted only in the 43.5-mile reach from Pilot Knob to East Highline Canal, supports a large gamefish population which is not widely fished. The Alamo River is not a good fishery, because of a small fish population and concern over bacterial and pesticide contamination. The saline Salton Sea at Wister has only three macroinvertebrates (pile worms, barnacles, and amphipods) and three gamefish species. The Santa Clara Slough, a small salt marsh, contains 14 species of salt water fish and a variety of fish-eating birds. The Butler Valley in Arizona has no perennial streams or standing waters, only desert washes. Groundwater is abundant at depths of 100-500 feet. (Cassar-PTT)
W86-01994

CLASS III SURVEY OF THE TUCSON AQUEDUCT PHASE A CORRIDOR, CENTRAL ARIZONA PROJECT: AN INTENSIVE ARCHAEOLOGICAL SURVEY IN THE LOWER SANTA CRUZ RIVER BASIN, PICACHO RESERVOIR TO RILLITO, ARIZONA,

Arizona State Museum, Tucson. Cultural Resource Management Div.
Archaeological Series 165, January 1984. Compiled by Jon S. Czaplicki. 286 p, 136 fig, 64 tab, 201 ref, 5 append. 0-07-30-X0091.

Descriptors: *Environmental effects, *Archeology, Water resources development, Right-of-way, Aqueducts, *Central Arizona Project, *Tucson Aqueduct, *Arizona, Aqueducts, Santa Cruz River.

A Class III intensive survey of 42 miles (about 9753 acres) of Phase A of the Tucson Aqueduct, Central Arizona Project, was conducted between June 7 and October 15, 1982. Seventy-eight prehistoric and eight historic sites were recorded. Twenty-one of the prehistoric sites are Archaic sites or are sites with an Archaic component. These sites, in addition to numerous isolated projectile points, indicate a potentially extensive Archaic occupation of the study area. The 57 Hohokam sites include three Classic period communities, one in each reach and each one apparently centered on a platform mound complex. The platform mound on Brady Wash in Reach 1 lies just outside the aqueduct right-of-way. Several Preclassic sites were also identified in Reaches 1 and 2, including a reservoir in Reach 2. The 1982 survey identified a previously undocumented Archaic occupation and a much more extensive Preclassic and Classic Hohokam occupation in the Lower Santa Cruz River Basin north of Tucson and south of Florence, Arizona. This area had received relatively little attention by archaeologists until the investigation carried out as a result of construction of the Tuscon Aqueduct. (Author)
W86-01995

POTENTIAL CONSEQUENCES OF REJECT STREAM REPLACEMENT PROJECTS ON AQUATIC, TERRESTRIAL, AND RECREATION RESOURCES: VOLUME III, TERRESTRIAL RESOURCES.

Engineering-Science, Inc., Arcadia, CA.
U.S. Bureau of Reclamation. Boulder City, NV. February 1980. 329 p, 23 fig, 15 tab, 4 append.

Descriptors: *Environmental effects, *Vegetation, *Wildlife, Habitats, Mammals, Birds, Reptiles, Amphibians, Plant populations, Yuma Desalting Plant, Butler Valley, *Arizona, Imperial Valley, *California, Alamo River, Salton Sea, All-American Deserts, Arid lands, Brines, Desalination.

Effects on terrestrial resources are discussed for several proposed projects for replacing the 44,000 acre-feet/year of brine flow rejected from the Yuma Desalting Plant. Proposed locations for these projects are the Imperial Valley, California, or Butler Valley, Arizona. Vegetation and wildlife characteristics are reported for both areas. The Imperial Valley has nine types of communities from wetlands and river riparian to creosote bush and sand dunes. The animal population (54 species of mammals, 297 species of birds, 42 species of reptiles and amphibians) features several special interest birds and reptiles. The major concern is the rare black rail and the endangered Yuma clapper rail, which would be severely threatened by the wetlands elimination. The mammal population is comprised of few game mammals but many furbearers and rodents. Waterfowl are abundant. Butler Valley is a sparsely settled, productive desert community is the most attractive wildlife habitat. Five endangered or threatened wildlife species are found in the Butler Valley: peregrine falcon, desert bighorn, zone-tailed hawk, desert tortoise, and Gila monster. Ten species of blue list birds (not endangered in the study area, but scarce in other areas of the U.S.) live in this valley. (Cassar-PTT)
W86-02011

FLUCTUATING WATER LEVELS IN RESERVOIRS; AN ANNOTATED BIBLIOGRAPHY

ON ENVIRONMENTAL EFFECTS AND MANAGEMENT FOR FISHERIES,

Fish and Wildlife Service, Fayetteville, AR.
For primary bibliographic entry see Field 10C.
W86-02033

WATER QUALITY, MACROINVERTEBRATES, AND FISHERIES IN TAILWATERS AND RELATED STREAMS: AN ANNOTATED BIBLIOGRAPHY,

Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
For primary bibliographic entry see Field 10C.
W86-02035

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 2: FIRST YEAR POSTSTOCKING RESULTS,

Florida Game and Fresh Water Fish Commission, Orlando.
S. Hardin, R. Land, G. Morse, and M. Spelman.
Volume II: The Fish, Mammals, and Waterfowl of Lake Conway, Florida, Technical Report A-78-2, February 1982. Report 2 of a Series. Army Engineer Waterways Experiment Station, Vicksburg, MS. 70 p, 15 fig, 9 tab, 55 ref, append. DACW39-76-C-0081.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Biological control, White amur, Fish diets, Waterfowl, Aquatic mammals, Lake Conway, *Florida.

Fish, waterfowl and wading birds, and aquatic mammal populations on Lake Conway, Orange County, Florida were surveyed for one year after the introduction of the herbivorous fish, white amur (Ctenopharyngodon ideila). Fish populations were sampled by Wegener ring, seine, gill nets and electrofishing. Standing crop estimates were made with blocknet and rotenone collections. The sportfishery was measured by creel surveys. Waterfowl were observed and counted from an airboat, and collected by shotgun. Aquatic mammals were collected by a variety of traps. Low water levels reduced littoral zone area, which lead to stunted panfish and poorer condition of largemouth bass. Vegetated samples supported more diverse fish populations than beach sites. White amur and migratory waterfowl consumed the same plant foods; continued reduction of submerged plants by white amur may adversely affect overwintering waterfowl populations. Aquatic mammals were influenced by removal of vegetation due to shoreline development. (Author's modified abstract)
W86-02037

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 2: FIRST YEAR POSTSTOCKING RESULTS,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. L. Crisman, and F. M. Kooijman.
Volume III: The Plankton and Benthos of Lake Conway, Florida, Technical Report A-78-2, November 1981. Report 2 of a Series. Army Engineer Waterways Experiment Station, Vicksburg, MS. 53 p, 28 fig, 4 tab, 22 ref.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Biological controls, White amur, Phytoplankton, Zooplankton, Lake Conway, Florida, Benthic fauna.

After the stocking of Lake Conway, Florida, with white amur to control aquatic vegetation, studies on the effects on plankton, benthos and zooplankton were conducted. Major fluctuations in plankton, benthos and zooplankton communities confounded the determination of the effects of white amur introduction. Further long-term studies are needed to determine the effectiveness and overall impact of introducing white amur for macrophyte control. The results are based on analyses of data on physical-chemical parameters, plant pigments, and abundance and species composition of phytoplankton, zooplankton and benthic macroinvertebrates. (Halterman-PTT)
W86-02038

ASSESSING AND MANAGING EFFECTS OF REDUCED FRESHWATER INFLOW TO TWO TEXAS ESTUARIES,

National Coastal Ecosystems Team, Slidell, LA.
N. A. Funicelli.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 435-446, 2 tab, 7 ref.

Descriptors: *Enviromental effects, *Estuaries, *Management, *Filtration, Coastal zone management, Wildlife, Fish, Nutrients, Marshes, Floods, Nueces River, Corpus Christi Bay, Matagorda Bay, Rivers, Saline water, Aquatic habitats, Habitats, Organic carbon, Phosphorus, Nitrogen, Deltas, Wastewater disposal, *Texas.

While a major objective of coastal zone management plans is to maintain the value and use of estuaries, decisions affecting inflow, a critical component of estuaries, are often based on considerations of water use inland. The functions of estuaries as filters for inland based signals is often ignored. For effective manaagementof both inland-water resources and estuarine freshwater inflow, methods for assessing the actual effects of inland perturbations are needed. Because no single method exists, the U.S. Fish and Wildlife Service used a set of evaluative methods to assess the effects of reduce freshwater inflow on estuaries in Nueces-Corpus Christi and Matagorda Bays and to develop management plans for ensuring fish and wildlife productivity. The set included (1) studying the effects of environmental changes on key species, (2) regression analysis between inflow and fishery harvest data, (3) compilation and analysis of a nutrient budget, and (4) comparison of historical and projected deltaic marsh inundations. Proposed management plans to address the findings of these assessment methods involved the release of freshwater during spring and low inflow, the rerouting of selected wastewater to the river delta, and the diversion of in-channel water to inundate deltaic marshes. These plans all depend upon compromises between inland and coastal needs. (Author)
W86-02090

DETERIORATION OF COASTAL ENVIRONMENTS IN THE MISSISSIPPI DELTAIC PLAIN: OPTIONS FOR MANAGEMENT,

Louisiana Universities Marine Consortium, Chauvin.
D. F. Boesch, J. W. Day, and R. E. Turner.
IN: The Estuary as a Filter, Academic Press, Orlando, FL. 1984. p 447-466, 2 fig, 1 tab, 34 ref. 14-16-0009-81-1016.

Descriptors: *Environmental effects, *Estuaries, *Deltas, *Management, *Mississippi River, *Louisiana, Channeling, Wetlands, Marshes, Canals, Dredging, Coastal zone management, Aquatic habitats, Habitats, Saline water, Water diversion, Sediment transport.

Coastal environments in the Mississippi Deltaic Plain of southeastern Louisiana are undergoing rapid change as a result of natural decay of Mississippi delta lobes, channelization of river flow, and dredging activities. As a result, over 100 sq km per year of coastal wetlands are converted to open water or uplands--85% of the total U.S. loss rate. Of the options available to reduce the deterioration of coastal wetlands, management of new delta accretion and regulatory control and rehabilitation of channelized wetlands are likely the most effective. Attempts to stabilize coastal barriers should also be made because of the potential for very rapid erosion in their absence. Controlled diversions of the river above the active deltas will be limited in capacity by the presence of populated areas and roads are unlikely to contribute significantly to new wetland accretion. (Author)
W86-02091

IMPACT OF RESERVOIRS ON SEASONAL AND HISTORICAL SALINITY OF THE COLORADO RIVER,

Bureau of Reclamation, Salt Lake City, UT.
For primary bibliographic entry see Field 5B.
W86-02279

HISTORICAL TRENDS IN CONCENTRATION AND LOAD OF MAJOR IONS IN THE COLORADO RIVER SYSTEMS,

Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 5B.
W86-02280

FISH AND WILDLIFE MITIGATION PROGRAM FOR THE COLORADO RIVER BASIN SALINITY CONTROL PROJECT - A CASE HISTORY,

Bureau of Reclamation, Boulder City, NV. Lower Colorado Region.
For primary bibliographic entry see Field 5G.
W86-02312

POTENTIAL FOR INTRODUCTION OF THREE SPECIES OF NONNATIVE FISHES INTO CENTRAL ARIZONA VIA THE CENTRAL ARIZONA PROJECT - A LITERATURE REVIEW AND ANALYSIS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. J. Grabowski, S. D. Hiebert, and D. M. Lieberman.
Report REC-ERC-84-7, June 1984. 124 p, 8 fig, 48 tab, 316 ref.

Descriptors: *Environmental impact statement, *Tilapia, *Bass, Environmental effects, *Pumping plants, *Food chains, Fish, Fish populations, Water resources development, Water quality, Ecological effects, Fisheries, Rivers, Lakes, Eagles, Birds.

During operation of the Central Arizona Project (CAP) which is designed to deliver allocated Colorado River water to central and southern Arizona, fish will be pumped from Lake Havasu to central Arizona receiving waters. The life history characteristics of three fish species, water quality aspects of CAP source and receiving waters, the existing fisheries of CAP sources and receiving waters, physical features of pumping plants, and some life history phenomena of the southern bald eagle are documented. Striped bass and blue tilapia may have an adverse impact on the existing fishery of Lake Pleasant. These two species and the white bass are suspected of having an adverse impact on the ecology of the Salt and Verde Rivers. If blue tilapia enter Lake Pleasant, they will likely survive and reproduce while striped bass will be much less likely to reproduce. Recruitment by introduction would continue to occur. If these fish become established and their numbers are not controlled by predators or environmental pressures, they could have an impact on the fish food base of the southern bald eagles along these rivers. (Geiger-PTT)
W86-02322

MORMON CARTER CLASS III CULTURAL RESOURCE SURVEY,

Bureau of Reclamation, Denver, CO. Lower Missouri Region.
S. R. Bradley, and M. Musitelli.
September 1984. 103 p, 53 fig, 28 ref, 2 append.

Descriptors: *Environmental effects, *Archeology, Mormon Carter Transmission Line, Fryingpan River, Colorado, Water resources development, Water transfer.

The Lower Missouri Region of the Bureau of Reclamation conducted a Class III cultural resources survey of the Mormon Carter Transmission Line in the North Fork Fryingpan River drainage, Pitkin County, Colorado. Four prehistoric sites and three historic sites were recorded during the survey. Manifestations of cultural behavior resulting from a lifeway of prehistoric, seasonal resource exploitation are contrasted to the manifestation resulting from a historic sedentary adaptation. The presence of a possible Rose Spring Corner Notched projectile point indicates human utilization of the North Fork drainage from at least

300 A.D. to the present. Five sites are recommended for avoidance or mitigation. The possible presence of subsurface deposits at these sites suggests eligibility to the National Register of Historic Places. (Author)
W86-02323

7. RESOURCES DATA

7A. Network Design

EVALUATION OF THE SURFACE-WATER DATA NETWORK, SUWANNEE RIVER BASIN, FLORIDA, 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. P. Rumenik, and J. E. Coffin.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4245, 1984. 22 p, 5 fig, 2 tab, 17 ref.

Descriptors: *Surface waters, *Gaging stations, *Water management, Flow characteristics, River forecasting, Flood profiles, Low flow, *Florida, *Suwannee River basin, Surface-water data network.

In the 9,950 square mile area of the Suwannee River basin in Florida and Georgia, a network of 33 surface-water gaging stations operated for different periods of time from 1927 to 1982 was evaluated for its capability to provide program information for floodplain mapping, floodplain management, forecasting of flow extremes, and defining the impact of changes in land use on surface-water quantity and quality. Gaging stations are classified based on the type of data and number of years record as current use, long-term trend, and planning and design. Goals are established for each classification. Suggestions for program revisions include establishing crest-stage gages for high-flow and flood-profile data, defining and establishing a low-flow network, and establishing two and discontinuing one daily discharge station. (USGS)
W86-01936

GROUND-WATER-QUALITY MONITORING NETWORK DESIGN FOR THE SAN JOAQUIN VALLEY GROUND-WATER BASIN, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
W. E. Templin.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Inbvestigations Report 83-4080, 1984. 133 p, 19 pl, 7 fig, 6 tab, 131 ref.

Descriptors: Groundwater, Water quality, *Network design, Geology, Land use, *Water pollution sources, *Nonpoint pollution sources, Groundwater levels, *Groundwater quality, *Groundwater pollution, *California, Point sources, San Joaquin Basin, Tulare Basin, Sacramento-San Joaquin Delta, Pesticides (DBCP), Pesticides, Regional network design.

This report proposes ideal and actual ground-water-quality monitoring networks for the San Joaquin Valley basin, California. The report outlines an ideal network, comprising several subnetworks, to provide direction in development of actual networks composed of wells currently (1981) known to be monitored. The ideal network serves as a basis for future expansion of the actual networks as more wells are included in the inventory of active monitoring networks. The management objectives of these networks are to develop a general baseline of ground-water quality, to identify trends in ground-water quality, and to identify sources of contamination. The networks are based on an information structure that includes land use, surface and subsurface geology, ground-water levels, surface- and ground-water quality, possible sources of contamination, and active ground-water-quality monitoring networks. Development of the categories and subcategories of network objectives, which are needed to describe the quality of ground water in the basin, make clear the inadequacy of the currently operated networks. The expansion of ground-water-quality monitoring in the San Joaquin Valley, therefore, would be necessary to approximate the objectives of the ideal network. (USGS)
W86-01953

COST-EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY STREAM-GAGING PROGRAM IN ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
M. E. Darling, and T. E. Lamb.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4084, 1984. 91 p 10 fig, 13 tab, 23 ref.

Descriptors: *Surface water records, *Statistical analysis, Gaging, Gaging station, Network, Streamflow, *Stream gaging, *Arkansas, *Cost-effectiveness.

This report documents the results of the cost-effectiveness of the stream-gaging program in Arkansas. Data uses and funding sources were identified for the daily-discharge stations. All daily-discharge stations were found to be in one or more data use categories, and none were candidates for alternate methods which would result in discontinuation or conversion to a partial record station. The cost for operation of daily-discharge stations and routing costs to partial record stations, crest gages, pollution control stations as well as seven recording ground-water stations was evaluated in the Kalman-Filtering Cost-Effective Resource allocation (K-CERA) analysis. This operation under current practices requires a budget of $292,150. The average standard error of estimate of streamflow record for the Arkansas District was analyzed at 33 percent.
W86-01961

ENVIRONMENTAL 'TERMITE' INSPECTIONS,
For primary bibliographic entry see Field 5A.
W86-02223

ANNUAL AVERAGE CLIMATIC MAPS OF THE UNITED STATES,
National Climatic Data Center, Asheville, NC.
Environmental Information Summaries, C-21, September 1983. 10 p, 4 ref.

Descriptors: *Mapping, *Maps, *Climatology, *Meteorological data collections, *United States, Hydrologic maps, Precipitation, Relative humidity, Humidity, Solar radiation, Corrosion control, Data collections, Weather data collections, Dewpoint, Thunderstorms.

Several annual average climatic maps of the United States prepared by the National Climatic Data Center are presented. The maps may be applied to areas of allergy studies, corrosion protection requirement determinations, agriculture, and general climatology. Average annual map presentations in this edition are: temperature, 1941-1970; total precipitation (water equivalent), 1941-1970; relative humidity, generally 1948-1977; dew point temperature, generally 1946-1965; annual average daily global solar radiation on a south facing surface, generally 1953-1975; mean annual number of thunderstorms, generally 1948-1977; and normal annual heating degree days (contiguous United States and Alaska), generally 1951-1980. These climatic maps reflect average atmospheric conditions that occur over periods of years. Often, observed conditions for any given year will differ significantly from those indicated in the analyses. Caution should be used in interpolating on these generalized maps as sharp changes may occur in short distances, particularly in mountainous areas, due to differences in altitude, slope of terrain, type of soil, vegetation cover, bodies of water, air drainage, urban heat effects and other effects. Upon examination of mapped data, sulfur oxide emission densities were found to be correlated with corrosion potential. (Geiger-PTT)
W86-02321

ILLINOIS GROUND-WATER OBSERVATION NETWORK - A PRELIMINARY PLANNING DOCUMENT,
Geological Survey, Urbana, IL. Water Resources Div.
L. R. Frost, M. O'Hearn, J. P. Gibb, and M. G. Sherrill.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-584, 1984. 37 p, 11 fig, 1 tab, 28 ref.

Descriptors: *Groundwater, *Geohydrologic units, Groundwater levels, Water quality, Groundwater reservoirs, Network design, Networks, Data storage and retrieval, *Illinois, *Groundwater monitoring, Data management.

Water-level and water-quality networks in Illinois were evaluated to determine the adequacy and completeness of available data bases. Ground-water data in present data bases are inadequate to provide information on ground-water quality and water levels in large areas of Illinois and in the major geohydrologic units underlying Illinois and surrounding areas. Data-management needs indicate that a new data base is desirable and could be developed by use of carefully selected available data and new data. Types of data needed to define ground-water quality and water levels in selected geohydrologic units were tentatively identified. They include data on concentrations of organic chemicals related to activities of man, and concentrations of inorganic chemicals which relate either to man's activities or to the chemical composition of the source aquifer. Water-level data are needed which can be used to describe short- and long-term stresses on the ground-water resources of Illinois. Establishment of priorities for data collection has been deferred until existing hydrologic data files can be stored for usable data and until input from other local, State, and Federal agencies can be solicited and compiled. (USGS)
W86-02355

EVALUATION OF THE CREST-STAGE GAGE PROGRAM IN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
R. A. Herbert, D. D. Carlson, and G. J. Wiche.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4204, 1985. 24 p, 11 fig, 9 tab, 10 ref.

Descriptors: *Network analysis, *Network design, Crest gages, Annual runoff, Peak flow, Design floods, Index stations, Regression analysis, *Flood frequency, *Flood recurrence interval, Flood peak, Annual-peak discharge, Crest-stage gages, Flood-frequency equations, *Louisiana, Pine Hills Region.

The crest-stage gage program in Louisiana was evaluated to determine if the data were adequate for use in developing regional flood-frequency equations and to determine if any crest-stage gages could be discontinued. An abundance of data at many crest-stage stations and a lack of data for urban area and flat-slope areas indicated a need for a shift in the number, type, and locations of gages. Extensive correlations and comparisons of annual peak flows and watershed characteristics of 96 sites resulted in a reduced network of 25 stations that could potentially be used as index sites. The adequacy of the reduced network for development and verification of regional flood-frequency equations was tested by comparing a set of regional flood-frequency equations developed using data from the full network with a set developed using data from the reduced network. The results indicate that the crest-stage gage network can be reduced to 25 stations and still provide adequate information for future flood-frequency analyses. (USGS)
W86-02399

PRAGMATIC APPROACH TO EVALUATING A MULTIPURPOSE STREAM-GAGING NETWORK,

Geological Survey, Lakewood, CO. Water Resources Div.
K. L. Wahl, and J. R. Crippen.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4228, 1984. 13 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Network design, *Gaging stations, Streamflow, *Streamflow measurement, *Multipurpose networks, California.

A method for evaluating the relative worth of individual streamflow gaging stations in a multipurpose network is presented. Each individual gaging station in the network is evaluated on the basis of selected rating factors. The factors relate to the need for information at the gaging stations, accuracy of data, economic aspects of operation, and usefulness of data as a basis for estimates at ungaged sites. The total score for the various factors provides a convenient basis for comparing relative importance of individual gaging stations. The rating-factor method is both flexible and definitive, but the point values that are assigned for each rating factor are somewhat subjective. A table of the point values and guidelines for assigning those values is presented. (USGS)
W86-02417

7B. Data Acquisition

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEAR 1984,

Geological Survey, Cheyenne, WY. Water Resources Div.
S. L. Green.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-622, 1984. 112 p, 4 fig, 5 tab, 6 ref.

Descriptors: *Water resources, *Hydrologic data, *Wyoming, Streamflow, Sediment load, Water quality, Groundwater, Water supply, Environmental effects, Oil shale, *Coal regions.

This report contains lists and location maps of streamflow and reservoir stations, crest-stage partial-record stations, water-quality stations, sediment stations, and ground-water observation wells that are currently being operated. Water-resources appraisal projects in Wyoming are also described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water-resources investigations with those of other agencies. This report is one phase of that coordination effort, and serves as an annual progress report to cooperators and the public. (USGS)
W86-01926

WIRELINE-ROTARY AIR CORING OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
W. E. Teasdale, and R. R. Pemberton.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4176, 1984. 9 p, 4 fig, 3 ref.

Descriptors: Drilling, *Coring, *Air-rotary drilling, Disturbed geologic samples, Undisturbed geologic samples, Sampling, *Wireline coring, Core-bit modifications.

This paper describes experiments using wireline-rotary air-coring techniques conducted in the Bandelier Tuff using a modified standard wireline core-barrel system. The modified equipment was used to collect uncontaminated cores of unconsolidated ash and indurated tuff at Los Alamos, New Mexico. Core recovery obtained from the 210-foot deep test hole was about 92 percent. A standard HQ-size, triple-tube wireline core barrel (designed for the passage of liquid drilling fluids) was modified for air coring as follows: (1) Air passages were milled in the latch body part of the head assembly; (2) the inside dimension of the outer core barrel tube was machined and honed to provide greater clearance between the inner and outer barrels; (3) oversized reaming devices were added to the outer core barrel and the coring bit to allow more clearance for air and cuttings return; (4) the eight discharge ports in the coring bit were enlarged. To control airborne-dust pollution, a dust-and-cuttings discharge subassembly, designed and built by project personnel, was used. (USGS)
W86-01934

ANNUAL SUSPENDED-SEDIMENT LOADS IN THE GREEN RIVER AT GREEN RIVER, UTAH, 1930-82,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-01935

THUDERSTORMS: A SOCIAL, SCIENTIFIC, AND TECHNOLOGICAL DOCUMENTARY. VOLUME 3: INSTRUMENTS AND TECHNIQUES FOR THUNDERSTORM OBSERVATION AND ANALYSIS.

National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W86-02003

STATION NETWORKS FOR STORM OBSERVATION,

National Weather Service, Sterling, VA. Test and Evaluation Div.
K. E. Wilk, and S. L. Barnes.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 1-31, 24 fig, 2 tab, 47 ref.

Descriptors: *Thunderstorms, *Meteorological data collections, *Radar, *Networks, *Data acquisition, Network design, Data collections, Weather data collections, Remote sensing, Reviews, Storms, Computers.

This chapter reviews the development of mesometeorological research networks and their instrumentation, and outlines some modern methods for data acquisition and analysis. The Thunderstorm Project in the 1940's was the first major national effort to collect data on thunderstorms. In 1955, the U.S. Army Signal Corps sponsored a reanalysis of the Thunderstorm Project and the data collection network was expanded. In the 1950's, the National Severe Storms Project (NSSP) was initiated within the U.S. Weather Bureau. In the early 1960's, the Air Force Air Weather Service and the Weather Bureau expanded their jointly operated Severe Local Storms Forecast Center to anticipate squall line development. Rapid improvement in research radars in the mid-1960's pointed the way to continuous, quantitative observations of storm development. By 1975, several low-cost devices became available to provide telemetry of analog data from remote sites to a central facility. By 1981, semiautomatic and automatic archiving and retrieval of meteorological data sensed at surface stations had become a standard practice. The objective map analysis method, a computerized method for analysis of spatially distributed time series observations, is described. The method is applied to surface, and upper-air data collected at an NSSP laboratory in central Oklahoma. (Geiger-PTT)
W86-02004

OBSERVATIONS FROM INSTRUMENTED AIRCRAFT,

National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
J. McCarthy, and D. L. Veal.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 47-76, 18 fig, 1 tab, 43 ref.

Descriptors: *Thunderstorms, *Radar, *Aircraft, *Aerial photography, *Meteorological data collections, Remote sensing, Lightning, Storms, Computers, Data acquisition, Storms, Weather data collections, Data collections.

Several major aircraft facilities exist which devote part of their efforts towards understanding the thunderstorm. Aircraft can serve as a direct in situ probe of thunderstorms whereas radar is indirect. Sensors that can be mounted on the aircraft are those that measure temperature, humidity, pressure, and air velocities. Observations of the cloud droplet spectrum are made by impactor sampling, optical devices, and electrostatic disdrometers. Liquid water content is calculated by summation of drop size spectrum or by direct bulk measurement techniques using evaporators, optical flow meters, transmissometers, microwave radiometers, paper tapes, synthetic filaments, and hot-wire total water indicators. Raindrop-sized hydrometeors can be measured by foil impaction, optical devices and momentum sensing. Ice crystals are collected by Formvar replication, on oil-coated slides, or are studied by optical techniques. Airborne radar can provide the aircraft crew with immediate thunderstorm data. Airborne computer-directed data systems are usually designed to operate for data acquisition, self-check or preflight-postflight program, and data processing. Chaff from aircraft has been used for radar jamming and lightning suppression. Examples are presented of cases where instrumented aircraft data have been combined with other direct and remote sensors to yield valuable data on thunderstorms. (Geiger-PTT)
W86-02005

PHOTOGRAMMETRY OF THUNDERSTORMS,

National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
R. L. Holle.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 77-98, 10 fig, 29 ref.

Descriptors: *Thunderstorms, *Clouds, *Photogrammetry, *Aerial photography, *Meteorological data collections, Photography, Data collections, Weather data collections, Storms, Tornadoes, Aircraft, Data acquisition.

Photogrammetry of every transient feature in thunderstorms is possible, but can be tedious. Mathematical equations which are used in conjunction with photogrammetry for determining cloud features are given. The simplest photographs of clouds are still photos taken by hand-held cameras. The next simplest system is the time-lapse movie camera which is usually focused on developing cloud systems. Panoramic photographs of the sky at fixed intervals provide benchmarks of cloud evolution in every direction from a single location. Multiple time-lapse camera photography of thunderstorms can be taken from either one or several locations with cameras usually unattended. Stereoscopic photographs afford a qualitative distance to clouds without any analysis. Analysis of airborne photos is more difficult than for those taken at ground level. Cloud maps can be developed from aircraft photos with the aid of lines drawn to connect the flight track to specific clouds when they are perpendicular to the side cameras and when they are at the azimuths corresponding to their entering, or leaving the side camera's view. Techniques for measuring widths and heights of clouds, and techniques for obtaining pictures from above thunderstorms are also discussed. (Geiger-PTT)
W86-02006

OBSERVATION AND MEASUREMENT OF HAILFALL,

National Center for Atmospheric Research, Boulder, CO. Convective Storms Div.
G. M. Morgan.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation

and Analysis, April 1982. p 149-180, 15 fig, 3 tab, 70 ref.

Descriptors: *Hail, *Networks, *Measuring instruments, *Remote sensing, *Weather data collections, Thunderstorms, Network design, Precipitation, Data acquisition, Radar, Meteorological data collections, Data collections, Tornadoes.

Techniques for measuring hailfall have undergone rapid improvements in the past 25 or 30 years through the introduction of simple but effective instruments in well-designed networks. The wind that accompanies hail has a strong influence on crop damage because it can impart a velocity component to the hailstone several times that acquired through free fall alone. For some purposes, volunteer observer networks of hailfall which were introduced 100 yr ago, are still useful today. Types of hail measuring or recording instruments in use today include the hailpad, hailcube, geophone hail gage, Illinois State Water Survey hail gage, hail-rain separator, time-resolving hail recorder, hailstone spectrometer, chilled-kerosene hailstone freezer, electro-optical hail recorder, hailstone sensor, and remote-sensing devices (radar). In developing hailfall observation networks, the ratio between the area of the hailstreak and the area represented by one grid point should be obtained for a sample of hailstreaks that represent the range and distribution of hailstreaks to be expected in the network. The size of the network determines the number of study events available each year and the number of instruments required to monitor them. (Geiger-PTT)
W86-02007

WEATHER RADAR

National Severe Storms Lab., Norman, OK.
R. J. Doviak, D. Sirmans, and D. Zrnic.
IN: Thunderstorms: A Social, Scientific, and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 181-239, 24 fig, 92 ref.

Descriptors: *Radar, *Remote sensing, *Data acquisition, *Meteorological data collections, *Measuring instruments, Data collections, Weather data collections, Tornadoes, Storms, Cyclones.

A foundation of weather radar principles is given and related to the target's meteorological properties. Subjects such as light scattering properties of hydrometeors and extracting a target's properties from its echoes are reviewed. Radar parameters and echo power are related to the weights given to a hydrometeoric target's backscatter cross section. The radar signal path starting from the transmitter is followed through the antenna, along the beam to the target, and return to the receiver, highlighting along the way the important signal properties. The pulsed Doppler radar is discussed and a discrete target to develop radar principles and the radar equation are considered. The theory for conventional non-Doppler radar is also included. These principles are then extended to the more complex weather target, which is a conglomerate of discrete targets producing a continuous stream of echoes with rapidly fluctuating amplitude and phase. The origin of these fluctuations is demonstrated and the weather radar equation is developed. The weather Doppler spectrum and its principal moments are related to the spatial distribution of target reflectivity and its velocity. Example analyses of radar data from severe storms are presented. (Geiger-PTT)
W86-02008

MEASURING STORM RAINFALL BY RADAR AND RAIN GAGE,

National Severe Storms Lab., Norman, OK.
E. A. Brandes, and J. W. Wilson.
IN: Thunderstorms: A Social, Scientific and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 241-277, 13 fig, 4 tab, 90 ref, 1 append.

Descriptors: *Radar, *Remote sensing, *Rain gages, *Data acquisition, *Comparison studies, Measuring instruments, Data collections, Weather data collections, Rainfall, Gages, Storms, Meteorological data collections.

Radar overcomes the primary difficulties associated with rain gages; radar measurements are over an area, available in real time, and from a single location. The cost of radar is similar to that of a dense rain gage network. Rain gages are simple, less costly, but often erroneous in their measurements. Instrument errors and areal errors of rain gages are described. The radar equation and calculation of rainfall rate are described. Factors causing errors in radar measurement of rainfall may be grouped into three broad categories: estimating of radar reflective factor; time and space averaging of substantial variations in reflectivity; and variations in the reflectivity-rainfall rate (Z-R) relationship and below-beam effects. A comparison of areal radar and gage measurements was made in nine experiments using one average relationship for all storms. The very large storm-to-storm and within storm errors in radar rainfall estimates dictate that estimates should be adjusted further. Adjustments usually involve either specifying the Z-R relationship by storm type or keeping the Z-R relationship fixed and using rain gage observations to correct the radar estimates. (Geiger-PTT)
W86-02009

USE OF SATELLITE OBSERVATIONS,

National Oceanic and Atmospheric Administration, Boulder, CO. Weather Modification Program Office.
R. A. Maddox, and T. H. VonderHaar.
IN: Thunderstorms: A Social, Scientific and Technological Documentary. Volume 3: Instruments and Techniques for Thunderstorm Observation and Analysis, April 1982. p 279-308, 22 fig, 52 ref.

Descriptors: *Satellite technology, *Thunderstorms, *Data acquisition, *Radiometry, *Weather data collections, Radar, Remote sensing, Storms, Weather modification, Meteorological data collections, Data collections, Cloud physics, Microwaves, Weather forecasting.

Satellite data are being developed for a variety of applications to thunderstorm research and operational forecasting and warning. The vertical-temperature profile radiometer has been used by NOAA satellites while the visible and infrared spin scan radiometer has been used by NASA. The rapid technological development of human/machine interactive computer systems that permits selective processing of digital satellite data is producing an increased amount of thunderstorm-related research. The NASA space shuttle will eliminate many restrictive weight and size limitations and allow more sophisticated infrared and microwave instruments to be placed in geosynchronous orbit. Satellite imagery is used in thunderstorm detection, monitoring, and forecasting by determining convective rainfall, monitoring movement and intensity of thunderstorm gust fronts, determining severe-thunderstorm/jetstream relationships and thunderstorm boundaries and intersections. Satellite technology has also been helpful in defining cloudtop tornadic signatures, studying mesoscale onvective weather systems, and examining cloudtop temperature fields, cloud motions and wind fields. Satellite technology has also aided studies involving thunderstorm microphysics such as weather modification. (Geiger-PTT)
W86-02010

EVAPOTRANSPIRATION OBTAINED FROM REMOTE SENSING METHODS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
J. L. Hatfield.
IN: Advances in Irrigation, Volume 2, Academic Press, New York. 1983. p 395-416, 15 fig, 62 ref.

Descriptors: *Evapotranspiration, *Remote sensing, *Soil-water-plant relationships, Canopy, Temperature, Infrared imagery, Spectral analysis, Microwaves, Soil water, Irrigation.

State-of-the-art remote sensing techniques for estimating crop stress and evapotranspiration include evapotranspiration models, infrared thermometry, spectral measurements, and microwave techniques. Canopy temperatures can be used to estimate crop stress directly and to estimate water availability to a crop. Canopy temperature is also combined with traditional methods to indicate crop water demands. (Caesar-PTT)
W86-02134

USE OF AERIAL PHOTOGRAPHY AND REMOTE SENSING IN THE MANAGEMENT OF HAZARDOUS WASTES,

Ohio State Univ., Columbus.
For primary bibliographic entry see Field 5G.
W86-02224

DETECTION OF SUBSURFACE SALINITY WITHIN THE NORTHERN SLOPES REGION OF VICTORIA, AUSTRALIA,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
B. G. Williams, and M. Braunach.
IN: Salinity in Watercourses and Reservoirs, Butterworth Publishers, Boston. 1984. p 515-524, 4 fig, 1 tab, 12 ref.

Descriptors: *Saline water, *Salinity, *Ground water, Subsurface mapping, Subsurface water, Electromagnetic induction, Exploration, Australia, *Geophysical studies.

The application of electromagnetic induction to determine the magnitude and spatial variability of apparent electrical conductivity values, and their relation to underlying geology and secondary salinization, are discussed. The broad scale reconnaissance survey across the lower Northern Slopes of Victoria indicates the magnitude of potential secondary salinization in that region. It also indicates the inherent variability in the distribution of saline materials within the major geological formations. The relatively coarse sampling frequency (5 km) does not permit detailed speculation of problems and possible controls but it does indicate that approximately 300 km of that 500 km transect have a potential for secondary salinization should the groundwater system be conducive to the mobilization and transport of soluble salts. (Halterman-PTT)
W86-02310

PROGRESS REPORT: PERFORMANCE OF THE VIBRATING U-TUBE FLUID DENSITY GAGE FOR MEASURING SUSPENDED-SEDIMENT CONCENTRATION,

Geological Survey, Minneapolis, MN. Water Resources Div.
J. P. Beverage.
Available from Fed Inter-Agency Sed Proj, St Anthony Falls Hyd. Lab, Minneapolis, MN 55414. U.S. Corps of Engineers, 1984. 16 p, 5 fig, 3 ref.

Descriptors: Measuring instruments, *Sediments, Suspended load, *Settling tubes, *Fluid-density gage, *Suspended-sediment concentration, *Density cell.

The vibrating U-tube fluid-density gage shows promise in automating the measurement of suspended-sediment concentration. The gage may be operated with the U-tube in the upright vertical position to increase sensitivity at low sediment concentrations by stopping the flow and letting the sediment settle to the bottom. Sediment with a particle-size range of 62 to 1000 micrometers was tested, and the sensitivity of the instrument increased by a factor of five. The condensation of humidity within the case was proved to be the cause of scattered readings at water temperatures below 12C. The gage response is linear with case pressure. An improved reference oscillator was tested and shown to be satisfactory at ambient temperatures from 15 to 35C. The reference frequency was increased to 20 kHz from the 12.8 to kHz of the earlier studies. (USGS)
W86-02348

INSTRUMENTATION FOR MEASURING LAKE AND RESERVOIR EVAPORATION BY THE ENERGY-BUDGET AND MASS-TRANSFER METHODS,

Geological Survey, NSTL Station, MS. Water Re-

sources Div.
A. M. Sturrock.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-863, 1985. 21 p, 7 fig, 4 ref.

Descriptors: *Evaporation, *Mass transfer, *Energy budget, Reservoir evaporation, Lake evaporation, Air temperature, Water temperature, *Instrumentation, Psychrometer, Micrologger, Pyranometer.

Instrumentation currently used by the U.S. Geological Survey in studies of lake and reservoir evaporation is described in this paper. This instrumentation is used for the measurement of solar and terrestrial energy necessary to apply the mass-transfer or energy budget methods. The energy budget requires a quantative determination of all form of energy entering or leaving the lake as well as determination of the change in storage of energy within the lake. (USGS)
W86-02379

DISCHARGE RATINGS FOR CONTROL GAGES AT MISSISSIPPI RIVER LOCK AND DAM 11, DUBUQUE, IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02401

7C. Evaluation, Processing and Publication

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01921

SEDIMENT YIELDS IN EASTERN MONTANA: SUMMARY OF DATA AND PROPOSED TECHNIQUES FOR ESTIMATING SEDIMENT YIELDS FROM SMALL, UNGAGED WATERSHEDS,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-01922

GROUND-WATER DATA FOR MICHIGAN--1983,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01950

HYDROGEOLOGIC DATA FROM PARTS OF THE DENVER BASIN, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01952

GROUND-WATER RESOURCES OF LANFAIR AND FENNER VALLEYS AND VICINITY, SAN BERNARDINO COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01955

IRRIGATION DATA FROM CHASE, DUNDY, AND PERKINS COUNTIES, NEBRASKA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01957

JANUARY 1984 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-01960

DEVELOPMENT AND EVALUATION OF TECHNIQUES FOR THE DETERMINATION OF THE GROUND-WATER POTENTIAL IN THE SOUTHERN ORANGE FREE STATE AND NORTHERN CAPE PROVINCE; VOLUME 5: STATISTICS AND DATA ANALYSIS,
Water Research Commission, Pretoria (South Africa).
G. J. Van Tonder, and F. D. I. Hodgson.
December 1981. 165 p, 29 fig, 25 tab, 33 ref. K5/17.

Descriptors: *Data processing, *Computer programs, *Statistical analysis, *Geohydrology, Mathematical studies, Standard deviation, Correlation coefficients, Cluster analysis, Linear regression, Maps, Contour maps, Graphical analysis, Factor analysis, Principal component analysis, Orange Free State, *South Africa.

A computerized hydrogeochemical data bank is available for users in South Africa. Three groups of programs are described: (1) programs to read data into the computer and obtain an output in the desired format (all data on a single sample or tables of data for multiple samples), (2) programs for statistical analysis (mean, mode, median, standard deviation, correlation coefficients, multiple linear regression, factor analysis, cluster analysis), and (3) programs to obtain graphical representation of data (histograms, Piper diagrams, Schoeller diagrams, sodium adsorption diagrams, contour maps, etc.). (Cassar-PTT)
W86-01993

MUNICIPAL SOLID WASTE MANAGEMENT FACILITY LOCATION MAPPING: SUPPORT ACTIVITIES REPORT,
Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 5E.
W86-02320

EVALUATION OF THE GROUND-WATER RESOURCES OF COASTAL GEORGIA: PRELIMINARY REPORT ON THE DATA AVAILABLE AS OF JULY 1983,
Geological Survey, Doraville, GA. Water Resources Div.
R. E. Krause, S. E. Matthews, and H. E. Gill.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-228, 1984. 55 p, 21 fig, 4 tab, 120 ref.

Descriptors: *Hydrologic data, *Groundwater, *Well use, *Georgia, *Coastal area, *Monitoring networks, *Principal artesian aquifer, *Floridan aquifer, Test-well drilling.

A compilation of ground-water data that have been collected for nearly 100 years in the coastal area of Georgia as part of cooperative activities between the U.S. Geological Survey and other agencies is presented in this report. The compilation of pertinent data indicates that information is available for use in the evaluation of the ground-water resources of the 13 counties of coastal Georgia. Included in this report is a fairly complete discussion of previous and ongoing investigations and monitoring networks, and an extensive list of references. Maps at 1:24,000, 1:100,000; and 1:1000,000 scales contain well locations and identifers for all wells in the Ground Water Site Inventory (GWSI) data base of the National Water Data Storage and Retrieval System (WATSTORE). Tabular summaries of selected site information from GWSI, including well identifiers and names, latitude-longitude location, depth of well, altitude of land surface, and use of water are presented. Water-use data from the National Water Use Data System, and water use for irrigation from the University of Georgia, Department of Agriculture survey, are tabulated. Also included are pertinent information on geophysical surveys and data obtained, and proposed project activities, particularly test-monitor well drilling. (USGS)
W86-02352

PRINCIPAL FACTS FOR GRAVITY STATIONS IN THE HUMBOLDT HOUSE GEOTHERMAL AREA, PERSHING COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-02358

RECORDS OF SELECTED WELLS, ST. MARYS AND CALVERT COUNTIES, MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
D. D. Drummond.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. Maryland State Basic Data Report 14, 1984. 117 p, 41 fig, 10 tab, 6 ref.

Descriptors: *Hydrogeologic data, Data collections, *Hydrologic data, *Maryland, *Calvery County, *St. Marys County.

Hydrogeologic data for Calvery and St. Marys Counties in southern Maryland were compiled from previously published and unpublished sources. The report includes records of wells inventoried by the U.S. Geological Survey such as state permit number, owner's name, driller, date drilled, elevation, well depth, aquifer, water-level data, discharge data, specific capacity, use of water, and pump type. Also included are observation well lists, lists of available geophysical logs, descriptive logs, chemical quality analyses, and pumpage data, as well as location maps for all data sites. (USGS)
W86-02359

MASS WATER-LEVEL MEASUREMENTS OF FALL 1984 IN THE CENTRAL PLATTE RIVER BASIN, NEBRASKA,
Geological Survey, Lincoln, NE. Water Resources Div.
J. T. Dugan.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-193, 1985. 22 p, 3 fig, 1 tab.

Descriptors: *Groundwater levels, *Observation wells, Data collections, Hydrologic data, *Nebraska, Central Platte River basin, *Water level measurements.

Mass water-level measurements were conducted in the Central Platte River basin, Nebraska, for the purpose of providing data to the U.S. Bureau of Reclamation for the development of a detailed map of water-table conditions during the fall of 1984. The objective was to provide a network of observation wells at approximately 2- to 3-mile intervals. In October and November 1984, 736 wells were measured, of which 526 were measured as part of existing ground-water observation-well networks. The remaining 210 wells not previously measured and required complete inventorying. The report consists of maps of the study area and locations of the observation wells. An appendix of pertinent well data includes: legal location, land-surface altitude, depth-to-water, water-table altitude, date of measurement, and type of well. (USGS)
W86-02360

ANALYSIS OF GROUND-WATER-QUALITY DATA IN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. E. Davis, and G. D. Rogers.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4173, 1984. 177 p, 26 fig, 79 tabs, 56 ref.

Descriptors: *Water quality, Chemical properties, Environmental protection, *Montana, *WATSTORE, *Data collections.

Ground-water-quality data for Montana in the U.S. Geological Survey's computer data file WATSTORE were evaluated for nine geohydrologic units in part of the State east of the Rocky Mountains and for two geohydrologic units in the western mountainous part of the stated region. The availability of data for inorganic, trace, and organic constituents for each grouping of units was assessed. Median dissolved-solids concentrations for the groupings of units range from about 100 to 5,000 milligrams per liter. However, the number and distribution of data sites for some groupings of units wee inadequate to be representative of the aquifer as a whole. Concentrations of most trace constituents do not exceed Federal primary drinking-water standards, although exceptions occur. Few data were available for organic constituents. (USGS)
W86-02361

DRAINAGE BASINS IN ST. JOHNS COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
D. W. Foose.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4232, 1984. 1 map, 3 fig, 3 tab, 4 ref.

Descriptors: *Drainage basins, Ditches, Divides, Beach, Drainage patterns, Tidal streams, *Maps, *Florida, *St Johns County, Hydrologic units, *Drainage areas.

The highest point in St. Johns County, Florida is only slightly above 65 feet above sea level and drainage divides are indistinct and readily influenced by cultural features. This report delineates some 80 drainage basins (or artificial equivalents to natural basins such as the Intracoastal Waterway) within the county and their areas in square miles. Total area of St. Johns County is about 670 square miles. (USGS)
W86-02363

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE OF PROVINCE, TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
B. T. Brady, M. S. Bedinger, D. A. Mulvihill, J. Mikels, and W. H. Langer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4121-B. 14 p, 3 fig, 38 ref.

Descriptors: *Groundwater levels, *Springs, *Maps, Basin and Range province, *Texas.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing hydrologic properties of the Texas part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to ground water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas where the depth to the water table is generally greater than 500 feet. (USGS)
W86-02366

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
B. T. Brady, M. S. Bedinger, and J. Mikels.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4121-A, 1984. 13 p, 3 fig, 38 ref.

Descriptors: *Groundwater, *Groundwater movement, *Maps, Selective withdrawal, Groundwater levels, Basin and Range province, *Texas.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing hydrologic properties of the Texas part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized groundwater flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02367

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. S. Gates, and J. R. Stark.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-A, 1984. 22 p, 3, fig, 1 tab, 98 ref.

Descriptors: Groundwater, *Groundwater movement, *Maps, Groundwater levels, Selected withdrawal, Hydrogeology, *Basin and Range province, *Utah.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Utah part of the Basin and Range province. The first map, at a scale of 1:500,000 divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized groundwater flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02368

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,

Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, W. H. Langer, and W. R. Moyle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4116-A, 1984. 12 p, 3 fig, 40 ref.

Descriptors: Groundwater, *Groundwater movement, *Maps, Groundwater levels, Selective withdrawal, Hydrogeology, *Basin and Range province, *California.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the southern California part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02369

GEOLOGIC AND HYDROLOGIC DATA COLLECTED DURING 1976-1984 AT THE SHEFFIELD LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE AND ADJACENT AREAS, SHEFFIELE, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02372

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MISSOURI, FISCAL YEAR 1985,

Geological Survey, Rolla, MO. Water Resources Div.
W. M. Kratzer, and K. L. Jenkins.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-188, 1985. 57 p, 8 fig, 1 tab, 64 ref.

Descriptors: *Missouri, *Hydrologic data, *Networks, Streamflow, *Gaging stations, Data collection, District projects, *Hydrologic reports.

Water-resource activities of the U.S. Geological Survey in Missouri consist of collecting hydrologic data and making interpretive studies. These projects are funded through joint-funding agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal funds. These data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. This report describes the hydrologic data-collection program and local or areal investigations in Missouri for fiscal year 1985 and provides a list of selected water-resources references for Missouri. (USGS)
W86-02375

GROUND-WATER DATA FOR GEORGIA, 1984,

Geological Survey, Doraville, GA. Water Resources Div.
J. S. Clarke, S. A. Longsworth, K. W. McFadden, and M. F. Peck.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-331, 1985. 150 p, 71 fig, 48 tab, 40 ref.

Descriptors: *Groundwater, *Water levels, Aquifers, *Georgia, Water quality, *Groundwater data, Groundwater levels, Groundwater quality.

Continuous water-level records from 155 wells and more than 800 water-level measurements made in Georgia during 1984 provide the basic data for this report. Selected wells illustrate the effects that changes in recharge and pumping have had on the various ground-water resources in the State. Daily mean water levels are shown in hydrographs for 1984. Monthly means are shown for the 10-year period 1975-84. Mean annual water levels ranged from 7 feet lower to 7 feet higher in 1984 than in 1983. Water-quality samples are collected periodically throughout Georgia and analyzed as part of a real and regional ground-water studies. Along the coast, chloride concentrations in the Floridan aquifer system generally remained steady. (USGS)
W86-02376

GAZATTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--MERRIMACK RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and R. A. Fontaine.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4284, 1984. 54 p, 5 fig, 5 tab, 32 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Nashua River basin, Concord River basin, Shawsheen River basin, Lower Merrimack River basin, *Maps.

The Merrimack River basin in northeastern Massachusetts includes streams draining the Nashua (507 square miles), Concord (400 square miles), Shawsheen (78.0 square miles), and lower Merrimack (275 square miles) River basins. Drainage areas using the latest available 1:24,000 scale topographic maps were computed for the first time for

streams draining more than 3 square miles and were recomputed for data collection sites. Streamflow characteristics at 12 gaging stations were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 79 partial-record sites and procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for 12 gaged streams. This gazetteer will aid in the planning and siting of water-resources related activities, and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02381

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. R. Harrill, W. H. Langer, J. M. Thomas, and D. A. Mulvihill.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations 83-4119-B, 1984. 11 p, 3 fig, 2 pl, 75 ref.

Descriptors: *Groundwater levels, Springs, Hydrologic data, Hydrogeology, *Basin and Range province, *Nevada, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Nevada part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas are shaded where the depth to the water table is generally greater than 500 feet. (USGS)
W86-02384

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. R. Harrill, and J. M. Thomas.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations 83-4119-A, 1984. 10 p, 3 fig, 2 pl, 75 ref.

Descriptors: *Groundwater, *Groundwater movement, Hydrologic data, Hydrogeology, Selective withdrawal, *Basin and Range province, *Nevada, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Nevada part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02385

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, T. W. Anderson, and W. H. Langer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-A, 1984. 7 p, 3 fig, 2 pl, 41 ref.

Descriptors: *Groundwater, *Groundwater movement, Hydrologic data, Selected withdrawal, Hydrogeology, *Basin and Range province, *Arizona, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Arizona part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water-table divides or topographic divides. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02386

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
M. S. Bedinger, J. L. Mason, W. H. Langer, J. S. Gates, and J. R. Stark.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-B, 1984. 12 p, 3 fig, 1 pl, 123 ref.

Descriptors: *Groundwater levels, Springs, Hydrologic data, Hydrogeology, *Basin and Range province, *Utah, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic properties of the Utah part of the Basin and Range province. The first map, at a scale of 1:500,000, shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water, and areas of basin fill or consolidated rocks. In areas where the depth to water table is less than 500 feet, the depth is shown by contours of data points where data are not sufficient to draw contours. Areas are shaded where the depth to the water table is generally greater than 500 feet. (USGS)
W86-02387

SURFACE-WATER INFLOW TO PUGET SOUND, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
J. R. Williams.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4090. 6 plates, 11 tab.

Descriptors: *Stream discharge, Water quality, Regression analysis, *Surface waters, *Streamflow, Puget Sound, Strait of Juan de Fuca, *Washington, Exceedance probabilities, *Maps.

Estimates were made of the annual and seasonal mean discharges that have 10- (wet year), 50- (normal year), and 90- (dry year) percent probabilities of exceedance at the mouths of all streams in the Puget Sound area, Washington, that have a mean annual flow of 20 cu ft/sec. or more. The information, an important factor in assessing the quality of water in Puget Sound and the Strait of Juan de Fuca, is presented on five map plates. (USGS)
W86-02395

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN TEXAS--FISCAL YEARS 1982-84,

Geological Survey, Austin, TX. Water Resources Div.
R. U. Grozier, and L. F. Land.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-346, 1985. 60 p, 1 tab.

Descriptors: *Groundwater, *Surface water, *Water quality, *Hydrologic data collection, *Data collections, *Texas, Water-resources appraisals.

Water-resources activities in Texas include the collecting of hydrologic data, performing interpretive studies, and conducting research projects. This report describes the activities of the Water Resources Division of the U.S. Geological Survey in Texas for fiscal years (October to September) 1982 to 1984. (USGS)
W86-02396

STREAM DISCHARGE IN MICHIGAN--MISCELLANEOUS MEASUREMENTS,

Geological Survey, Lansing, MI. Water Resources Div.
D. J. Holtschlag, and D. V. Eagle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-350, 1985. 344 p, 5 fig, 10 tab, 3 ref.

Descriptors: *Hydrologic data collections, *Streamflow, *Michigan, Discharge, Water yield.

This report contains 17,607 miscellaneous stream discharge measurements made at 2,897 sites in Michigan. An average of 515 measurements were made each year from 1960 through 1984; most of these were made from April through October of each year. Miscellaneous measurements include periodic and occasional measurements of streamflow at sites where systematic records are unavailable. (USGS)
W86-02409

APPROACH FOR APPRAISING THE ACCURACY OF SUSPENDED-SEDIMENT DATA,

Geological Survey, Sacramento, CA. Water Resources Div.
D. E. Burkham.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1333, 1985. 18 p, 4 fig, 1 tab, 14 ref.

Descriptors: *Statistical analysis, *Statistical methods, *Suspended sediments, Sediment discharge, Error analysis, Sediment concentration, Sand, Streams.

Procedures are presented for appraising the accuracy of suspended-sediment data. Types of errors involved are sampling error, spatial error, temporal error, and sediment-discharge error. The standard error of estimate is used to represent errors. Suspended-sediment data for 17 U.S. Geological Survey gaging stations in Arizona, California, Nebraska, New Mexico, Pennsylvania, and Washington are used in applications of the procedures. For the study sites, the magnitudes of the different types of error apparently vary directly with percentage of sediment-water mixture that is sand; when the percentage sand is relatively high, magnitudes of the different types of error have a relatively wide range. For seven sites of the Sacramento River, Calif., and its tributaries, the standard sampling error apparently can range from 2.5 percent when percentage sand is relatively low to 20 percent when percentage sand is relatively high. For 16 sites in Arizona, California, Nebraska, New Mexico, and Pennsylvania, the coefficient of variation for concentrations of suspended sediment

across streams apparently can range from 2.5 percent (low percentage sand) to 70 percent (high percentage sand). (USGS)
W86-02415

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS–HUDSON RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4250, 1984. 24 p, 5 fig, 5 tab, 29 ref.

Descriptors: *Drainage flow, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Hoosic River basin, *Maps.

The Hudson River basin includes streams draining the Hoosic River (205 square miles), Kinderhook Creek (20.9 square miles), and Roeliff Jansen Kill (13.3 square miles) basins in western Massachusetts, eastern New York, and southern Vermont. Drainage areas, using the latest available 1:24,000 scale topographic maps, are re-computed for data-collection sites and computed for the first time for streams draining greater than 3 square miles. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for the five gaged streams in the Hoosic River basin. Streamflow characteristics, representing statistics computed using a new data base with records through 1979, include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 21 partial-record sites. The procedures used to determine the hydrologic characteristics are summarized. This gazetteer of hydrologic characteristics will aid in the planning and siting of water-resources-related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02416

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS–COASTAL RIVER BASINS OF THE NORTH SHORE,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4281, 1984. 60 p, 5 fig, 5 tab, 47 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, *Flow characteristics, Streamflow, Surface water, *Massachusetts, Rowley River basin, Parker River basin, Ipswich River basin, Mystic River basin, Charles River basin, Neponset River basin, Weymouth River basin, Weir River basin, *Maps.

The coastal river basins of the North Shore and Boston Bay include streams draining the Parker River (60.4 square miles), Rowley River (9.9 square miles), Ipswich River (156 miles), Mystic River (66.0 square miles), Charles River (311 square miles), Neponset River (117 square miles), Weymouth Fore and Weymouth Back Rivers (about 63 square miles) and Weir River (about 20 square miles) basins. The study area in eastern and northeastern Massachusetts also includes the minor river basins draining into Massachusetts Bay, Ipswich Bay, or the Atlantic Ocean. Drainage areas using the latest available 1:24,000 scale topographic maps were computed for the first time for streams draining more than 3 square miles and were recomputed for data-collection sites. Streamflow characteristics at 15 gaging stations were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 95 partial-record sites and the procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for 15 gaged streams. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02418

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS–CONNECTICUT RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4282. 110 p, 10 ill, 5 tab, 39 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, *Connecticut River basin, *Maps.

The Connecticut River basin study area includes streams draining the Ashuelot River (6.6 square miles), Millers River (389 square miles), Deerfield River (663 square miles), Chicopee River (727 square miles), Westfield River (517 square miles), Farmington River (158 square miles), and Connecticut River lowlands (656 square miles) basin in western Massachusetts, northern Connecticut, southern Vermont, and southern New Hampshire. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for the first time for streams draining more than 3 square miles and were re-computed for data-collection sites. Streamflow characteristics at 45 gaging stations, representing statistics were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 118 partial-record sites, and the procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for 54 sites in the Connecticut River basin. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02419

8. ENGINEERING WORKS

8A. Structures

MODEL STUDY ON WAVE ABSORBERS FOR APPLICATION IN HARBOURS ALONG THE SOUTH AFRICAN COASTLINE,
National Research Inst. for Oceanology, Stellenbosch (South Africa). Coastal Engineering and Hydraulics Div.
D. J. P. Scholtz.
Available from the National Technical Information Service, Springfield, VA 22161 as N83-11686, Price codes: A06 in paper copy, A01 in microfiche. CSIR Report T/SEA 8114, September 1981. 117 p, 73 fig, 7 tab, 20 ref.

Descriptors: *Hydraulics, *Erosion control, *Waves, Harbors, *South Africa, Model studies, Coastal engineering, *Breakwaters, *Shore protection, *Bank protection, Wave absorbers.

The performance of wave absorbers for South African harbors was studied using a model. Tests were done on rubble slopes, dolos slopes, discontinuous composite rubble slopes, patented absorber blocks, and a column wave absorber. Generally, the reflection coefficients were high when the relative depth was low, and vice versa. The wave steepness had an insignificant effect on the reflection coefficient in the wave steepness range of 0.004 to 0.024. The individual mean reflection coefficients for dolos slopes and rubble slopes were similar, 0.37 and 0.35, respectively, for relative depths of 0.10 and 0.13 and for wave steepness of 0.004-0.024. The reflection coefficients for narrow structures (6.0-6.5 m wide in the model) were high (0.6-0.8). Smaller reflection coefficients were obtained for wider structures. For example, reflected wave heights were 0.3-0.4 for structures 18.00-18.75 m wide in the prototype. With the column wave absorber, reflected wave height decreased linearly with increase in width. The efficiency of the most effective hollow-block type (column) and of the slope type (composite slope with ratio of depth of top of vertical face of the discontinuous composite rubble slope below SWL to water depth at structure = 0.4) wave absorbers was similar (reflected wave height = 0.5) for w/d (width/water depth) = 1. The latter was more efficient for w/d > 1 and less efficient for w/d < 1. (Cassar-PTT)
W86-02000

AIR DEMAND AND VIBRATION MEASUREMENTS, WYNOOCHEE DAM, WYNOOCHEE RIVER, WASHINGTON,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-02002

CONDITION SURVEY OF CEDARS LOCK AND DAM, LOWER FOX RIVER, WISCONSIN,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
R. L. Stowe, and J. C. Ahlvin.
Miscellaneous Paper SL-82-4, June 1982. Final Report. 114 p, 2 fig, 5 tab, 26 plates, 2 app, 1 exhibit, 7 ref.

Descriptors: *Cedars Lock and Dam, *Wisconsin, *Dam inspection, Concrete dams, Elastic modulus, Shear strength, Triaxial strength, Poisson's ratio.

A condition survey was performed at Cedars Lock and Dam on the Lower Fox River, Wisconsin. Results of the field investigation and laboratory tests indicated that the concrete in the lock and dam is locally cracked and lightly deteriorated but structurally sound. Rock masonry in the lock appears sound even though the outside surface is weathered. Cycles of freezing and thawing have caused the deterioration. The lock and dam is founded on competent bedrock. Soundings should be made to detect any scouring behind the dam. It is suggested that the reinforced steel in the tainter gate piers, adjacent to the hinge pins, be examined for corrosion. The field investigation included drilling for core samples of concrete, foundation rock, and backfill. Selected specimens of these materials were tested in the laboratory for certain physical and mechanical properties. Data on unit weight, compression wave velocity, compression strength, water content, elastic moduli and Poisson's ratio are presented for concrete cores. Data on effective and dry unit weight, water content, compression shear strength are presented for the rock cores. (Author's modified-abstract)
W86-02036

8B. Hydraulics

MODEL STUDY ON WAVE ABSORBERS FOR APPLICATION IN HARBOURS ALONG THE SOUTH AFRICAN COASTLINE,
National Research Inst. for Oceanology, Stellenbosch (South Africa). Coastal Engineering and Hydraulics Div.
For primary bibliographic entry see Field 8A.
W86-02000

AIR DEMAND AND VIBRATION MEASUREMENTS, WYNOOCHEE DAM, WYNOOCHEE RIVER, WASHINGTON,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.

E. D. Hart.
Miscellaneous Paper HL-82-2, December 1982. Final Report, 45 p, 10 fig, 5 tab, 16 plates, 13 ref.

Descriptors: *Hydraulics, *Vibrations, *Dams, *Gates, Air demand, Hydraulic structures, *Wynoochee Dam, *Washington, Sluice gates.

Tests were conducted at the Wynoochee Dam, Washington, after vibrations were noted during sluice discharges. The measurement program included (a) the magnitude of vibrations occurring at the dam, the Vista House, and sluice gate, (b) gate-lip pressure fluctuations, (c) air flow rates, (d) the correlation between the gate and Vista House vibrations. Measurements were made with gate openings at 1-ft increments from 1 to 10 ft with an essentially full pool. Some correlation was seen between the frequency of the gate-lip pressure fluctuations and both the accelerations of the Vista House and the air-vent pressure fluctuations during the test with a gate opening of 9 ft. The maximum pk-pk acceleration recorded during the test was 0.0008 g. The maximum recorded air-vent velocity and head loss were within suggested limits. The ratio of air discharge through the vent and water discharge in the sluice plotted reasonably well on the suggested design curve. Air-vent flow reached a maximum when the sluice gate was fully open. Air flowed into the sluice exit portal at all gate openings for which measurements were made. (Cassar-PTT)
W86-02002

8C. Hydraulic Machinery

HAND-PUMP TECHNOLOGY FOR THE DEVELOPMENT OF GROUNDWATER RESOURCES,
Agency for International Development, Washington, DC.
F. E. McJunkin, and E. H. A. Hofkes.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 37-52, 1 fig, 11 ref.

Descriptors: *Groundwater, *Pumps, *Pump wells, *Water supply development, *Developing countries, Pump testing, Water supply, Water resources development, Maintenance costs, Models, Rural areas.

In areas where groundwater is readily available at moderate depth, constructing a number of wells fitted with hand pumps is by far the cheapest means of providing a good water supply. The most common hand pump is the reciprocating type. Inherent features of the reciprocating hand pump are subject to friction and wear. The diaphragm pump is another type of positive displacement pump. In the rotary-type pump, the helical rotary requires no valves nor cup seals, and in place of the reciprocating lever linkage of the pump head, it uses a rotary crank with a right-angle gearbox to turn the rotor. The local manufacture of the hand pump is desireable due to lower capital costs of production, transportation savings, reduction in foreign exchange requirements, stimulation of local initiative, industry and labor, and better availability and access to repair and replacement parts. Most hand-pump maintenance programs can be characterized as a one-level or two-level system. The one-level system is one where all maintenance is the responsibility of the central organization. In the two-level organization, maintenance is shared with local villages or communities. Hand pumps are compared and selected on the basis of relative total cost, capital costs of purchase and installation, plus costs of operation and maintenance. A protocol for evaluating and comparing hand pumps is now under development. (Geiger-PTT)
W86-02327

RENEWABLE ENERGY PUMPING FROM RIVERS AND STREAMS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 53-64, 6 fig, 1 tab, 6 ref.

Descriptors: *Pump turbines, *Streams, *Pumps, *Water supply development, *Developing countries, Hydraulic equipment, Streamflow, Rivers, Pumping, Pump testing, Water supply, Water resources development, Maintenance costs.

In developing countries, there are many situations where water is available from a nearby stream. Various devices have been constructed to utilize the energy available in flowing streams. This chapter reviews two of the more successful devices: the hydraulic ram pump (hydram) and the low head turbine pump. The hydram converts pressure energy to mechanical work, while the low-head turbine pump converts kinetic energy to mechanical work. The hydram works more efficiently, and in general its capital cost is approximately half that of the Platapump turbine pump. There is, however, ancillary equipment that must be installed with the hydram (feed tank, drive pipe, pump compartment), making it a rather permanent installation. The turbine pump can be installed quite easily with a simple dam, and is fairly temporary and portable. In terms of operation and maintenance, the hydram, with two moving valve parts, would probably be easier to maintain. (Geiger-PTT)
W86-02328

WIND-POWER PUMPING,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
G. M. Bragg.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Sciences, Ann Arbor, MI, 1982. p 65-84, 7 fig, 4 tab, 3 ref.

Descriptors: *Pumps, *Pump turbines, *Wind, *Hydraulic equipment, Pumped storage, Pumping, Turbines, Pump testing, Hydraulic machinery, Design criteria, *Windmills.

Several aspects of wind power pumping are outlined, with emphasis on the data needed to decide on the basic types of wind power devices to be used and the availability of wind for power generation. Historically, most windmills have been used for grinding and water pumping. When deciding on windmill location, optimum geographic placement, variation of wind speed with heights and time, and maximum winds for stress analysis should be considered. Windmill designs should be stress-analyzed comprehensively before construction. The most common type of water pumping windmill is the American farm windmill. Many new designs of this type of windmill are becoming available. These new machines are capable of pumping water using positive-displacement pumps at depths up to 200 or more meters. The mechanical simplicity of vertical axis water pumping windmills suggests that machines of this type may become popular in the future. The most common positive-displacement pump for water applications at present is the reciprocating type. In North America, centrifugal pumps have been used to provide water pumping while being driven electrically by submersible motors. In the case of water pumping, the economic and engineering advantages are often strongly in favor of wind power. The peak achievable efficiency for aerodynamic optimization is 0.59, if angular momentum effects, drag and tip losses are ignored. Optimization of a wind turbine connected to a pump or electrical generator is considered. (Geiger-PTT)
W86-02329

8D. Soil Mechanics

INFLUENCE OF A SHALLOW WATER TABLE ON CRATERING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
B. L. Carnes.
Technical Report SL-81-6, September 1981. Final Report. 118 p, 21 fig, 10 tab, 9 ref, 4 append. 4A762719AT40.

Descriptors: *Soil mechanics, *Excavation, *Explosives, *Water table, Rapid excavation, Water level, Sand, Craters, Shallow water table.

The influence of a shallow water table on crater shapes and sizes in various types of soils was investigated. Tests using high-explosive charges ranging from 1 to 322 pounds were conducted at four separate sites. Site 1 was a specially constructed sand basin with a variable water table level. Site 2 was a natural sandbar of the Mississippi River near Vicksburg. Site 3 was on a natural sand site in central Florida, and Site 4 was a layered clay/sand site at Camp Shelby, Mississippi. Results showed that craters of drastically different shapes can be formed in the presence of a near-surface water table if the water table is in a highly saturated, loose, granular material. Wide, shallow craters were caused by soil liquefaction in loose, saturated, fine medium-loose sands; however, in a relatively dense sand that was not fully saturated, craters were 5 to 10% smaller in radius and depth than normal (in homogeneous soil), but still regular and bowl-shaped. In a clay/sand environment, craters tended to be about 10 to 15% wider than normal because of sloughing crater slopes of soft clay caused by the shallow water table in the sand.
W86-01999

RELATIONSHIP OF LABORATORY AND FIELD DETERMINED HYDRAULIC CONDUCTIVITY IN COMPACTED CLAY SOILS,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2F.
W86-02119

8E. Rock Mechanics and Geology

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-D, 1984. 11 p, 2 fig, 68 ref.

Descriptors: *Granitic rocks, Aquifers, Hydrogeology, *Geologic maps, *Basin and Range province, Utah.

Outcrops of granitic rocks have been delineated in Utah as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, geologic age, distribution, and sources of data of the granitic rocks, are described. (USGS)
W86-01938

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFF AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, K. Roggensack, and D. A. Lopez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4118-F, 1984. 24 p, 93 ref.

Descriptors: *Ash-flow tuff, *Laharic breccia, *Aquifers, Hydrogeology, Basin and Range province, *New Mexico, Geologic maps.

Outcrops of ash-flow tuff and laharic breccia have been delineared in New Mexico as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and sources of data of the rocks are described. Also, caladreas and cauldrons from which the major tuffs erupted are described. (USGS)
W86-01939

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY ARGILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Re-

sources Div.
W. D. Johnson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-E, 1984. 11 p, 2 fig, 2 pl, 61 ref.

Descriptors: *Argillaceous Rocks, Aquifers, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of formations containing thick units of argillaceous rocks in Arizona as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution of the rocks, and the sources of data are described. (USGS)
W86-01945

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
W. D. Johnson, and R. B. Scarborough.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-D, 1984. 33 p, 2 fig, 2 pl, 135 ref.

Descriptors: *Granitic rocks, Aquifer, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of granitic rocks of part of Arizona have been mapped as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, geologic age, distribution, and the sources of data of the granitic rocks are described. (USGS)
W86-01946

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
W. D. Johnson, and R. B. Scarborough.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-G, 1984. 19 p, 3 fig, 2 pl, 93 ref.

Descriptors: *Basaltic rocks, Aquifers, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of basaltic rocks older than 2 million years have been delineated in Arizona as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and the sources of data for the basaltic rocks, are described. (USGS)
W86-01947

MAP SHOWING OUTCROPS OF THICK, DOMINANTLY AGRILLACEOUS SEDIMENTARY AND METASEDIMENTARY ROCKS, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
W. D. Johnson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-E, 1984. 10 p, 1 fig, 1 tab, 52 ref.

Descriptors: *Agrillaceous rocks, Aquifers, Geologic maps, *Basin and Range province, *Utah.

Outcrops of thick argillaceous sedimentary and metasedimentary rocks generally in excess of 500 feet thick have been delineated in Utah as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The sources of data, lithologic chracter, thickness, and distribution of thick argillaceous geologic units ranging in age from Late Proterozoic to Late Cretaceous are described. (USGS)
W86-01948

MAP SHOWING OUTCROPS OF PRE-QUATERNARY ASH-FLOW TUFFS AND VOLCANICLASTIC ROCKS, BASIN AND RANGE PROVINCE,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, D. A. Lopez, and J. R. LaFortune.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-F, 1984, 16 p, 2 fig, 66 ref.

Descriptors: *Tuffs, *Volcaniclastic rocks, Aquifers, *Geologic maps, *Basin and Range province, *Arizona.

Outcrops of ash-flow tuffs and valcaniclastic rocks older than 2 million years have been delineated in Arizona as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and the sources of data for the rocks, are described. (USGS)
W86-01972

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND PRE-QUATERNARY ASH-FLOW TUFFS, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, K. A. Sargent, and D. A. Lopez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-D, 1984. 12 p, 2 fig, 41 ref.

Descriptors: *Granitic rocks, *Ash-flow tuffs, Calderas, *Geologic maps, Aquifers, *Basin and Range province, *Oregon.

Outcrops of granitic rocks and pre-Quaternary ashflow tuffs have been delineated within the Basin and Range province or Oregon as part of a study by the U.S. Geological Survey to identify potentially suitable regions for future study for disposal of high-level nuclear waste within the Basin and Range province, western United States. The distribution, lithologic character, geologic and, if available, radiometric age, thickness (where appropriate), and sources of data of the geologic units are described. Locations of known and postulated calderas are shown, and they are briefly described. (USGS)
W86-01973

MAP SHOWING OUTCROPS OF PRE-QUATERNARY BASALTIC ROCKS, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Jenness, K. E. Sargent, and D. A. Lopez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-E, 1984. 8 p, 2 fig, 27 ref.

Descriptors: *Basaltic rocks, *Geologic maps, Hydrogeology, *Basin and Range province, *Oregon, Aquifers.

Outcrops of basaltic rocks have been delineated in Oregon as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The lithologic character, thickness, geologic age, distribution, and sources of data of the basaltic rocks are described. (USGS)
W86-01974

PRINCIPAL FACTS FOR GRAVITY STATIONS IN THE HUMBOLDT HOUSE GEOTHERMAL AREA, PERSHING COUNTY, NEVADA,

Geological Survey, Carson City, NV. Water Resources Div.
B. G. Duffrin, D. L. Berger, and D. H. Schaefer.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-163, 1985. 11 p, 1 tab, 2 ref, 1 fig.

Descriptors: *Gravity Studies, *Geophysics, Gravimetric prospecting, *Humboldt House area, Pershing County, *Nevada.

Principal fact for 172 gravity stations in and near Humboldt House, Nevada are tabulated; they consist of latitude, longitude, altitude, observed gravity, free-air anomaly, terrain correction, and Bouguer anomaly values, at a bedrock density of 2.67 grams per cubic centimeter. (USGS)
W86-02358

8G. Materials

LABORATORY INVESTIGATION OF PHYSICAL PROPERTIES OF FLEXIBLE MEMBRANE LINERS (FML),

Carlisle SynTec Systems, PA.
B. D. Giah, and W. E. Witherow.
IN: Toxic and Hazardous Wastes, Technomic Publishing Co. Lancaster, PA. 1984. p 510-519, 14 fig.

Descriptors: *Membranes, *Impervious membranes, *Materials testing, *Linings, Materials engineering, Rubber, Elastomers, Polymers.

A wide spectrum of physical properties, especially durability and degradation, for the most common non-reinforced and fabric reinforced flexible membrane liners (FML's) e.g., butyl and ethylene propylene diene monomer (EPDM), rubbers and thermoplastic polyvinyl chloride (PVC), chlorinated polyethylene (CPE) and chlorosulfonated polyethylene (CSM) were investigated. All of these materials are used widely today in many canal, reservoir, wastewater, and dam projects. Testing was performed in accordance with the latest American Society of Testing and Materials methods. Water resistance, tensile strength, elongation, dimensional stability, and puncture resistance were determined on five commercially available membranes (Butyl rubber, EPDM, rubber, thermoplastics CPE, thermoplastic PVC, and Hypalon). Physical characteristics were determined after heat aging for 28 days at 70degrees and for 7 days at 116 degrees. Butyl rubber showed the least dimensional changes, the highest puncture resistance, good retention of brittle point, and the least permeability. Thermoplastic PVC and CSM increased in tear resistance after heat aging. PVC exhibited the worst tensile strength retention after 28 days at 70 degrees. (Geiger-PTT)
W86-02120

8H. Rapid Excavation

INFLUENCE OF A SHALLOW WATER TABLE ON CRATERING,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8D.
W86-01999

8I. Fisheries Engineering

HABITAT SUITABILITY INDEX MODELS: REGRESSION MODELS BASED ON HARVEST OF COOLWATER AND COLDWATER FISHES IN RESERVOIRS,

Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
For primary bibliographic entry see Field 2A.
W86-01985

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

TRAINING OF COUNTERPARTS,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller.
IN: Water Supply and Sanitation in Developing Countries, Ann Arbor Science, Ann Arbor, MI, 1982. p 343-361, 1 fig, 11 ref.

Descriptors: *Education, *Training, *Water supply development, *Sanitation, *Developing countries, Case studies, Project planning, Future planning, Manpower, Personnel.

Training of personnel will be a key factor in any expansion of water supply and sanitation systems. To train personnel, students may go outside the country for specialized training not available within the country, outside teachers may come into the country, or local teachers may be used to train local personnel using local institutions. Training plans should be preceded by a proper manpower survey. Most developing countries focus on operation/maintenance as the most critically needed training. Practical on-the-job training is also often lacking. Trained personnel require incentives to stay on the job after training. Failure to fulfill training requirements may be considered a breech of contract where certain training must gradually be shifted from outside training advisors to local trainers. Four projects involving a large training component are described. These are: training in rural water supply in Malawi, training the professionals and technicians in Tanzania, a training project for operation and maintenance in Kenya, and training of trainers in the East Caribbean. The PANO/GIBA report has defined the major activities of the training program. These include: development of the training delivery system organization, training of trainers, development of training/job manuals, and manager/supervisor workshop and premier briefing. (Geiger-PTT)
W86-02342

9D. Grants, Contracts, and Research Act Allotments

HISTORY OF THE STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
J. S. Burton.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-736, 1984. 49 p, 6 fig, 7 tab, 64 ref.

Descriptors: Administration, Education, Administrative agencies, *Water Resources Institutes, Universities, *Technology transfer, History, Manpower, Research priorities, *State Water Resources Research Institute Program, *Water Resources Scientific Information Center.

The State Water Resources Research Institute Program, established in 1964, consists of 54 Water Resources Research Institutes located at land-grant universities in each of the 50 states and Puerto Rico, the District of Columbia, Guam, and the Virgin Islands. The program evolved from the Water Resources Research Act of 1964, as amended, the Water Research and Development Act of 1978, Public Law 94-457, and the Water Research and Development Act of 1984. These laws authorize the following components of the Institute Program: (1) the annual allotment and matching grants program for the institutes and (2) the additional and saline water research programs for organizations in addition to the State Water Resources Research Institutes. This report summarizes the legislative history, budget history, research program development, and program accomplishments. The State Water Resources Research Program has been administered to by the Office of Water Resources Research (OWRR) (1964-1974), the Office of Water Research and Technology (OWRT) (1974-1982), the Office of Water Policy (OWP) (1982-1983), and the U.S. Geological Survey (USGS) (1983-present). (USGS)
W86-02347

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN MISSOURI, FISCAL YEAR 1985,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02375

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN TEXAS--FISCAL YEARS 1982-84,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02396

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

PARAHO ENVIRONMENTAL DATA: BIBLIOGRAPHY,
Development Engineering, Inc., Rifle, CO.
L. K. Talley.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019378, Price codes: A02 in paper copy, A01 in microfiche. May 1981. 19 p. EP-78-C-02-4708.A000.

Descriptors: *Bibliographies, *Water pollution effects, *Oil shale, *Coal liquefaction, Toxicity, Land reclamation, Revegetation, Vegetation establishment, Public health, Safety, Leachates.

A bibliography on oil shale processing includes references on process characterization, air quality, water quality, land reclamation and revegetation, biological effects, occupational health and safety, and end use. (Cassar-PTT)
W86-01983

FLUCTUATING WATER LEVELS IN RESERVOIRS; AN ANNOTATED BIBLIOGRAPHY ON ENVIRONMENTAL EFFECTS AND MANAGEMENT FOR FISHERIES,
Fish and Wildlife Service, Fayetteville, AR.
G. R. Ploskey.
Technical Report E-82-5, May 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 142 p. Intra-Army Order WESRF-80-112.

Descriptors: *Bibliographies, *Environmental effects, *Water level fluctuations, *Reservoirs, *Aquatic life, Aquatic habitats, Habitats, Fish, Invertebrates, Aquatic plants, Macrophytes, Productivity, Zooplankton, Limnology, Water quality, Algae, Nutrients, Drawdown, Erosion, Temperature, Water temperature, Turbidity, Falling stage, Rising stage.

The effects of reservoir water level fluctuations on fish is the subject of a 367-reference annotated bibliography. Affected are physicochemical variables, alagae, aquatic invertebrates, fish, fishing, erosion, and reservoir aesthetics. Research on natural lakes, ponds, marshes, and floodplains is included when data contribute to an understanding of aquatic systems in general. A subject index lists several main headings: biology, fish taxa, and limnology (chemical and physical). Examples of subjects under the main headings are fish (with 17 subheadings), drawdown, high water, erosion, temperature, reservoirs, receding waters, and rising waters. (Cassar-PTT)
W86-02033

WATER QUALITY, MACROINVERTEBRATES, AND FISHERIES IN TAILWATERS AND RELATED STREAMS: AN ANNOTATED BIBLIOGRAPHY,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
C. H. Walburg, J. F. Novotny, K. E. Jacobs, W. D. Swink, and T. M. Campbell.
Technical Report E-81-8, May 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 200 p. Interagency No. WES 79-04.

Descriptors: *Bibliographies, *Environmental effects, *Reservoirs, *Aquatic life, *Tailwater, Fish, Invertebrates, Aquatic habitats, Habitats, Streams, Dams, Flow, Water quality.

An annotated bibliography lists available literature information on water quality, macroinvertebrates, and fish in tailwaters and related streams. It is divided into two sections: (1) tailwater studies - references which show the project-imposed changes in water flow and quality on the tailwater environment and downstream biota and (2) stream studies - selected references on stream studies which are applicable to tailwater research. (Cassar-PTT)
W86-02035

10D. Specialized Information Center Services

HISTORY OF THE STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 9D.
W86-02347

10F. Preparation Of Reviews

REVIEW OF THE CHEMISTRY AND ENVIRONMENTAL FATE OF REACTIVE OXIDANT SPECIES IN CHLORINATED WATER,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5F.
W86-02136

REVIEW OF ANALYTICAL METHODS FOR REACTIVE OXIDANT SPECIES IN CHLORINATED WATERS,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5A.
W86-02177

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VOLUME 19, NUMBER 7
JULY 1986

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 7
JULY 1986

W86-02420 -- W86-02919

MARCH 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
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Reston, VA 22092

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

ADSORPTION OF METAL IONS AND MINERAL COMPLEXES ON MINERALS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-02715

2. WATER CYCLE

2A. General

BASIN-SCALE EVAPOTRANSPIRATION DETERMINATION THROUGH WATERSHED AND CLIMATE ANALYSIS,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 2D.
W86-02420

DEVELOPMENT OF A SIMPLE, RELIABLE, INDEX OF DROUGHT WARNING AND DROUGHT EMERGENCY TO AID MUNICIPAL WATER SUPPLY MANAGEMENT,
Delaware Univ., Newark. Dept. of Geography.
J. R. Mather.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-218980/AS, Price codes: A03 in paper copy, A01 in microfiche. Delaware Water Resources Research Center, Newark, Project Completion Report, 1984. 25 p, 7 tab, 7 ref. USGS G833/05. 14-08-0001-G833/05.

Descriptors: Drought, Hydrologic budget, Water shortage, New Jersey, Drought index, Planning.

The goal of the present research was to achieve a simple, reliable, easily evaluated index of drought that could be used to alert county and State officials to the development of conditions that might result in water shortage for municipal and industrial users. A survey of various drought identification techniques using data from Delaware for the past twenty or more years not only revealed a number of their shortcomings but also suggested two techniques that had the desired qualities of simple, reliable and easily evaluated. One, the newly formulated Phillips drought index, is based on exceedance probabilities of monthly precipitation but it can also shift to utilize daily data when the need arises in order to present drought information on a real-time basis. The other, the NOAA cumulative precipitation program, uses weekly precipitation data summed as running eight-week totals and their deviations from normal. An evaluation of both techniques revealed the need to incorporate data from a number of stations in each county because of the great local variations in precipitation that exist even within fairly homogeneous areas as well as the need to base normals or probabilities on fairly long periods of record because of the influence of just a few years of very dry or very wet conditions on the normals.
W86-02545

MATHEMATICAL MODELS FOR UNGAGED WATERSHEDS WITH POTENTIAL FOR QUANTIFYING THE EFFECT OF LAND USE CHANGES ON STREAMFLOW,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219012/AS, Price codes: A08 in paper copy, A01 in microfiche. Technical Completion Report, Louisiana Water Resources Research Institute, Baton Rouge, October 1984, 143 p, 35 fig, 11 tab, 183 ref. USGS G845-03.

Descriptors: *Louisiana, *Rainfall-runoff relationships, *Mathematical models, Response time characteristics, Hydrograph characteristics, Direct runoff, Effective rainfall, Unit hydrograph, Ungaged watersheds, Streamflow.

There has been a growing need in the United States to Quantify the impact on watershed hydrology of such land use changes as urbanization, forest clearing, surface mining, construction and agricultural practices. This is required to satisfy federal legislation and anticipate the potential impacts so that ecological and environmental detriment can be minimized. This study was undertaken to evaluate existing mathematical models for simulation of streamflow from watersheds with insufficient hydrologic data. Response time and hydrograph characteristics were included in evaluation. On recognizing limitations of these models and taking advantage of experience with their use, a mathematical model based on drainage network characteristics was developed. Because it contains parameters which can be determined from physically measurable watershed characteristics, the model is eminently suitable for ungaged basins. Its parameters are affected by land use changes. Therefore, the effect of these changes can be quantified. Paucity of data did not allow this quantification on natural watersheds.
W86-02548

MIGRATION OF HEAVY ELEMENTS IN GROUNDWATER FOLLOWING URANIUM SOLUTION MINING OPERATIONS,
Wyoming Univ., Laramie. Coll. of Engineering.
M. J. Humenick, R. J. Charbeneau, and B. Hassler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-226314/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Wyoming Water Research Center, Laramie, September 1984. 74 p, 17 fig, 2 tab, 1 app, 1 ref. USGS G878-05.

Descriptors: *Wyoming, *Simulation models, *Path of pollutants, *Uranium, Mine wastes, Groundwater, *Groundwater pollution, *Uranium mining, *Mathematical models.

Simulation models and example output are presented for the analysis of heavy element migration in ground water from in-situ uranium solution mining sites under conditions of ground water flow. The models are one dimensional and include the effects of advection, dispersion, mass transfer, and equilibrium for selected heavy elements. Previous laboratory data for uranium, molybdenum, vanadium, selenium and arsenic were used to obtain necessary mechanistic relationships used in the models. Hydrologic characteristics and status of solution mining sites in Wyoming are presented.
W86-02578

EVALUATION OF THE NWS SOIL MOISTURE ACCOUNTING MODEL FOR AUTOMATED FLASH FLOOD FORECASTING IN SMALL ARID AND SEMI-ARID WATERSHEDS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. Sorooshian.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229722/AS, Price codes: A03 in paper copy, A01 in microfiche. Research Project Technical Completion Report, Arizona Water Resources Research Center, Tucson, Sept 1984. 37 p, 5 fig, 1 tab, 28 ref, 2 append. USGS G828-08.

Descriptors: *Flood forecasting, Flash floods, Arid zone hydrology, Computer models, *Arizona, Rainfall-runoff relationships, Infiltration.

An analysis of the NWS model and the hydrological characteristics of small arid watersheds indicated that modifications to the model would be necessary for arid zone applications. One modification, based on the absence or insignificance of base-flow in the typical small, arid watershed, involves removal of the lower zone reservoirs and replacement of the complex percolation function by a proportional loss rate. In light of the extreme rainfall intensities and rapid runoff rates associated with desert floods, the infiltration representation was revised so that overland flow may begin before the upper zone is saturated and so that maximum infiltration capacity is a parameter. Other modifications include the use of watershed subcells and routing which simulates percolation of flows into the channel bed. The amount of data required for model calibration can be reduced by the use of the modified model in conjunction with recommended calibration procedures.
W86-02601

EFFECT OF STOCKPONDS ON DOWNSTREAM SURFACE WATER YIELDS,
Arizona Univ., Tucson. School of Renewable Natural Resources.
J. L. Thames.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233005/AS, Price codes: A05 in paper copy, A01 in microfiche. Research Project Technical Completion Report, Arizona Water Resources Research Center, Tucson, Sept 1984. 69 p, 18 fig, 7 tab, ref, append. USGS G828-09.

Descriptors: Water yield, *Stock ponds, Stochastic models, Watershed models, *Rainfall-runoff relationships, Livestock, Small watersheds, Arizona, Model studies.

A computer simulation model is presented for evaluating the performance of small water impoundments. This model originally developed by Charles Almestad (unpublished M.S. Thesis, U. of Arizona, 1983) was modified in this project for use in the desert scrub vegetation type of southeastern Arizona. A stochastic model of precipitation was used to generate a synthetic time stream of precipitation, and the SCS runoff formula was used to convert rainfall to runoff. An autoregressive maximum daily temperature model was used to estimate evaporation. These three model components were linked in the final computer program, PONDY. This program was used to synthesize the hydrologic behavior of stock ponds using a range of pond geometries, pond sizes, watershed sizes and seepage rates. Output of the program consists of statistics on annual water retention, annual spillage, and the number of days of a pond is dry on an annual and monthly basis. All statistics are based on 200-year. simulation runs for each pond-watershed-seepage condition.
W86-02645

POTENTIAL SEEPAGE LOSSES IN AN ALLUVIAL CHANNEL--RIO GRANDE BASIN BETWEEN COCHITI DAM AND ELEPHANT BUTTE RESERVOIR, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
R. L. Gold.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4268, 1985. 22 p, 13 fig, 5 tab, 10 ref.

Descriptors: *Seepage, *Model studies, *Surface-groundwater relationships, Aquifer, Alluvial channels, Groundwater recharge, Streamflow, *New Mexico, *Rio Grande Basin, Cochiti Dam, Elephant Butte Reservoir.

A two-dimensional, digital, cross-sectional model was used to simulate seepage of water from an alluvial channel, which had the general characteristic of the Rio Grande channel, into the underlying alluvium within the reach from Cochiti Dam to Elephant Butte Reservoir. Seepage rates were determined for losing and gaining reaches, and reaches affected by pumping of ground water. The seepage rates were computed for stream surcharges (height of additional water applied on top of base flow) ranging from 0.5 foot to 3 feet and for application periods ranging from 1 to 100 days. The net seepage rates, which were nearly identical for each type of reach, ranged from 0.0 cubic foot per second per mile of channel length for a 0.5 foot surcharge applied for 1 day to 0.37 cubic foot per second per mile of channel length for a 3 feet

surcharge applied for 100 days, followed by a 180 day seepage return flow from the aquifer. (USGS)
W86-02779

ANALYSIS OF URBAN RUNOFF DATA AND EFFECTS ON THE SOUTH PLATTE RIVER, DENVER METROPOLITAN AREA, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02813

ANALYSIS OF WATER-LEVEL FLUCTUATIONS OF THE U.S. HIGHWAY 90 RETENTION POND, MADISON, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Bridges.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4057, 1985. 19 p, 8 fig, 5 tab, 6 ref.

Descriptors: *Water level fluctuations, *Simulation analysis, Storm water, Retention basin, Florida, Madison.

A closed basin stormwater retention pond, located 1 mile west of Madison, Florida, has a maximum storage capacity of 134.1 acre-feet at the overtopping altitude of 100.2 feet. The maximum observed altitude (July 1982 to March 1984) was 99.52 feet (126.7 acre-feet) on March 28, 1984. This report provides a technique for simulating net monthly change-in-altitude in response to rainfall and evaporation. A regression equation was developed which relates net monthly change in altitude (dependent variable) to rainfall and evaporation (independent variables). Rainfall frequency curves were developed using a log-Pearson Type III distribution of the annual, January through April, June through August, and July monthly rainfall totals for the years 1908-72, 1974, 1976-82. The altitude of the retention pond increased almost 7 feet during the 4-month period January through April 1983. The rainfall total was 35.1 inches, and the recurrence interval exceeded the 100-year January-April rainfall. (USGS)
W86-02881

2B. Precipitation

CHARACTERIZATION OF ALUMINUM CHEMISTRY FOR ACID PRECIPITATION,

Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
D. R. Hemenway, and B. Fitzgerald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214542/AS, Price codes: A03 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Burlington, December, 1984. 21 p, 7 fig, 2 tab, 23 ref. USGS G873-05.

Descriptors: Acid precipitation, *Aluminum, *Precipitation chemistry, Speciation, Acidic deposition, *Acid rain.

Aluminum has come under increasing scrutiny as a toxic element either being released by acid precipitation interaction with soils or by being transported in the primary precipitation event. The study describes several analytical techniques for quantitatively evaluating the form of aluminum. A unique method of using molecular weight (mw) cut-off filtration and the 8-hydroxy quinulate extraction technique to assess monomeric aluminum speciation has been developed. A cut-off mw filter of 50,000 was found to be effective in separating monomeric aluminum from other aged forms of polymeric species found in precipitation.
W86-02458

MIGRATION OF HEAVY ELEMENTS IN GROUNDWATER FOLLOWING URANIUM SOLUTION MINING OPERATIONS,

Wyoming Univ., Laramie. Coll. of Engineering.
For primary bibliographic entry see Field 2A.
W86-02578

STATISTICAL ANALYSES OF SPATIAL AND TEMPORAL STORM RAINFALL CHARACTERISTICS IN PUERTO RICO,

Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
I. Pagan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-247955/AS, Price codes: A12 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute, Technical Completion Report, Mayaguez, 1984. 253 p, 33 fig, 30 tab, 24 ref. USGS G866-03. 14-08-0001-G-866.

Descriptors: *Rainstorms, *Statistical analysis, *Frequency distribution, Rainfall distribution, Rainfall intensity, *Puerto Rico.

Hourly rainfall data from ten representative rainfall stations in Puerto Rico were analyzed to determine storm rainfall characteristics. Spatial and temporal variabilities of storm rainfall were presented. Storm events were identified objectively. Storm durations for various events were estimated. Mean storm rainfall intensities were found for all historical storms with mean intensities higher than 0.20 in/hr. Non-dimensional storm rainfall distributions were found for all the stations. The distributions were stratified by storm duration and storm class where a class is defined as the portion of the storm with heavier rainfall. Frequency analyses were done on storm durations, and storm rainfall intensities. Relevant tendencies were analyzed. Daily rainfall distributions at various stations were found. Three predominant tendencies were found, namely, skewed uni-modal, bi-modal, and multi-modal distributions. Frequencies analysis of order statistics was done on storm data and hourly data independent of storm events. Relevant discrepancies are between both analysis. Results suggest that the intensity-duration-frequency design criteria recommended by National Weather Service (Technical Paper No. 42) need to be updated.
W86-02675

2C. Snow, Ice, and Frost

SNOWMELT INFILTRATION INTO FROZEN GROUND,

Alaska Univ., Fairbanks. Inst. of Water Resources.
D. L. Kane.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214740/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report I84-17, March, 1985. 14 p, 2 fig, 4 tabs. USGS G827-05.

Descriptors: *Snowmelt, *Seasonal frost, *Runoff, *Infiltration, *Alaska, Groundwater recharge, Frozen soil, Frozen ground.

Recent research has shown that the rate of runoff from snowmelt can be related in part to the condition of the underlying frozen soil. Quantification of this generalization cannot be made until both processes that result in soil-water redistribution and infiltration into seasonally frozen soils are understood. This project sought to collect field data on the process of snowmelt runoff generation with the hope that, in the next phase of research, we can modify existing models to improve runoff predictions for snowmelt events. Runoff from four bounded plots was collected. The volume of runoff was compared with results obtained from previous years of data collection for varying soil-moisture conditions. Surveys to quantify the snowpack and meteorological data were also collected. For the runoff plots, the percentage of runoff to the maximum snowpack content varied from 15% to 25%. This compares to results from other years that varied from 0% to 56%. High runoff ratios are generally associated with high soil moisture contents and low runoff ratios with low soil moisture contents. A strong correlation appears to exist between the antecedent precipitation prior to freeze-up and the seasonal volume of snowmelt runoff. This relationship could be useful for improving model prediction capability.
W86-02477

2D. Evaporation and Transpiration

BASIN-SCALE EVAPOTRANSPIRATION DETERMINATION THROUGH WATERSHED AND CLIMATE ANALYSIS,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
L. A. Harper, W. M. Snyder, and D. W. Kolber.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-222174, Price codes: A04 in paper copy, A01 in microfiche. Report ERC 01-83, Environmental Resources Center, Georgia Inst. of Technology, Atlanta, April 1983, 48 p, 12 fig, 7 tab, 11 ref. A-103-GA.

Descriptors: *Hydrologic models, *Evapotranspiration, *Rainfall-runoff relationships, *Deep seepage, *Water loss, *Basins, *Storage capacity, Models, Climatology, Model studies, Seepage, Runoff, Rainfall, Precipitation, Evaporation, Storm runoff, Storm seepage, Climatic data.

A model was developed to express evapotranspiration as a function of recovery of basin storage capacity between storms. Non-linear least squares were used to simultaneously evaluate five parameters structured to estimate evapotranspiration as a function of pan evaporation and three parameters expressing deep seepage. This new model could not be satisfactorily optimized probably due to difficulty in calculating storm event runoff and precipitation at the basin scale. A water yield model used for comparison utilizes monthly rainfall and runoff data providing more stability in parameter estimation. However, since water yield models must inherently contain some expression of evapotranspiration losses in that structures, an attempt was made to re-interpret results of the successful optimizations. A summation of delayed runoff for six months following the month of rainfall input (potential runoff) was used to calculate what was not runoff. These values were plotted for three of the four basins that had continuous flow to identify two loss components, evapotranspiration and deep seepage. These two loss components could be used in water resource planning if additional research is conducted to make them applicable to other basins.
W86-02420

FIELD MEASUREMENT OF EVAPORATION AND TRANSPIRATION FOR IRRIGATED CORN, SORGHUM AND SOYBEANS,

Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
D. L. Martin, and N. L. Klocke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227296/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, September 1984. 41 p, 10 fig, 2 tab, 8 ref. USGS G854-08. 14-08-0001-G854.

Descriptors: *Evaporation, *Transpiration, *Evapotranspiration, Lysimeters, *Nebraska, Corn, Sorghum, Soybeans.

Field and laboratory experiments were conducted to develop and evaluate techniques of separately measuring evaporation and transpiration of corn, sorghum and soybeans. Large, hydraulically weighing, lysimeters were used to measure evapotranspiration in the usual manner. Another set of lysimeters were equipped with vinyl covers to prevent evaporation but to allow crop growth and transpiration. Evaporation from bare soil and beneath the crop canopy was also measured using the hydraulic lysimeters and small (15 cm diameter x 20 cm deep) mini-lysimeters. Results showed that the thermal regime of the soil in the mini-lysimeters was comparable to that in the surrounding field area, but that special management of the mini-lysimeters is needed to maintain a representative soil moisture condition. The evaporation rate appears to be significantly affected by the moisture content of the mini-lysimeter. With proper management the mini-lysimeters are more representa-

tive than the hydraulic lysimeters for evaporation measurement since the moisture content can be controlled with the mini-lysimeters. The transpiration from corn was successfully measured; however, more analysis is needed to refine transpiration data available at this time.
W86-02594

WATER RELATIONS OF HIGH-ELEVATION SALIX PHREATOPHYTES IN WYOMING,

Wyoming Univ., Laramie. Coll. of Arts and Sciences.
D. R. Young, I. C. Burke, and D. H. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229755, Price codes: A02 in paper copy, A01 in microfiche. Technical Completion Report. Wyoming Water Research Center, Laramie, September 1984. 23 p, 3 tab, 3 fig, 22 ref. USGS G879-06.

Descriptors: *Wyoming, *Phreatophytes, *Willow, *Forest hydrology, *Transpiration, Soil-water-plant relationships.

High-elevation phreatophytes were studied to identify environmental parameters influencing daily and seasonal water consumption. The water relations of Salix planifolia, S. wolfii, and Betula occidentalis at 2865 m were similar throughout the day. Transpiration was reduced before 1,000 h as a result of dew on the leaves, but high stomatal conductances to water vapor diffusion and transpiration flux densities occurred from 1,000 to 1,6000 h, resulting in a daily water loss per unit leaf area of 4.5, 5.2, and 4.0 Kg m-2, respectively. The period of significant water consumption was from 10 July through 20 September. For comparison, a site at lower elevation (2,255 m) was examined. Diurnal variations of S. exigua and S. amygdaloides at this site were similar to the high-elevation site, but maximum stomatal conductances were only 51 percent of the high-elevation Salix species. However, transpiration occurred from sunrise to sunset at lower elevations, resulting in a daily water loss of 3.7 and 3.4 Kg m-2 of leaf area, respectively. A midday depression in leaf conductance at the lower site may have been in response to xylem pressure potentials below-1.7 MPa. The growth season at the low-elevation site was estimated to be from 15 June to 30 September. Although differences between the two sites occurred, the data suggest that for both sites and all species examined, stomatal conductance and seasonal water use were most influenced by solar irradiance, dew on leaves, minimum air temperatures in spring and fall, and phenology.
W86-02604

ANALYSIS OF WATER-LEVEL FLUCTUATIONS OF THE U.S. HIGHWAY 90 RETENTION POND, MADISON, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02881

2E. Streamflow and Runoff

ASSESSMENT OF CHANGES IN STORM AND SEASONAL RUNOFF RESPONSE OF WATERSHEDS IMPACTED BY MT. ST. HELENS ASH DEPOSITION,

Washington Univ., Seattle. Dept. of Civil Engineering.
B. Datta, D. P. Lettenmaier, and S. J. Burges.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-204014/AS, Price codes: A06 in paper copy, A01 in microfiche. Technical Completion Report No. 82, August 1983. 105 p, 36 fig, 15 tab, 13 ref. Bu Rec C-00234 (1429)(1). 14-34-0001-1429.

Descriptors: *Washington, *Mt. St. Helens, *Runoff forecasting, Volcanoes, Runoff, Catchment areas, Watersheds, Model studies, Orographic precipitation, Snowmelt, Storm runoff.

The most significant effects of the ash deposition following the major Mt. St. Helens eruptions during May to July 1980 were twofold. The immediate consequence of the ashfall was either to increase or decrease the runoff from snow-covered areas, depending upon the thickness of the ash cover. The second consequence of the ashfall was to change the hydrologic response of ash covered catchments to a given amount of precipitation. To study the changes in the hydrologic response of a catchment, it was necessary to model both the snowmelt process to determine effective precipitation and the transformation of effective precipitation to runoff. Difficulties in calibrating existing snowmelt models due to large variations in topography and precititation patterns led to rejection of classical approaches. As an alternative, it was decided to modify the Constrained Linear System (CLS) model in such a way that the physical characteristics of the catchments could be explicitly incorporated. The modified CLS model was calibrated for the period October 1972 to September 1976 for the Toutle River on a daily time scale. The model was run in prediction mode for the period June 1980 to September 1982. An analysis of the prediction errors show that the overall post-eruption hydrologic response of the catchment remained practically the same for the months from October to March. For other months, particularly June to September, the post-eruption runoff for given precipitation was less than under pre-eruption conditions. These results may be attributable to a post-eruption increase in ponding or depression storage capacity due to debris and blast deposits in the catchment.
W86-02434

FLOW PROPERTIES OF THE MT. ST. HELENS MUDFLOW MATERIAL,

Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2J.
W86-02453

MEASUREMENT OF LOW FLOW VELOCITIES FOR SHALLOW BODIES OF WATER,

Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 7B.
W86-02459

INSTREAM FLOW NEEDS IN CRITICAL AREAS OF THE GREAT LAKES REGION,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
N. R. Kevern, C. Gowan, R. Wallace, and J. T. Pawloski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214641/AS, Price codes: A08 in paper copy, A01 in microfiche. Project Completion Report, Michigan Institute of Water Research, East Lansing (1984). 105 p, 22 fig, 6 tab, 15 ref. USGS G849-04.

Descriptors: *Michigan, *Water demand, Model studies, *Stream fisheries, *Instream water use, *Streamflow forecasting, *Instream flow, Habitat, Brown trout, Irrigation demand.

The Instream Flow Incremental Methodology (IFIM) was utilized for the first time in a Michigan stream. The objective was to test the method's applicability to the midwest, and to detail the impacts of irrigation withdrawals on a typical Lower Michigan marginal trout stream. The IFIM was found to be able to accurately simulate the hydraulic characteristics of a midwestern stream, and to be able to predict brown trout Salmo trutta habitat locations within the stream. Brown trout habitat losses were most critical in the month of July, with reductions of up to 19 percent. A greater percentage of the remaining fish experienced negative growth rates as reduced habitat availability. Benthic macroinvertebrate habitat was less impacted by irrigation withdrawals. Habitat losses for Hydropsyche sp. and Ephemerella sp. reached a maximum of 11.05 and 6.35 percent respectively during irrigation periods in July of 1983. This study describes a method for assessing the impacts of withdrawing water from the stream channel for crop irrigation. Monthly irrigation demands are estimated and added to measured streamflow to determine the natural streamflow. Natural streamflow is correlated with flow on a nearby watershed to develop an extensive series of monthly flows. Reduced flows under several levels of irrigation usage were determined. The procedure produces probability distributions for average monthly flow for each month of the growing season, for each irrigation level of usage. These results may be combined with habitat flow relationships developed with the incremental Flow Methodology to determine habitat reduction which would result from water withdrawals.
W86-02468

PHYSICAL MODEL STUDIES TO VERIFY A NUMERICAL MODEL OF FLOOD ROUTING,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
N. Kabir, and J. F. Orsborn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214831, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report, Washington Water Resources Research Institute, Pullman, August, 1984. 116 p, 63 fig, 3 tab, 31 ref. USGS G876-06.

Descriptors: *Flood routing, *Flood forecasting, Flood flow, Flood hydrographs, *Computer models, Finite difference model, Mathematical studies, Channel flow, Unsteady flow, Simulation, *Washington.

A numerical model has been developed to simulate flood flows in a natural channel. The mathematical model utilizes a modified form of the complete equations of continuity and momentum for the unsteady open channel flow to include the off-channel storage area with no significant longitudinal flow. A four-point implicit finite difference scheme was used for solving the non-linear governing equations numerically in the dimensionless form. Model performance was evaluated by comparing numerical solutions with the data collected from laboratory experiments. The agreement between the simulated solutions and the experimental data was satisfactory. For a given flood, dimensionless peak flowrate and depth, and their time of arrival at any location along a reach are determined by the controlling parameters related to the channel geometry and flood hydrograph. A series of solution graphs were prepared from numerical experiments performed to investigate the effects of the controlling parameters on the propagation of a flood wave in the downstream direction along the length of a channel. These solution graphs can be used for flood forecasting.
W86-02486

CONTINUOUS SYNTHESIS OF RUNOFF FROM THE KAWISHIWI RIVER IN NORTHEASTERN MINNESOTA,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
J. W. Toso, and C. E. Bowers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215150/AS, Price codes: A08 in paper copy, A01 in microfiche. Technical Completion Report, Minnesota Water Resources Research Center, Minneapolis, 1983. 147 p, 18 tab, 60 fig. B-161-MINN(1). 14-34-0001-1237.

Descriptors: *Mathematical model, *Hydrologic model, *Floods, *Minnesota, SSARR, Simulation models, Flood forecasting, Rainfall-runoff relationships, *Water quality forecasting.

A mathematical simulation model (SSARR) will compute flows at selected points in the system for use with water quality data. Initial input to the SSARR consists of data concerning (1) watershed areas, (2) storage-outflow for lake/reservoirs, (3) monthly evapotranspiration, (4) routing data, and (5) selected coefficients. Using past observed flows, curves are fitted for (1) Soil Moisture Index versus Percent Runoff, (2) Baseflow Infiltration versus Baseflow Percent, and (3) Moisture Input Rate as a function of the Surface Runoff Component, and (4) Melt Rate per Degree-Day. Following the fitting process, temperature and precipita-

tion data are input for the desired period, plus an initial Soil Moisture Index. The model then computes the flow and lake levels at sixteen locations on a continuous synthesis basis. Runs with up to eighteen monthly in length have been made in this study. The SSARR has two basic modes of operation, (1) the split basin and (2) the snow band option. The model was fitted with the first option in an earlier study. The second option was used in the current study. Good results were obtained with the second or snow band option. This is the option recommended for future use in the Kawishiwi Basin. The SSARR is an excellent continuous synthesis model. It has performed very well in both the agricultural and forested regions of Minnesota. The input data format could be improved and additional control options at the dams may be desirable.
W86-02518

MATHEMATICAL MODELS FOR UNGAGED WATERSHEDS WITH POTENTIAL FOR QUANTIFYING THE EFFECT OF LAND USE CHANGES ON STREAMFLOW,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-02548

ENHANCEMENT OF DURATION CURVE PREDICTION USING SHORT TIME LOW FLOW MEASUREMENTS,

Idaho Univ., Moscow. Coll. of Engineering.
L. F. Heitz, and J. R. Filler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249118/AS, Price codes: A06 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, May, 1984, 102 p, 18 fig, 15 tab, 47 ref. USGS G839-08. 14-08-0001-G839.

Descriptors: *Idaho, Statistical methods, *Streamflow forecasting, Stream discharge, Flow duration, *Low flow.

An analysis is presented of the year-to-year and day-to-day variation of low-flow stream discharge used in small-scale hydroelectric power projects. Primary use was made of flow duration procedures. Past streamflow gaging records were used to evaluate the variation over time as well as the variation of simultaneous measurements at different sites. Methodologies were developed for determing the low flow percentage exceedance values at an ungaged site using a single streamflow measurement coupled with knowing the exceedance percentages of gaged streamflow sites in the area. A major contribution of this methodology is a means of estimating the confidence bounds of the estimates made. The report also includes a number of field measurements of unregulated streams in northern Idaho for which interest in hydropower development has been shown or where streams were thought to be indicators of smaller basin behavior.
W86-02690

LOW FLOW HYDRAULICS IN ALLUVIAL CHANNELS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-02698

DIFFUSION AND ADVECTION IN TWO-DIMENSIONAL ROTATING FLOW,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
V. Alavian, and S. M. Broeren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249670/AS, Price codes: A03 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, Research Report No 191, October 1984. 28 p, 6 fig, 24 ref. USGS G840-02. 14-08-0001-G840.

Descriptors: *Mass transport, *Mixing, Flow pattern, Circulating flow, Shear flow, *Dispersion, *Diffusion, *Finite element analysis, Fluid mechanics.

This paper presents the results of an investigation of mass transport by diffusion and advection in two-dimensional steady, spatially varied confined flow. In practice, this type of flow occurs in recirculating regions of streams and rivers or behind hydraulic structures. A simple vorticity transport model is used to simulate shear-induced flow in a square region confined on three sides and open to a uniform flow on one side. The differential equation governing diffusion and advection of a known quantity of tracer mass introduced in such flow is solved. The solution scheme is based on Galerkin finite element approximation of the transport equation. Diffusion is represented by a second-order tensor, the components of which are related to the eddy diffusion coefficient, as well as the magnitude and direction of the mean local velocity. The unsteady transport term is approximated by implicit finite differencing in time. Simulation results are given for one and two-dimensional test cases and for shear induced rotating flow.
W86-02699

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1983, VOLUME 4, NORTHERN CALIFORNIA VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,

Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman, J. R. Mullen, W. F. Shelton, R. G. Simpson, and D. A. Grillo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-225127, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report CA-83-4, 1985. 361 p, 12 fig. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for California consists of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 4 contains discharge records for 153 gaging stations; stage and contents for 25 lakes and reservoirs; precipitation data for 2 stations; water quality for 7 stations; and water levels for 147 observation wells. Also included is one low-flow partial-record station. Additional water data are collected at various sites, not part of the systematic data-collection program, and are published as special investigations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating state and Federal agencies in California. (USGS)
W86-02771

WATER RESOURCES DATA FOR CALIFORNIA, 1983, VOLUME 3, SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,

Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman, T. C. Hunter, J. R. Mullen, R. G. Simpson, and D. A. Grillo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-223726, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report CA-83-3, 1985. 393 p, 12 fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and quality of water in wells. Volume 3 contains discharge records for 159 gaging stations; stage and contents for 41 lakes and reservoirs; gage height records for two lakes; water quality for 6 streams and 46 wells; and water levels for 99 observation wells. Also included are 11 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W86-02772

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN IOWA,

Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02773

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NORTHEASTERN CALIFORNIA.

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02774

MEASUREMENT OF DISCHARGE USING TRACERS,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-02776

POTENTIAL SEEPAGE LOSSES IN AN ALLUVIAL CHANNEL--RIO GRANDE BASIN BETWEEN COCHITI DAM AND ELEPHANT BUTTE RESERVOIR, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02779

TECHNIQUES FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS ON STREAMS IN INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
D. R. Glatfelter.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water Resources-Investigations Report 84-4134, 1984. 110 p, 10 fig, 10 tab, 16 ref.

Descriptors: *Flood frequency, *Flood peak, *Rainfall-runoff relationships, *Regional analysis, *Regression analysis, Flood recurrence interval, Frequency analysis, *Indiana, Model studies, Regulated flow, Small watersheds, Statistical analysis, Stream discharge, Basin characteristics, Synthesis of discharge, *Wabash river.

Equations for estimating the magnitude and frequency of floods on ungaged streams in Indiana were developed by multiple-regression analysis of basin characteristics and peak-flow statistical data from 242 gaged sites in Indiana, Ohio, and Illinois. The state of Indiana was divided into seven areas on the basis of regression analysis. A set of equations for estimating peak discharges with recurrence intervals of 2, 10, 25, 50, and 100 years was developed for each area. The equations are valid for unregulated and nonurban streams. Significant basin characteristics in the equations are drainage area, channel length, channel slope, mean annual precipitation, intensity of precipitation, storage, and a runoff coefficient. Standard errors of estimate for the equations range from 24 to 45 percent. A rainfall-runoff model was used to extend the length of record at 11 gaged sites on small streams. Flood-frequency data from the synthetic peaks and from the observed peaks were combined by weighting techniques. (USGS)
W86-02780

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAM IN ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02782

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE KISHWAUKEE RIVER BASIN, ILLINOIS,

Geological Survey, De Kalb, IL. Water Resources Div.
H. E. Allen, and E. A. Cowan.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4311, 1985. 35 p, 9 fig, 7 tab, 16 ref.

Descriptors: *Flow characteristics, *Low flow, *Base flow, Streamflow, Forecasting, Wastewater discharge, Channel storage, Groundwater storage, Statistical analysis, Regression analysis, Frequency distribution, *Illinois, *Kishwaukee River basin, Streamflow-recession index.

Seven-day, 2-year, and 7-day, 10-year natural low flows are estimated at five continuous-record gaging stations based on streamflow records and records of wastewater effluent furnished by treatment plants. Low flows are also estimated at 22 partial-record stations by relating natural low-flow estimates for long-term stations to discharge measurements at partial-record stations. Standard error of estimates for the 27 gaged sites averaged 33 percent for 2-year estimates and 51 percent for 10-year estimates. A technique for estimating flows at ungaged stream sites is based on drainage area and indexes of streamflow recession. Streamflow-recession indexes were used to account for effects of geology on low flows. Multiple-regression analyses relates the low flows to drainage area and streamflow recession rates. Average standard errors of estimates of 61 and 97 percent were indicated for the 2-year and 10-year estimating equations, respectively. Wastewater treatment plant location and effluent discharged during 7-day low-flow periods in 1981 are presented for use in adjusting natural low-flow estimates at gaged and ungaged sites to represent 1981 streamflow conditions. (USGS)
W86-02787

RUNOFF AND CHEMICAL LOADING IN SMALL WATERSHEDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
M. A. Ayers, R. G. Brown, and G. L. Oberts.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4122, 1985. 35 p, 1 fig, 6 tab, 15 ref.

Descriptors: *Runoff, Water quality, *Urban hydrology, *Urban runoff, *Water pollution sources, Storm runoff, *Twin Cities Metropolitan Area, *Minnesota.

Flow, rainfall, and water-quality data were collected during 1980 for 15 to 30 rainfall and snowmelt events on 6 rural and 11 urban watersheds in the Twin Cities Metropolitan Area. Event or daily flow and load models (for seven constituents) were developed and used with runoff and rainfall data for 1963-80 to compute 2-year frequency annual and seasonal flows and loads for each watershed. In models of storm-sewered watersheds, total storm rainfall proved to be the most significant factor controlling runoff and loads. Depending on the watershed type, antecedent soil-moisture indices and rainfall intensity also were important factors in estimating runoff. Annual runoff from storm-sewered watersheds averaged about 27 percent of annual precipitation, ranging from 13 to 57 percent. Runoff in urban main-stem streams ranged from 13 to 20 percent and was related to the percent of urbanization in the watershed. Annual runoff in rural watersheds ranged from 6 to 20 percent of annual precipitation. Runoff responses were highest in the snowmelt season for all watersheds and declined through the rest of the year. Rural watersheds showed a considerable decrease in runoff response during late summer and fall. Urban-watershed response from season to season was more consistent than rural watersheds because of the impervious area and storm sewers in urban watersheds. (USGS)
W86-02794

STREAMFLOW AND SPECIFIC-CONDUCTANCE DATA FOR SELECTED SITES, FEBRUARY 15 THROUGH APRIL 9, 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE,

Geological Survey, Knoxville, TN. Water Resources Div.
R. D. Evaldi.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Hydrologic-Data Report OFR 84-625, 1984. 13 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Discharge measurement, *Specific conductance, *Stream discharge, Base flow, *Tennessee, *Oak Ridge Reservation, Y-12 Plant, Bear Creek, Clinch River.

Discharge and specific conductance were measured February 15 through April 9, 1984, during base flow of streams in 18 watersheds in the vicinity of the Y-12 Plant of the Oak Ridge Reservation, Tennessee. Discharge of springs and streams measured at specific sites ranged from 0 to 16 cubic feet per second. Specific conductance ranged from 23 to 6,300 micromhos per centimeter. During the days of instantaneous discharge measurements, flow of Bear Creek at the continuous-record station at Highway 95 near Oak Ridge ranged from 3.6 to 17 cubic feet per second. (USGS)
W86-02817

METHOD FOR ESTIMATING MEAN AND LOW FLOWS OF STREAMS IN NATIONAL FORESTS IN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, and J. A. Hull.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4071, May 1985. 13 p, 1 fig, 5 tab, 5 ref.

Descriptors: Annual runoff, Regression analysis, *Estimating equations, *Mean flow, Gaging station, *Low flow, Active-channel width, Channel geometry, *Montana, National forests.

Equations were developed for estimating mean annual discharge, 80-percent exceedance discharge, and 95-percent exceedance discharge for streams on national forest lands in Montana. The equations for mean annual discharge used active-channel width, drainage area and mean annual precipitation as independent variables, with active-channel width being most significant. The equations for 80-percent exceedance discharge and 95-percent exceedance discharge used only active-channel width as an independent variable. The standard error or estimate for the best equation for estimating mean annual discharge was 27 percent. The standard errors of estimate for the equations were 67 percent for estimating 80-percent exceedance discharge and 75 percent for estimating 95-percent exceedance discharge. (USGS)
W86-02824

AVAILABILITY OF NATURAL AND REGULATED STREAMFLOWS FOR INSTREAM USES DURING HISTORICAL DROUGHTS, LOWER NEOSHO RIVER, SOUTHEASTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
R. J. Hart, and T. C. Stiles.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4292, 1984. 42 p, 11 fig, 27 tab, 8 ref.

Descriptors: Natural flow, *Regulated flow, Reservoir operations, Reservoir storage, Hydrologic models, *Routing, *Instream use, *Streamflow, Water yield, *Lower Neosho River, John Redmond Reservoir, Iola, Parsons, Strawn, *Kansas.

The effects of three historical droughts on streamflows available for instream use on the lower Neosho River at Iola and Parsons, Kansas, were investigated. Natural streamflows that occurred during the three droughts were compared to the multiple-use and water-quality streamflows recommended by State agencies. A reservoir model was used to investigate the effects of John Redmond Reservoir on the natural streamflows. The regulated streamflow produced from the reservoir model then was compared to the multiple-use and water-quality streamflows. The regulated streamflows usually satisfied the multiple-use and water-quality streamflows more often than the natural streamflows. Frequency analysis made on the natural and regulated streamflows showed that the number of days of low flow (less than 30 cubic feet per second) were reduced by the regulated streamflows, which aided in the achievement of the multiple-use and water-quality streamflows goals. The reservoir model was used to determine if sufficient storage was available in John Redmond Reservoir to modify the natural streamflows in order to satisfy the multiple-use and water-quality streamflow recommendations. Additional storage of 15,400 acre-feet was estimated to be needed to maintain the multiple-use streamflows at Parsons. (USGS)
W86-02838

SELECTED CLIMATOLOGICAL AND HYDROLOGIC DATA, RATON BASIN, HUERFANO AND LAS ANIMAS COUNTIES, COLORADO, AND COLFAX COUNTY, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
A. L. Geldon, and P. O. Abbott.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-138, 1985. 268 p, 5 fig, 44 tab, 33 ref.

Descriptors: *Climatic data, *Hydrologic data, Surface water data, Groundwater data, Data collections, Coal mining, *Colorado, Las Animas County, Huerfano county, *New Mexico, Colfax County, *Raton Basin.

The hydrology of the coal-bearing Raton Basin of Colorado and New Mexico was investigated by the U.S. Geological Survey. Data in the report were collected from 1977 to 1982, mainly in the watersheds of the Apishapa and Purgatoire Rivers; data from the Cucharas, Canadian, and Vermejo River watersheds are also included in the report. The report contains records of precipitation, temperature, relative humidity, evaporation, and wind movement at U.S. Geological Survey and U.S. Army Corps of Engineers meteorological stations; records of soil water collected by the U.S. Geological Survey; records of stream discharge and quality at U.S. Geological Survey gaging stations and miscellaneous sites; and a variety of ground-water data. The ground-water data includes records of 231 wells, springs, and mines, including 87 chemical analyses of the water, recorded water levels in 29 observation wells, results of 125 aquifer tests, and 87 logs of wells and test holes. (USGS)
W86-02839

SPIRIT LAKE DAM-FAILURE FLOOD ROUTING ASSESSMENT,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02846

VELOCITY PROFILE, WATER-SURFACE SLOPE, AND BED-MATERIAL SIZE FOR SELECTED STREAMS IN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
J. P. Marchand, R. D. Jarrett, and L. L. Jones.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-733, 1984. 82 p, 18 fig, 4 tab, 21 ref.

Descriptors: *Current meters, *Velocity distribution, *Velocity curve, Streamflow, High-gradient streams, Mountain streams, Hydraulics, Flow measurement, Hydrologic data collections, Particle size, *Colorado.

Existing methods for determining the mean velocity in a vertical sampling section do not address the conditions present in high-gradient, shallow-depth streams common to mountainous regions such as Colorado. The report presents velocity-profile data that were collected for 11 streamflow-gaging stations in Colorado using both a standard Price type AA current meter and a prototype Price Model PAA current meter. Computational results are compiled that will enable mean velocities calculated from measurements by the two current meters to be compared with each other and with existing methods for determining mean velocity. Water-surface slope, bed-material size, and flow-characteristic data for the 11 sites studied also are presented. (USGS)
W86-02852

SYNTHESIZED FLOOD FREQUENCY OF URBAN STREAMS IN ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02856

MAGNITUDE AND FREQUENCY OF FLOODS IN ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
D. A. Olin.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4191, 1984. 105 p, 24 fig, 9 tab, 16 ref.

Descriptors: *Floods, *Frequency analysis, Surface water, *Regression analysis, *Flood frequency, Flood recurrence interval, Statistical methods, *Alabama.

Methods are presented to estimate flood magnitude for selected recurrence intervals for urban and rural streams with drainage areas from 1 to 22,000 square miles. Seven hydrologic areas were delineated and regression equations were developed for six areas. Hydrologic data could not be regionalized for the seventh area. Drainage area was the only independent variable used in the equations for five hydrologic areas. Drainage area and a storage factor were used in the equations for the other area. One hydrologic area, located in the central part of the State, has flood runoffs two to four times greater than the other areas. It is recommended that the rural equations be used for estimates of flood magnitudes for both urban and rural streams in the hydrologic area. Rivers with drainage areas greater than 1,500 square miles could not be regionalized. Estimating methods for these rivers are shown graphically. Maximum flood magnitudes versus drainage area also are presented. (USGS)
W86-02857

ESTIMATION OF THE FLOW AND WATER-QUALITY CHARACTERISTICS OF ALASKAN STREAMS,

Geological Survey, Fairbanks, AK. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02864

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS–FISCAL YEARS 1983 AND 1984,

Geological Survey, Lawrence, KS. Water Resources Div.
L. J. Combs.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-178, 1985. 97 p, 10 fig, 6 tab.

Descriptors: *Groundwater, Aquifers, *Streamflow, *Water quality, *Kansas, *Hydrologic data, Data collections.

The principal mission of the U.S. Geological Survey, Water Resources Division, in Kansas is to investigate the occurrence, quantity, quality, distribution, and movement of surface and ground waters throughout the State. Primary activities include the systematic collection, analysis, and interpretation of hydrologic data, evaluation of water demands, and water-resources research. Hydrologic investigations are conducted through four basic types of projects: (1) data-collection programs, (2) local or areal investigations, (3) statewide or regional investigations, and (4) research projects. These projects are funded through cooperative agreements with State and local agencies, transfer of funds from other Federal agencies, and direct Federal funds. Fifty water-related projects were ongoing during fiscal years 1983 and 1984 in Kansas. This report describes for each of these water-resources activities the problem that initiated the study, the objectives of the project, and the approach designed to achieve these objectives. Information on data-collection stations in Kansas is presented in maps and tables. A list of the 40 reports approved for publication by the U.S. Geological Survey, its cooperators, or technical and scientific organizations during 1983 and 1984 is provided. (USGS)
W86-02865

EFFECTS OF RELOCATING STATE ROUTE 151 ON THE FLOOD PROFILES OF CONOTTON CREEK AND ITS TRIBUTARIES BETWEEN BOWERSTON AND SCIO, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02872

COST-EFFECTIVENESS OF THE STREAMGAGING PROGRAM IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02885

SUMMARY OF WATER RESOURCES DEVELOPMENT AND HYDROLOGIC DATA OF SAIPAN, MARIANA ISLANDS,

Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4121, 1985. 578 p, 35 fig, 77 tab, 48 ref.

Descriptors: *Water-resources development, *Hydrologic data, Weather data, Pacific Islands, *Mariana Islands, *Saipan, Data collections.

Saipan is the largest island of the Northern Mariana Islands, a chain of 14 islands north of Guam. Saipan comprises one third of the land area of the islands. No long-term rainfall record is available at any location, but some rainfall records are for periods up to 16 years, some of which began in 1901. Average annual rainfall for the island is 81 inches, with the southern end receiving about 10 inches less annually than the rest of the island. The amount of rainfall which runs off in northeast Saipan ranges from 23 to 64 percent and averages about 40 percent. Runoff on the rest of the island is from springs or occurs only during heavy rainfall. Surface-water development appears impractical. Ground water is the main source of water for the island and production was almost 4 million gallons per day in 1982. However, chloride concentration in ground water exceeds 1,000 milligrams per liter in many locations. The average chloride concentration of the domestic water stays near the maximum permissible level (600 milligrams per liter). This report summarizes the history of the water-resources development and presents all available hydrologic data, including rainfall records since 1901, streamflow records since 1968, and drilling logs, pumping tests, chemical analyses, and production figures from 180 testholes and wells drilled on Saipan. (USGS)
W86-02887

SUMMARY OF STATISTICAL AND TREND ANALYSES OF SELECTED WATER-QUALITY DATA COLLECTED NEAR THE BIG THICKET NATIONAL PRESERVE, SOUTHEAST TEXAS,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02893

PRELIMINARY REPORT ON A STUDY TO ESTIMATE FLOOD VOLUMES OF SMALL RURAL STREAMS IN OHIO: METHODS, SITE SELECTION, AND DATA BASE,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02906

PENNSYLVANIA GAZETTEER OF STREAMS - PART II,

Geological Survey, Harrisburg, PA. Water Resources Div.
L. C. Shaw.
Available from OFSS, USGS Box 25425, Lakewood, CO 80225. Bulletin No. 16. 300 p, 32 fig, 2 ref.

Descriptors: *Streams, *Pennsylvania, *Hydrologic data, *Drainage area, *Drainage pattern, Channel pattern, Main channel, Stream length, Meander ratio, Relief ratio, Channel slope, Geomorphology, Water data, Data collections, *Hydrologic unit maps.

The Pennsylvania Gazetteer of Streams, Part II, contains detailed descriptions of 571 streams with drainage areas greater than 25 square miles. Natural resources, natural, artificial, and hydrologic features describe the basin. Planners, water users, and water managers will be able to better utilize the basin's physical and hydrological information to prepare an effective ecological evaluation. (USGS)
W86-02907

BASE-FLOW CHARACTERISTICS OF SEGMENTS OF THE PINEY RIVER, AND EAST AND WEST PINEY RIVERS, DICKSON AND HICKMAN COUNTIES, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
V. J. May.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-155, 1985. 19 p, 8 fig, 4 tab, 10 ref.

Descriptors: *Baseflow, *Seepage, *Drought, *Flow profiles, *Frequency analysis, Discharge measurement, *Tennessee, Piney River, Dickson County, Hickman County.

Base-flow profiles based on discharge measurements made during a seepage investigation on August 28, 1984, define losing and gaining reaches of segments of the Piney River, and East and West Piney Rivers, Dickson and Hickman Counties, central Tennessee. A similar profile defines losing and gaining reaches for the average 3-day minimum discharge, 20-year recurrence interval, and the variability of that discharge along the river channels. The average 3-day minimum discharge, 20-year recurrence interval, ranged from 2.4 cubic feet per second for the site on East Piney River to 45.6 cubic feet per second at the Vernon gage, farthest site downstream in the study area. On the Piney River, the lowest 3-day, 20-year discharge, occurs at river mile 23.5, 0.1 river mile downstream from the confluence of the East and West Piney Rivers. Comparison of discharge measurements to recorded August discharges at the Vernon gage shows that the measurements represent base-flow conditions in the Piney River basin. The measurements and analyses can be used to formulate water management plans for use during droughts. (USGS)
W86-02910

STREAMFLOW AND SEDIMENT DATA COLLECTED AT SEVEN STREAM-GAGING STATIONS IN THE JAMES RIVER BASIN DOWNSTREAM FROM FORESTBURG, SOUTH DAKOTA, FROM OCT 1, 1982 - SEP 30, 1983,

Geological Survey, Huron, SD. Water Resources Div.
J. R. Little.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-156, 1985. 60 p, 23 fig, 15 tab, 2 ref.

Descriptors: *Data collection, Hydrologic data, *Streamflow data, *Sediment data, *South Dakota, James River basin, Forestburg.

A compilation of streamflow and suspended-sediment data collected from October 1, 1982, to September 30, 1983, at seven gaging stations in the James River basin downstream from Forestburg, South Dakota, is presented in tabular and graphic form. Three of the gaging stations are on the main stem and four are on tributary streams. These are the results from the second year of a two-year study in cooperation with the Lower James Conservancy Sub-District. The data listed in the tables and figures include location, a summary of the streamflow for the period of record, tables listing the daily streamflow, mean suspended-sediment concentration, and suspended-sediment discharge; and figures showing the daily streamflow, mean suspended-sediment concentration and suspended-sediment discharge for each gaging station. Sandbars are developing in the river and this data is to be used in studies analyzing sources of the sediment and tributary sediment loads relative to those carried by the main stem. (USGS)
W86-02912

HARMONIC ANALYSES OF STREAM TEMPERATURES IN THE UPPER COLORADO RIVER BASIN,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7 .
W86-02917

2F. Groundwater

UTILIZATION OF THERMAL EMITTANCE DATA TO MONITOR SOIL MOISTURE AND SUBSURFACE GROUNDWATER,

South Dakota State Univ., Brookings. Dept. of Physics.
J. A. Tunheim, and W. W. Hein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203966/AS, Price codes: A06 in paper copy, A01 in microfiche. South Dakota Water Resources Research Institute, Brookings, Completion Report, Feb 1985, 110 p, 9 tab, 45 fig, 41 ref. Bu Rec B-068-SDAK. 14-34-0001-1263.

Descriptors: *Soil moisture, *Thermography, *Thermal prospecting, *Groundwater, Soil temperature, *Remote sensing, *South Dakota, Irrigation effects, Satellites.

Experimental and theoretical investigations were carried out relating to the detection and mapping of soil moisture and subsurface groundwater by the use of remote sensed thermal emmittance data (thermography). Calculations performed employing a previously developed finite difference model showed a quadratic relationship between temperature difference between two soil plots and their corresponding soil moisture difference. The relationship between the surface soil heat flux and calculated maximum diurnal temperature difference was found to be linear. Modifications of the model were also made to siimulate light penetration through the plant canopy. Experimental investigations consisted of measurements on both small controlled plots and over large land areas. Statistical analysis of small plot data showed a significant correlation between soil moisture differences between irrigated and nonirrigated plots and apparent surface temperature differences. Soil moisture and other measurements made throughout the state of South Dakota gave only marginal correlations with satellite thermal emmittance data. However, model calculations of apparent surface temperature differences agree well with satellite values. General results of this study indicate promise for use of satellite thermal emittance data in determining soil moisture but further study is needed.
W86-02429

GROUNDWATER QUALITY AND MINERAL DEPOSITS RELATIONSHIPS IN THE OZARK MOUNTAINS,

Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-02448

UNIFIED MASS TRANSPORT MODEL FOR HIGH AND LOW GROUNDWATER DISPERSIVITIES,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02467

FINITE ELEMENT SIMULATION OF SATURATED-UNSATURATED SUBSURFACE FLOW,

Kentucky Water Resources Research Inst., Lexington.
G. E. Blandford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214658/AS, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 155, August 1984. 71 p, 13 fig, 34 ref. USGS G-844-03.

Descriptors: Mathematical models, Model studies, Saturated flow, Unsaturated flow, Storm seepage, Finite element method, *Groundwater movement, *Infiltration, *Surface-groundwater relationships.

A two-dimensional transient model for flow through saturate-unsaturated porous media is developed. The model numerically solves the pressure head dependent or moisture content dependent form of Richard's equation. The model code uses isoparametric quadratic triangular and/or quadrilateral finite elements for the geometric representation and for the weak Galerkin spacial integrations. An implicit, unconditionally stable single-step numerical time integration scheme with an oscillatory noise reduction option is utilized for the temporal discretization. The highly efficient symmetric skyline (profile) solution scheme is used to solve the resulting simultaneous equations. The nonlinear subsurface flow parameters are approximated using cubic spline interpolation. The element material properties can be independently defined thus permitting the modelling of layered geologic formations. Derivative smoothing is presented for the post-calculation of Darcian velocities. Currently, the program is limited to time varying specification of pressure head or moisture content and fluxes. Several sample problems are presented illustrating the accuracy and validity of the developed model.
W86-02469

DISCHARGE AND TRAVEL TIME DETERMINATIONS IN THE ROYAL SPRING GROUNDWATER BASIN, KENTUCKY,

Kentucky Water Resources Research Inst., Lexington.
J. Thrailkill, and D. R. Gouzie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214765/AS, Price codes: A04 in paper copy, A01 in microfiche. Research Report No. 149, August, 1984. 49 p, 7 fig, 6 tab, 14 ref. USGS G-844-07.

Descriptors: Dyes, *Karst hydrogeology, Groundwater basins, Dye releases, Groundwater movement, Groundwater pollution, Aquifiers, Karst, Limestone, Springs, *Kentucky.

Groundwater flow in many karst regions, including the Inner Bluegrass Karst Region of central Kentucky in which the study area was located, is unlike groundwater flow in granular aquifers. At least the major flows are turbulent and often with a free surface in large conduits, and applying concepts based on Darcy's Law to describe and model these flows is inappropriate. Parameters such as linear velocity, channel geometry, and conveyance used to describe surface streamflows are more applicable, and the primary objective of the project was to estimate these in a groundwater basin using the travel time of dye slugs and discharges obtained by dye dilution. These data were also needed to determine the travel time-discharge relationship required to manage contaminent-spills and evaluate methods of enhancing low flows in the basin, the second and third objective of the project. These latter two objectives are of importance because the flow in the Royal Spring groundwater basin that was investigated is used as a municipal water supply. Preliminary results indicate that the data will permit such parameter estimation and have suggested methods of increasing the amount of water available during low-flow periods.
W86-02479

MATHEMATICAL MODELS FOR WATER RESOURCES POLICY AND MANAGEMENT WITH APPLICATION TO THE EUTAW-MCSHAN AQUIFER,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
V. L. Zitta, and R. L. Frnka.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214914/AS, Price codes: A07 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report, September 1984, 133 p, 33 fig, 23 tab, 57 ref, 2 append. USGA G-851-03.

Descriptors: *Mississippi, *Groundwater movement, *Mathematical models, *Management planning, *Simulation analysis, Groundwater management, Water management, Unconfined aquifers, Confined aquifers.

This study sets forth a set of models for the simulation of groundwater flow in confined or unconfined aquifers along with optimization methods for the purpose of facilitating the work of the water manager. In particular the procedure contains routines for simulation of hydraulic head within the aquifer, power for transport of water from well source to demand center, unit cost of transport/treatment alternatives and well field development, and optimization of the many possible source locations with the demand centers. Application of the models was made to a hypothetical scenario of well fields and demand centers within the Eutaw-McShan aquifer in Mississippi. Twenty-six possible well field locations were to serve nine demand centers. Unit costs were computed and the optimum alternatives were determined from the Out-of-Kilter algorithm. A major part of the effort was to automate the procedures to input aquifer, well location and demand centers into the groundwater and transport, cost and optimization models. The model grid, county boundaries, aquifer outcrop areas, top and bottom elevations of the aquifer along with the well/demand centers were digitized and all geometric data transferred from longitude and latitude to state plane coordinates. All major plots were produced by software written for implementation on the MSU Computing Center equipment.
W86-02494

SUITABILITY OF MARINE CLAYS AS LINERS FOR HAZARDOUS WASTE DISPOSAL SITES,

Maine Univ. at Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-02516

PARAMETER IDENTIFICATION IN LAYERED AQUIFER SYSTEMS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. Aral, and M. Zakihani.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216935/AS, Price codes: A05 in paper copy, A01 in micro-

fiche. Environmental Resources Center Report No. ERC-02-84, Georgia Institute of Technology, Atlanta, July, 1984, 73 p, 1 tab, 2 fig, 59 ref. USGS G-836(02).

Descriptors: *Groundwater movement, Model studies, *Groundwater seepage, *Finite element method, *Multilayer aquifers, Aquifer parameters, Geohydrology.

In this study, the finite element least squares optimization algorithm is utilized to identify the hydrogeologic field parameters of a multilayer aquifer system. The techniques developed rely on accurate steady-state piezometric head data for each aquifer in the multilayered system. The Least squares iterative approach developed systematically adjusts the local transmissivity values and the resistance prameters of the confining layers until a good fit is achieved between the observed and computed piezometric head values at several locations. This is an iterative approach which automates the trail and error model calibration process and extends it to a multilayer system. The technique is applied to a field problem with considerable success and the algorithm shows promise as a practical tool and a definite alternative to the manual trial and error approach.
W86-02524

STUDY OF THE MECHANICS OF GROUNDWATER AQUIFER/AQUITARD EXPANSION CAUSED BY HEATING,

Auburn Univ., AL. Dept. of Civil Engineering.
R. K. Moore, and D. R. Hampton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219061/AS, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, Alabama Water Resources Research Institute, Auburn, September 1984. 51 p, 27 ref, 12 fig, 3 tab. USGS G880-06.

Descriptors: *Thermal storage, *Alabama, *Aquifers, *Temperature effects, Subsidence, Heave, Computer modeling.

FORTRAN computer models were developed to predict the expansion and contraction of aquifers bounded by upper and lower aquitards caused by injection-storage-retrieval cycles associated with aquifer storage and recovery of thermal energy. The model is based on four volume change components: (1) reversible volume change caused by temperature change (2) irreversible volume change caused by temperature change (3) volume change caused by decrease in effective stress in an undrained geotechnical material and (4) dissipation of excess pore pressure through a consolidation process. The computer results were compared to field observations obtained from a thermal energy-aquifer storage demonstration experiment in Mobile, Alabama. The computer model over-predicts surface heave in the early portion of the injection cycle, but satisfactorily approximates the field observations during the last half of the total injection-storage-recovery cycle. The error may be associated with the simplified approach assumed to model the time-dependent consolidation/drainage process.
W86-02553

SINGLE-WELL, MULTIPLE-PULSE TRACER TECHNIQUE FOR ESTIMATING GROUND WATER VELOCITIES AND POLLUANT TRANSPORT RATES: THEORETICAL DEVELOPMENT,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W86-02560

GROUNDWATER PROBLEMS IN THE MID-ATLANTIC FALL-LINE CITIES,

District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, and J. V. O'Connor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225985/AS, Price codes: A05 in paper copy, A01 in microfiche. Report No. 62, September 1984. 70 p, 11 tab, 8 fig. USGS G834-02.

Descriptors: *Groundwater, Pollution, Urbanization, *Urban hydrology, *Dewatering, Wells, Construction, Groundwater management, Hydrogeology, Building foundations, Fall Zone, Groundwater recharge, Groundwater laws, Oil seepage, Mid-Atlantic, District of Columbia.

In recent years, researchers and managers in the northeastern United States have focused most of their efforts on groundwater problems such as contamination and overdraft. However, little attention has been given to the groundwater regime of the major cities of the Fall Zone. The Fall Zone is a dividing zone between the Piedmont province and the Atlantic Coastal Plain province in the East Coast of the United States. The Fall Zone extends from New York to Georgia. The cities that lie along the Fall Zone are referred to as Fall-Line cities (e.g., Philadelphia, Wilmington, Baltimore, Washington, and Richmond). Here are a number of problems related to groundwater underlying urban areas. These are related to the construction, tunneling, and history of land use activities. The purpose of this project is to develop an understanding of the groundwater situation of the Fall-Line cities. The project examines groundwater quantity and quality of these cities. The impact of urbanization as well as institutional problems related to groundwater are discussed. Special emphasis was placed on the study of the District of Columbia's groundwater problems as they relate to construction, tunneling, and other urban activities.
W86-02574

TECTONIC STRUCTURES RESPONSIBLE FOR ANISOTROPIC TRANSMISSIVITIES IN THE PALEOZOIC AQUIFERS--SOUTHERN BIGHORN BASIN, WYOMING,

Wyoming Univ., Laramie. Coll. of Arts and Sciences.
D. L. Blackstone, and P. W. Huntoon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227155/AS, Price codes: A05 in paper copy, A01 in microfiche. Wyoming Water Research Center, Technical Completion Report, Laramie, September 1984. 84 p, 35 fig, 3 tab, 92 ref, append. USGS G879-02.

Descriptors: *Wyoming, *Structural geology; *Groundwater movement, *Anisotropy, Groundwater, Permeability, Drilling fluids, Oil wells, Aquifer characteristics, *Pennsylvanian Tensleep, *Bighorn Basin.

A structure contour map datum on top of the Pennsylvanian Tensleep sandstone aquifer was drafted by the Wyoming Geological Survey. The map covers approximately 7,200 square miles in the southern Bighorn Basin, Wyoming including Washakie and Hot Springs Counties and parts of Fremont, Park and Bighorn Counties; scale 1:125,000. Regional cross sections are included; scale 1" = 1 mile. Specific detailed cross sections for 20 anticlinal structures are completed. All available surface geology, well data and reflection seismic lines have been utilized. The emphasis is on the disruption of the aquifer by folding and faulting (anisotropy); scale 1:24,000.
W86-02582

ANALYSIS OF INJECTION IN STRATIFIED AQUIFERS,

Florida Univ., Gainesville. Dept. of Civil Engineering.
S. J. Laux, and B. A. Benedict.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227247/AS, Price codes: A05 in paper copy, A01 in microfiche. Florida Water Resources Research Center, Gainesville, Publication No. 81, Aug. 1984. 79 p, 10 fig, 2 tab, 43 ref, append. USGS G835-02.

Descriptors: Groundwater, Modeling, Water quality, *Injection wells, *Florida, Finite element method, Saline-freshwater interfaces.

An extension of the integral method was made to model the case of injection into a two-layer system with injection into the top of the lower layer. An alternating direction implicit (ADI) finite-difference model was developed to solve the equations describing this system. The need for small time steps for model convergence and the rapid stabilization of drawdowns led to the alternative use of an analytical method (the Hantush equation for leaky aquifers) to calculate drawdowns and drastically reduce computer time. Attempts were made to fit the model to data from injection wells in Pinellas County, Florida. The basic extent of the injected water field was reproduced fairly well, except that the drawdown and injected water thickness in the immediate vicinity of the well are too small. Neglect of vertical flows in the well region may be of importance here. The complicated system here, with salt water both above and below the injected water, makes it difficult to estimate well concentrations currently. The model developed in this work produces a tool for analysis of injections of wastes which should prove useful for preliminary assessments. Work is continuing to further the development and test against other data.
W86-02589

ISOTOPIC INVESTIGATION OF GROUNDWATER RESOURCES IN THE OJO ALAMO SANDSTONE, NACIMENTO, AND SAN JOSE FORMATIONS, SAN JUAN BASIN, NEW MEXICO,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
F. M. Phillips, L. A. Peeters, and M. K. Tansey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229805/AS, Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institue, Technical Completion Report, Las Cruces, October 1984. 104 p, 17 fig, 9 tab, 88 ref, 2 append. USGS G-858-02.

Descriptors: *Groundwater resources, *New Mexico, Coal mining, Groundwater dating, Carbon radisotopes, Tritium, Deuterium, Oxygen isotopes, Paleoclimatology.

The San Juan Basin, in northwest New Mexico, has vast reserves of strippable, low sulfur coal. Development of this resources will require large quantities of water, from an area where water resources are not abundant. Since surface-water supplies are fully allocated, increased future water demands will have to be met through groundwater development. This study concentrates on the Ojo Alamo, Nacimiento, and San Jose Formations, the aquifers directly above the principal coal unit. Carbon-14 and tritium methods were used to date the ground water in these units. Initial radiocarbon activities were calculated using the models of Vogel, Tamers, Pearson, Mook and Fontes. Ages from Fontes' model, ranging from modern to 26,000 years, were used for hydraulic conductivity estimates, which varied from 3 X 10-7 m/sec to 10-5 m/sec. Tritum analyses showed that postbomb precipitation was present in samples with modern radiocarbon dates, indicating that active recharge is occurring. Stable isotope results showed a clear correlation between ground-water age and stable-isotope concentrations. Samples with Pleistocene radiocarbon ages exhibited a significant depletion in deuterium and oxygen-18. This observation lends support to the hypothesis of isotopically lighter Pleistocene precipitation. Such lighter recharge was most likely due to a colder mean annual temperature and perhaps increased winter precipation. Consideration of various factors controlloing the stable isotope composition of ground water allows estimation of a 5 to 7 C temperature decrease during the late Wisconsin, accompanied by increased effective precipitation. A similar change is obtained from nobel-gas paleothermometry.
W86-02609

HYDROGEOLOGY OF DEKE ISLAND, PINGELAP ATOLL, EASTERN CAROLINE ISLANDS,

Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
J. F. Ayers, H. L. Vacher, R. N. Clayshulte, D.

Strout, and R. Stebnisky.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232809/AS, Price codes: A17 in paper copy, A01 in microfiche. Technical Report No. 52, July, 1984. 366 p, 49 fig, 19 tab, 13 ref. USGS G837-02.

Descriptors: *Guam, *Geohydrology, *Atolls, Groundwater, Groundwater movement, Reefs, Carbonates, Carbonate rocks, Limestones, Seismology, Geophysics.

An extensive hydrogeological investigation was conducted on Deke Island located on Pingelap Atoll, Ponape State. Field work included installation of observation wells, water-level monitoring, installation of a tidal gage, core drilling, surface geological and topographical mapping, geophysical surveys, and water-quality analysis. Results indicate a number of previously unknown aspects of atoll island hydrology. The most significant is the partial confinement of the fresh-water lens system beneath the landward extension of the reef-flat plate. Where the plate is absent water-table conditions are prevalent. The plate acts as a leaky confining layer which allows some rainwater to enter the flow system by downward movement under gravity. A method of reducing observed water levels in wells to actual sea level was developed. Also, several subsurface hydrogeologic units were identified and their roles within the overall hydrology of Deke were defined. In general, the size and extent of the lens was mapped. Based on the interpretation of study results, an atoll island hydrogeologic (conceptual) model is presented. Finally, some practical implications of the study findings are discussed and recommendations for further work are made.
W86-02625

CHARACTERIZING WATER MOVEMENT IN THE WEATHERED ZONE OF GLACIAL TILLS UNDER CONTINUOUS IRRIGATION,

South Dakota State Univ., Brookings. Water Resources Research Inst.
A. R. Bender, and C. G. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232817/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, December, 1984. 26 p, 6 tab, 3 fig, 6 ref. USGS G-869-06. 14-08-0001-G-869.

Descriptors: *South Dakota, *Glacial till, *Hydraulic conductivity, *Porosity, Irrigation design.

A natural prairie site in Hyde County, South Dakota was instrumented and sprinkler irrigated to determine the hydraulic properties of the glacial till substrates. Sufficient water was added to the soil profile during a 40 day period to achieve static, saturated conditions with a water table at the surface. Water penetrated to at least 4.5 meters but less than 9 meters depth below the surface during the study period (9 months). Saturated hydraulic conductivities were calculated to be in the range .02-.03 cm/hr in the 1-3 meter layer. Drainable porosity was in the range of .03-.06 with .04-.05 being the most probable range in the 1-3 meter layer. Piezometers on the plots indicated a significant fall in the water table during the winter but the data was insufficient to verify the validity or meaning of these observations.
W86-02626

INDICATORS OF GROUND WATER QUALITY AND YIELD FOR A PUBLIC WATER SUPPLY IN ROCK FRACTURE ZONES OF THE PIEDMONT.

Clemson Univ., SC. Dept. of Chemistry and Geology.
D. S. Snipes, L. L. Burnett, J. A. Wylie, L. A. Sacks, and S. B. Heaton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233765/AS, Price codes: A05 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute Completion Report, No. 115, Clemson, August 1984. 80 p, 11 fig, 21 tab, 29 ref, 2 append. USGS, G-868-02. 14-08-0001-G-868.

Descriptors: *Well data, *Fracture permeability, *Magnetic studies, *South Carolina, Profiles, *Groundwater, Dikes, Metamorphic rocks, Igneous rocks, Granite, Water quality, Acidity, Yield, *Water yield.

This investigation deals with field and laboratory studies on indicators of ground water quality and well yields from a variety of igneous, metamorphic, and fault rocks situated in the Piedmont of South Carolina. The yields of 206 wells drilled in Greenwood County varied from 0 to 150 gpm, while the median was 17 gpm. The median yield of the wells situated in fracture traces and lineaments was 25 gpm, which was about twice the median yield of 12 gpm of the randomly located wells. The median productivity of the wells situated in the Carolina Slate Belt was 28 gpm, while the median yields of the Charlotte and Kings Mountain belts were 17 gpm and 15 gpm respectively. The higher productivity of the Carolina Slate Belt was caused by a greater abundance of permeable bedding planes and joints in these rocks. The principal water quality problem was the low pH. The median value was 6.4, and 25 percent of the samples had pH values below 6.0. The lowest median pH, 5.8, was reported from 9 wells drilled in the Coronaca Granite-Tyenite. Two new dikes, the Sholas Junction Dolerite of Greenwood County and the Due West Dolerite of Abbeville County, were mapped. Studies of magnetometer profiles and field data suggest that the Shoals Junction Dolerite consists of multiple dikes emplaced in extensional fractures which cut across rocks of the Kings Mountain Belt. Unfortunately, no drilled wells were located in the Shoals Junction Dolerite and thus, its ground water capability is not known. Nevertheless, because of the high incidence of fractures here, this zone might well contain good supplies of ground water.
W86-02654

CALIBRATION OF THE SNAKE PLAIN AQUIFER GROUND-WATER FLOW MODEL,

Idaho Univ., Moscow. Dept. of Agricultural Engineering.
G. S. Johnson, C. E. Brockway, and J. Lindgren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249100/AS, Price codes: A02 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Completion Report, Moscow, May, 1985. 10 p, 2 fig, 5 ref. USGS G839-06. 14-08-0001-G839.

Descriptors: *Idaho, Groundwater resources, Aquifer characteristics, Aquifer systems, Groundwater movement.

The Snake Plain aquifer ground-water flow model is operated by the Idaho Department of Water Resources as a tool for management of the aquifer and the hydraulically connected Snake River. Data made available by the 1980 U.S. Geological Survey RASA program is being used to recalibrate the model. This project provided technical assistance for the assembly and interpretation of the hydrologic data necessary to recalibrate the model.
W86-02689

FEASIBILITY OF DIRECT UTILIZATION OF SELECTED GEOTHERMAL WATER FOR AQUACULTURE OF MACROBRACHIUM ROSENBERGII,

Boise State Univ., ID. Dept. of Geology and Geophysics.
C. Spinosa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249126/AS, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water Research Institute, Moscow, Completion Report, May, 1984, 18 p, 3 fig, 2 tab, 15 ref, USGS G839-09. 14-08-0001-G839.

Descriptors: *Geothermal resources, *Idaho, *Aquaculture, Crustaceans, *Water quality, Groundwater, Commercial shellfish.

The feasibility was tested of direct utilization of geothermal water for the aquaculture of Malaysian freshwater prawns (Macrobrachium rosenbergii). A problem with using geothermal water for aquaculture is the chemical composition of the water with high flouride levels being a particular problem. Results show that (1) some geothermal water in Idaho can be used directly for the aquaculture of Macrobrachium rosenbergii, (2) high flouride levels cannot be directly correlated with high mortality rates and (3) low flouride levels do not correlate with high growth rates.
W86-02691

EVALUATION OF DATA REQUIREMENTS FOR GROUNDWATER CONTAMINANT TRANSPORT MODELING,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02723

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTH-CENTRAL MISSISSIPPI, AUGUST 1984,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02761

WATER RESOURCES OF AURORA AND JERAULD COUNTIES, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02763

GROUND-WATER SYSTEM AND POSSIBLE EFFECTS OF UNDERGROUND COAL MINING IN THE TRAIL MOUNTAIN AREA, CENTRAL UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02765

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1983, VOLUME 4. NORTHERN CALIFORNIA VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02771

WATER RESOURCES DATA FOR CALIFORNIA, 1983, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02772

WATER-DATA PROGRAM OF THE U.S. GEOLOGICAL SURVEY IN KANSAS, FISCAL YEAR 1983,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02778

WATER-LEVEL DECLINES IN THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND RELATED TO INCREASES IN PUMPAGE,

Maryland Dept. of Natural Resources, Annapolis.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 82-919, 1983. 29 p, 13 fig, 3 tab, 13 ref.

Descriptors: *Groundwater, *Potentiometric level, Water wells, Coastal Plain, *Water-level fluctuations, Pumpage, Aquifer evaluation, Hydrographs, *Maryland, Charles County, Prince Georges County, Calvert County, *Magothy aquifer.

Pumpage from the Magothy aquifer in the project area in southern Maryland increased from about 0.45 million gallons per day (Mgal/d) in 1962 to about 3.3 Mgal/d in 1981. Distinct and extensive cones of depression developed in two parts of the project area: (1) localities surrounding the electric power generation plant at Chalk Point, in southeastern Prince Georges County, and (2) the rapidly developing Waldorf area of northern Charles. Hydrographs of daily values for water levels and pumpage data show several examples of the close relationship between pumpage and water levels. One shows that water levels rose one foot in an observation well as a result of the temporary termination of pumpage of 0.25 Mgal/d from a production well located 2-1/2 miles away. Pumpage from the Magothy aquifer in the Chalk Point area commenced in 1963 and stabilized at approximately 0.8 Mgal/d by 1975. Water levels declined as much as 61 feet by 1980. Pumpage from the Magothy aquifer in the Waldorf area commenced in 1948 and increased at a rather uniform rate to about 2 Mgal/d by 1980. Water levels declined about 85 feet in parts of the area during that period. (USGS)
W86-02781

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN SOUTHWESTERN NEW JERSEY, 1923-83,

Geological Survey, Trenton, NJ. Water Resources Div.
T. V. Fusillo, J. J. Hochreiter, and D. G. Lord.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-737, 1984. 127 p, 2 fig, 7 tab, 36 ref, 1 pl.

Descriptors: *Water quality, *Groundwater, *New Jersey, Unconsolidated aquifers, Inorganic compounds, Organic compounds, Water analysis, Well data, Coastal plain, Potomac-Raritan-Magothy aquifer system.

Water-quality data for wells in and near the outcrop area of the Potomac-Raritan-Magothy aquifer system in Mercer, Burlington, Camden, Gloucester, and Salem Counties, New Jersey, have been compiled for the period 1923-83. The data were collected during various U.S. Geological Survey projects, including county-wide ground-water studies, the New Jersey saltwater-intrusion monitoring network, and regional ground-water assessments. (USGS)
W86-02783

GROUND-WATER LEVELS IN OBSERVATION WELLS IN OKLAHOMA, 1982-83 CLIMATIC YEARS,

Geological Survey, Oklahoma City, OK. Water Resources Div.
R. L. Goemat, L. D. Mize, and D. E. Spiser.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-472, 1984. 583 p, 4 fig, 2 tab, 46 ref.

Descriptors: Groundwater, *Water levels, Wells, Monitoring, *Observation wells, *Groundwater levels, *Oklahoma.

In the 1982-83 climatic years, the U.S. Geological Survey, in cooperation with the Oklahoma Water Resources Board, collected ground-water level data from 1,014 sites in 77 counties. Data consist of records from continuous recorders, 3 wells measured monthly, 6 quarterly, and 1041 annually. (USGS)
W86-02784

ESTIMATING HIGHEST GROUND-WATER LEVELS FOR CONSTRUCTION AND LAND-USE PLANNING--A CAPE COD, MASSACHUSETTS, EXAMPLE,

Geological Survey, Boston, MA. Water Resources Div.
M. H. Frimpter, and M. N. Fisher.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4112, 1983. 23 p, 18 fig, 9 tab, 6 ref.

Descriptors: *Groundwater levels, Water table, *Water-level fluctuations, Observation wells, *Massachusetts, Cape Cod.

High ground water is a major cause of septic-system failures, wet basements, and other problems for suburban and rural residents. A technique for estimating the level to which groundwater can rise as a consequence of weather and seasonal factors has been developed. Water-level records from about 160 sites were used to make four maps of ranges of annual water-level change: 0-2 feet, 2-3 feet, 3-4 feet, 4-5 feet, and 5-6 feet. Nine observation wells with 16 or more years of record were used to index water-level fluctuations throughout Cape Cod. To estimate high water levels, measurements of the current depth to water at test sites are cross referenced with current depth to water in the index wells. The technique assumes good correlation between water-level fluctuations at septic-system sites and the index wells. Eighty-seven percent of the correlation coefficients determined from correlating water-level fluctuations from 146 sites with water-level fluctuations in the index wells were greater than 0.8. (USGS)
W86-02785

PRESENT AND PROPOSED GROUND-WATER LEVEL PROGRAM IN MAINE,

Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02788

HYDROGEOLOGIC RECONNAISSANCE OF THE SAN MIGUEL RIVER BASIN, SOUTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
D. J. Ackerman, and F. E. Rush.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4133, 1984. 25 p, 10 fig, 4 tab, 23 ref.

Descriptors: Aquifers, Confining beds, *Groundwater movement, *Groundwater contamination, Hydrologic budget, *Radioactive-waste disposal, *San Miguel River Basin, Salt anticlines, Paradox Member of the Hermosa Formation, Paradox basin, *Colorado, *Path of pollutants.

The San Miguel River Basin encompasses 4,130 square kilometers of which about two-thirds is in the southeastern part of the Paradox Basin. The Paradox Basin is a part of the Colorado Plateaus that is underlain by a thick sequence of evaporite beds of Pennsylvanian age. The rock units that underlie the area have been grouped into hydrogeologic units based on their water-transmitting ability. Evaporite beds of mostly salt are both overlain and underlain by confining beds. Aquifers are present above and below the confining-bed sequence. The principal element of ground-water outflow from the upper aquifer is flow to the San Miguel River and its tributaries; this averages about 90 million cubic meters per year. A water budget for the lower aquifer has only two equal, unestimated elements, subsurface outflow and recharge from precipitation. The aquifers are generally isolated from the evaporite beds by the bounding confining beds; as a result, most ground water has little if any contact with the evaporites. No brines have been sampled and no brine discharges have been identified in the basin. Salt water has been reported for petroleum-exploration wells, but no active salt solution has been identified. (USGS)
W86-02789

GENERALIZED CONFIGURATION OF THE BASE OF THE HIGH PLAINS AQUIFER IN KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
K. R. Watts, and L. E. Stullken.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 81-344, 1985. 1 p, 4 fig, 19 ref.

Descriptors: *Aquifers, *Geohydrologic units, *Geologic control, Faults, Subsidence, Hydrogeology, Maps, *Kansas, *High Plains.

The High Plains aquifer in Kansas is part of a regional system that extends from South Dakota to Texas. In Kansas, the aquifer underlies an area of 30,900 square miles in the western and south-central part. The aquifer is a hydraulically connected aggregation of unconsolidated water-bearing deposits. The High Plains aquifer is composed principally of unconsolidated alluvial deposits of Tertiary and Quaternary age. These materials were deposited on an erosion surface that had been cut into consolidated rocks of Permian, Cretaceous and Jurassic age. Dissolution of underlying Permian evaporites by ground water has been a significant factor in the faulting and subsidence of the bedrock surface in southwestern and south-central Kansas. Maps published at a scale of 1:500,000 show the altitude and configuration of the base of the aquifer. The regional gradient of the base is from west to east at about 10 feet per mile, but the gradient of the base is from west to east at about 10 feet per mile, but the local gradient may exceed 100 feet per mile in the vicinity of faults, collapsed areas, and erosional features. (USGS)
W86-02791

PRELIMINARY EVALUATION OF HYDROLOGIC PROPERTIES OF CORES OF UNSATURATED TUFF, TEST WELL USW H-1, YUCCA MOUNTAIN, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
E. P. Weeks, and W. E. Wilson.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4193, 1984. 30 p, 30 fig, 1 tab, 10 ref.

Descriptors: *Unsaturated flow, *Radioactive waste disposal, Permeability, Tension, Test holes, *Nevada Test Site, Yucca Mountain, *Hydrogeology, *Path of pollutants.

Analyses were made on 19 core samples of unsaturated tuff from test well USW H-1. Moisture-characteristic curves relating saturation and moisture tension were developed from results of mercury-injection tests. Ambient moisture tension estimated from these curves generally was 1 to 2 bars. Values of relative permeability ranging from about 0.002 to 0.1 were determined by fitting an analytical expression to eight of the moisture-characteristic curves, and then integrating to solve for relative permeability. These values of relative permeability were applied to values of saturated hydraulic conductivity of core from a nearby test well to obtain effective hydraulic conductivities of about 8 x 10 to the minus twelfth power to 7 x 10 to the minus tenth power centimeter per second. If a unit hydraulic-head gradient is assumed, these values convert to a vertial matrix flux of 0.003 to 0.2 millimeter per year. The validity of this assumption was not verified due to the sparseness of data and uncertainties in their reliability. Consequently, the results of this study are preliminary and need to be used principally as a guide for future studies. (USGS)
W86-02792

HYDROGEOLOGIC APPRAISAL OF A STRATIFIED-DRIFT AQUIFER NEAR SMYRNA, CHENANGO COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
R. J. Reynolds, and G. A. Brown.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4029, 1984. 53 p, 8 fig, 6 pl, 7 tab, 26 ref.

Descriptors: *Hydrogeology, *Groundwater data, Glacial aquifers, Aquifer management, Induced infiltration, Groundwater storage, Unconsolidated aquifers, Unconfined aquifers, Confined aquifers, Pumping tests, Glacial drift, *Groundwater storage, Separated aquifers, Valley aquifers, Stratified drift, Aquifer evaluation, Aquifer yield, *New York, Smyrna, Chenango County.

A broad, Y-shaped valley near Smyrna, New York, contains extensive water-table and confined aquifers that are largely hydraulically separated from the nearby Chenango River to the east. Accordingly, ground-water withdrawals from this valley would not appreciably decrease streamflow in the Chenango River by induced infiltration and could be used for specialized needs. The aquifers in the valley are capable of sustaining a long-term total withdrawal of about 12.7 million gallons per day during prolonged drought conditions. Larger withdrawals could be made on a short-term basis or during periods of normal or above-normal precipitation. Saturated thickness of undifferentiated stratified-drift deposits in the valley ranges from 20 feet in the northwestern part of the valley to more than 300 feet at its southern end. Direct areal recharge accounts for about 56 percent of the total recharge to the valley aquifer infiltration from streams accounts for 24 percent, and runoff from the adjacent till-mantled hillsides accounts for 20 percent. The water-table and confined aquifers within the valley hold at least 19.6 billion gallons of usable ground water in storage. (USGS)
W86-02793

GENERALIZED POTENTIOMETRIC-SURFACE MAP OF THE HIGH PLAINS AQUIFER IN WYOMING, 1981,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02795

EVALUATION OF THE HYDROLOGIC SYSTEM IN THE DICKINSON LIGNITE AREA, EASTERN SLOPE AND WESTERN STARK AND HETTINGER COUNTIES, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
C. A. Armstrong.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4194, 1984. 35 p, 10 fig, 5 tab, 22 ref.

Descriptors: *Hydrologic system, *Groundwater, *Aquifers, Hydraulic conductivity, Recharge, Chemical properties, Potential yield, Slope County, Stark County, Hettinger County, *North Dakota.

Aquifer systems in the Dickinson lignite area of North Dakota are in sandstone beds in the Fox Hills Sandstone and lower Hell Creek Formation, in the upper Hell Creek Formation and lower Ludlow Member of the Fort Union Formation, in the upper Ludlow and lower Tongue River Members of the Fort Union Formation, and in the upper Tongue River and the Sentinel Butte Members of the Fort Union Formation. Well yields from each of the aquifer systems generally are less than 100 gallons per minute. Water in the Fox Hills-lower Hell Creek aquifer system and in the upper Hell Creek-lower Ludlow aquifer system is soft and a sodium bicarbonate type. Dissolved-solids concentrations range from 1,010 to 1,690 milligrams per liter. Water in the upper Ludlow-lower Tongue River aquifer system and in the upper Tongue River-Sentinel Butte aquifer system ranges from soft to very hard and generally is a sodium bicarbonate type. Dissolved-solids concentrations range from 574 to 2,720 milligrams per liter. Discharges of ground water are less than 0.1 cubic foot per second to the Cannonball River and less than 1.0 cubic foot per second to the Heart River. (USGS)
W86-02796

QUALITY OF GROUND WATER IN MONITOR AND WILLIAMS TOWNSHIPS, BAY COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02798

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02799

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02800

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02801

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02802

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02803

GROUND-WATER CONDITIONS IN AND NEAR THE GILA RIVER INDIAN RESERVATION, SOUTH-CENTRAL ARIZONA,

Geological Survey, Tucson, AZ. Water Resources Div.
B. W. Thomsen, and S. Baldys.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4073, 1985. 2 p, 6 fig, 1 tab, 25 ref.

Descriptors: *Groundwater pumping, *Water-level decline, Specific conductivity, *Groundwater levels, Water yield, *Arizona, *Gila River Indian Reservation, Salt River Valley.

In the early 1900's when ground-water pumping began in the vicinity of the Gila River Indian Reservation, depths to water below the land surface ranged from less than 10 feet to about 130 feet and the general direction of ground-water flow was toward the northwest. In 1983, depths to water ranged from less than 50 feet to more than 700 feet. Water level decline since 1900 was more than 550 feet near Stanfield, 500 feet near Chandler Heights, and 350 feet east of Mesa and southeast of Eloy; about 100 feet near Sacaton; and less than 50 feet near Gila Crossing. In 1983, the ground water flowed westward toward the center of cones of depression east of Mesa; near Chandler Heights, Eloy, and Arizona City; and in the Maricopa-Stanfield area. An increase in the specific conductance of ground water has accompanied the lowering of water levels in many areas.
W86-02804

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND SILICIC SHALLOW-INTRUSIVE ROCKS, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-02805

MAP SHOWING OUTCROPS OF ASH-FLOW TUFFS, BASIN RANGE PROVINCE AND VICINITY, TRANS-PECOS TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-02806

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, PRE-1950,

Geological Survey, Garden City, KS. Water Resources Div.
L. E. Stullken, and M. E. Pabst.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 82-117, 1985. 1 p, 3 fig, 36 ref.

Descriptors: *Water table, *Potentiometric surface, Groundwater, Unconfined aquifers, Underflow, Underground storage, Water-bearing formations, Maps, *Kansas, *High Plains aquifer.

The High Plains aquifer in Kansas is a part of a regional system that extends from South Dakota to Texas. The aquifer in Kansas underlies an area of 31,000 square miles in the western and south-central part. The aquifer is a hydraulically connected assemblage of unconsolidated water-bearing deposits of Tertiary and Quaternary age. Maps at a scale of 1:500,000 show the altitude and configuration of the water table in Kansas prior to 1950. The water-table maps depict the water-level surface that was present prior to major development of the High Plains aquifer. Ground water moves from higher altitudes in the western part of the High Plains to lower altitudes in the eastern part at an average slope of 10 feet per mile. The upgradient flexure of water-table contours along some of the valleys indicates that ground water is discharged to the streams in those areas. (USGS)
W86-02807

HYDROGEOLOGIC SETTING AND THE POTENTIOMETRIC SURFACES OF REGIONAL AQUIFERS IN THE HOLLANDALE EMBAYMENT, SOUTHEASTERN MINNESOTA, 1970-80,

Geological Survey, St. Paul, MN. Water Resources Div.
G. N. Delin, and D. G. Woodward.
Available from Distribution Br. USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2219, 1984. 56 p, 21 fig, 1 tab, 37 ref.

Descriptors: *Areal hydrogeology, *Groundwater movement, *Potentiometric level, Aquifer characteristics, Groundwater recharge, Hollandale Embayment, *Minnesota, Cambrian-Ordovician aquifer system, Hydrogeologic units, Groundwater divides, Discharge boundary, Northern Midwest RASA study.

Sedimentary Paleozoic rocks in the Hollandale embayment in southeastern Minnesota are as much as 2,000 feet thick. This sedimentary sequence, together with the Proterozoic Hinckley Sandstone and the Quaternary drift, is divided into six regional aquifers: the undifferentiated drift, Upper Carbonate, St. Peter, Prairie du Chien-Jordan, Ironton-Galesville, and Mount Simon-Hinckley. Potentiometric-surface maps for each aquifer indicate that movement of ground water is predominantly toward the major rivers. The St. Croix, Minnesota, and Mississippi Rivers constitute regional discharge boundaries for ground-water flow. A major ground-water divide in the St. Peter, Prairie due Chien-Jordan, Ironton-Galesville, and Mount Simon-Hinckley aquifers in the south-central part of the Hollandale embayment separates ground-water flow northward toward the Twin Cities area and southward toward Iowa. The St. Peter and Prairie du Chien-Jordan aquifers in the southeastern part of the embayment contain ground-water mounds as high as 90 feet above the regional potentiometric surface. The mounds occur as a

result of recharge where the Decorah-Platteville-Gleawood confining bed has been removed by erosion and the aquifers subcrop beneath drift about 20 feet thick. This head distribution produces a locally complex pattern of flow in which ground water moves southwestward toward Iowa instead of directly toward the Mississippi River. (USGS)
W86-02809

APPRAISAL OF DATA FOR GROUND-WATER QUALITY IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
R. A. Engberg.
Available from Distribution Br. USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2245, 1984. 54 p, 29 fig, 10 tab, 20 ref.

Descriptors: *Groundwater quality, *Chemical composition, *Dissolved solids, *Calcium, *Alkalinity, *Sulfate, *Contamination, *Nebraska, Aquifer groupings, Water-quality diagrams.

Existing data on ground-water quality in Nebraska, and their adequacy as a data base, are summarized. Analyses have been made of water from nearly 10,000 wells by 8 agencies. Those analyses meeting reliability criteria have been aggregated by geologic source of water into four principal aquifer groupings--Pleistocene-Holocene aquifers, Tertiary aquifers, Mesozoic aquifers, and Paleozoic aquifers. For each aquifer grouping, data on 25 constituents or properties of water are summarized statistically. Also, diagrams are presented showing differences in statistical parameters, or in chemical composition, of water from the different aquifer groupings. Furthermore, maps show, for each grouping except Paleozoic aquifers, ranges in concentration of total dissolved solids, calcium, alkalinity, and sulfate. Areas where data are insufficient to delimit ranges in concentration are also shown on these maps. Point-source contamination has been identified at 41 locations and nonpoint-source contamination in 3 areas, namely, the Central Platte Valley, Holt County, and Boyd County. Potential for nonpoint-source contamination exists in 10 major areas, which together comprise more than one-third of the State. Existing data are mostly from specific projects having limited areas and objectives. Consequently, a lack of data exists for other areas and for certain geologic units, particularly the Mesozoic and Paleozoic aquifers. Specific data needs for each of the four principal aquifer groupings are indicated in a matrix table. (USGS)
W86-02810

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1985,

Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds, and J. L. Spencer.
Available from OFFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-478, 1985. 60 p, 3 fig, 16 tab, 22 ref.

Descriptors: *Groundwater levels, Aquifers, Well hydrographs, *Arkansas, Alluvial aquifer, Sparta sand, Observation wells.

The report contains 622 ground-water level measurements made in observation wells in Arkansas in the spring of 1985. In addition, the report contains well hydrographs relating to the Quaternary aquifer and the Sparta Sand aquifers, the most important aquifers with respect to ground-water availability and use in Arkansas. (USGS)
W86-02812

GROUND-WATER CONTAMINATION IN EAST BAY TOWNSHIP, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02814

HYDROLOGIC DATA FOR AQUIFERS IN PHILADELPHIA, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02815

AQUIFEM-SALT: A FINITE ELEMENT MODEL FOR AQUIFERS CONTAINING A SEAWATER INTERFACE,

Geological Survey, Reston, VA. Water Resources Div.
C. I. Voss.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4263, 1984. 37 p, 2 fig, 9 ref, append.

Descriptors: Aquifer, *Simulation, *Saline-freshwater interfaces, *Groundwater models, *Model studies, *Finite-element analyses, Ghuben-Heerzberg lens, Freshwater lens.

Described are modifications to AQUIFEM, a finite element areal ground-water flow model for aquifer evaluation. The modified model, AQUIFEM-SALT, simulates an aquifer containing a freshwater body that freely floats on seawater. Parts of the freshwater lens may be confined above and below by less permeable units. Theory, code modifications, and model verification are discussed. A modified input data list is included. This report is intended as a companion to the original AQUIFEM documentation. (USGS)
W86-02822

HYDROLOGY OF THE TERTIARY-CRETACEOUS AQUIFER SYSTEM IN THE VICINITY OF FORT RUCKER AVIATION CENTER, ALABAMA,

Geological Survey, Montgomery, AL. Water Resources Div.
J. C. Scott, L. R. Law, and R. H. Cobb.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4118, 1984. 232 p, 14 fig, 3 tab, 25 ref.

Descriptors: *Groundwater, *Pumpage, *Coastal aquifers, *Aquifer testing, *Alabama, Potentiometric level, Water use, Municipal water, Water shortage, *Fort Rucker Aviation Center, Cones of depression, Mutual interferences, Well spacing.

Fort Rucker Aviation Center, built in 1941-42, uses ground water for its water supply. The demand for water began to exceed the capacity of the well field in 1976. The Tertiary-Cretaceous aquifer system in the Fort Rucker area consists of an upper and lower aquifer. The upper aquifer consists of the basal part of the Tuscahoma Sand, the Nanafalia and Clayton Formations, and the upper part of the Providence Sand. The lower aquifer consists of the lower part of the Providence Sand and the Ripley Formation. Most large capacity (greater than 100 gal/min (gallons per minute)) wells in the Fort Rucker area are developed in one of these aquifers, and produce 500 gal/min or more. An aquifer test made at Fort Rucker during the study indicates that the transmissivity of the upper aquifer is about 7,000 ft sq/d (feet squared per day). This test and a potentiometric map of the area indicate that wells spaced too closely together is a major problem at pumping centers in the study area. (USGS)
W86-02825

GEOHYDROLOGY OF TEST WELL USW, H-3, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
W. Thordarson, F. E. Rush, and S. J. Waddell.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4272, 1985. 38 p, 20 fig, 4 tab, 32 ref.

Descriptors: *Aquifer tests, *Hydraulic conductivity, *Transmissivity, *Geophysical logging, *Nevada, Crater Flat Tuff, Lithic Ridge Tuff, Yucca Mountain, Nevada Test Site, Nye County.

Test well USW H-3 is one of several wells drilled in the southwestern part of the Nevada Test Site for hydraulic testing, hydrologic monitoring, and geophysical logging. The work was performed in cooperation with the U.S. Department of Energy. The rocks penetrated by the well to a total depth of 1,219 meters were volcanic tuffs of Tertiary age. The most transmissive zone in this well is in the upper part of the Tram Member of the Crater Flat Tuff that was penetrated at a depth from 809 to 841 meters; transmissivity is about 7 x 10 -1 meter squared per day. The remainder of the rocks penetrated between the depths of 841 to 1,219 meters have a transmissivity of about 4 x 10 -1 meter squared per day and are predominatly in the Tram Member of the Crater Flat Tuff and the Lithic Ridge Tuff in the depths from 841 to 1,219 meters. (USGS)
W86-02830

QUALITY OF WATER IN THE ALLUVIAL AQUIFER, AMERICAN BOTTOMS, EAST ST. LOUIS, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02832

PRELIMINARY ASSESSMENT OF GROUND-WATER RESOURCES OF LAUDERDALE COUNTY, TENNESSEE,

Geological Survey, Memphis, TN. Water Resources Div.
W. S. Parks, J. K. Carmichael, and D. D. Graham.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4104, 1985. 35 p, 16 fig, 5 tab, 32 ref.

Descriptors: *Aquifer systems, *Groundwater level, *Water quality, *Aquifer characteristics, Geologic units, Subsurface mapping, Structural geology, *Tennessee, Lauderdale County.

The ground-water resource in Lauderdale County is in a rudimentary stage of development. The principal shallow aquifers are the Mississippi alluvial deposits of Quaternary age and the Cockfield Formation, Memphis Sand, and Fort Pillow Sand of Tertiary age. Water levels fluctuate seasonally. High water levels generally occur in the winter, spring, or early summer, and low water levels occur in the fall or early winter. Water from the Mississippi alluvial deposits, Cockfield Formation, and Memphis Sand is a calcium bicarbonate type and is generally of good quality. Undesirable parameters from the standpoint of use are hardness and concentrations of dissolved iron and dissolved solids. The Fort Pillow Sand, as yet untapped, has potential to yield a sodium bicarbonate type of water of somewhat better quality than is available from the shallow aquifers. Estimated values of transmissivity from single-well pumping tests are highest for the Mississippi alluvial deposits and lowest for the Cockfield. Several north-northeast and west-northwest trending faults cross the country. (USGS)
W86-02833

GENERALIZED POTENTIOMETRIC SURFACE OF AQUIFERS OF PLEISTOCENE AGE, SOUTHERN LOUISIANA, 1980,

Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02835

APPRAISAL OF THE WATER RESOURCES OF THE EASTERN PART OF THE TULARE AQUIFER, BEADLE, HAND, AND SPINK COUNTIES, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
L. K. Kuiper.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4078, 1984. 52 p, 33 fig, 2 ref.

Descriptors: *Computer models, *Aquifers, *Surface water-groundwater relationships, Beadle County, Hand County, Spink County, *South Dakota.

A system of glacial outwash aquifers lie in the central James Valley in east-central South Dakota. Within this system, the eastern part of the Tulare aquifer, which has an area of approximately 681 square miles, was simulated by means of a numerical ground-water flow model. The model estimates the yearly average recharge rate for that part of the aquifer lying west of the James River to be approximately 23,000 acre-feet per year. This rate is considerably more than the estimated 1978 yearly average irrigation pumpage rate of 9,800 acre-feet per year. It is expected that, since pumping will reduce discharge from the aquifer through evapotranspiration and flow to the James River, this part of the aquifer would be able to supply irrigation water at recent pumpage rates for an indefinite period. For that part of the aquifer lying east of the river, estimated recharge is 6,800 acre-feet per year; a rate slightly smaller than the estimated 1978 yearly average irrigation pumpage rate of 7,200 acre-feet per year. It is estimated that this part of the aquifer would be able to supply irrigation water at 7,200 acre-feet per year for approximately 50 years, at which time excessive drawdown would begin to cause reduced well yields at several locations. (USGS)
W86-02836

SELECTED CLIMATOLOGICAL AND HYDROLOGIC DATA, RATON BASIN, HUERFANO AND LAS ANIMAS COUNTIES, COLORADO, AND COLFAX COUNTY, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02839

GEOHYDROLOGY AND GROUND-WATER FLOW AT VERONA WELL FIELD, BATTLE CREEK, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
N. G. Grannemann, and F. R. Twenter.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4056, 1985. 54 p, 31 fig, 7 tab, 18 ref.

Descriptors: *Groundwater flow, *Hydrology, *Water supply, Municipal water, Geology, Model studies, *Michigan, *Battle Creek, Marshall Formation.

The city of Battle Creek has 30 wells in the Verona well field capable of yielding 300 to 1,000 gallons per minute each. During summer, total withdrawals are as little as 6,000 gallons per minute. In early 1984, only 9 to 12 of the wells were being used; the remaining wells were contaminated by volatile hydrocarbons. Ground-water flow is in three aquifers--a sand and gravel aquifer in deposits of Pleistocene age that overlies upper and lower sandstone aquifers of the Marshall Formation of Mississippian age. Horizontal hydraulic conductivity values are 15 to 110 feet per day for the sand and gravel aquifer, 150 feet per day for the upper sandstone aquifer, and 550 feet per day for the lower sandstone aquifer. Recharge rates range from 8 to 13 inches per year. Model simulations to evaluate the feasibility of installing new supply wells immediately north of the present field indicate that pumping 3,750 gallons per minute from new wells at the site would produce about 7 feet of drawdown. Because the new wells tap only the lower sandstone aquifer, the pumping would have little effect on the potentiometric surfaces for the two overlying aquifers. (USGS)
W86-02840

GROUND-WATER RESOURCES AND POTENTIAL HYDROLOGIC EFFECTS OF SURFACE COAL MINING IN THE NORTHERN POWDER RIVER BASIN, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02841

GROUND WATER IN UTAH'S RAPIDLY GROWING WASATCH FRONT AREA--THE CHALLENGE AND THE CHOICES,

Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Available from Dist Branch, USGS 604 S. Pickett St., Alexandria, VA 22034. USGS Water-Supply Paper 2232, 1985. 71 p, 46 fig, 29 ref.

Descriptors: *Groundwater, Water levels, Water use, Water quality, Water cycle, *Utah, *Salt Lake City, Wasatch Front, Salt Lake County, Davis County, Weber County, Utah Valley.

Utah's Wasatch Front area comprises about 4,000 square miles in the north-central part of the State. In 1980 the area had a population of more than 1.1 million, or about 77 percent of Utah's population. It contains several large cities, including Salt Lake City, Ogden, and Provo. The principal source of ground water in the area is the unconsolidated fill (sedimentary deposits) in the valleys of the Wasatch Front area and the Bear River Bay area. Maximum saturated thickness of the fill in the principal ground-water reservoirs exceeds 6,000 feet, and the estimated volume of water that can be withdrawn from just the upper 100 feet of the saturated fill is about 8 million acre-feet. In most places the water is fresh, containing less than 1,000 milligrams per liter of dissolved solids; in much of the Bear River Bay area and most of Goshen Valley (and locally in the other valleys), the water is slightly to moderately saline, with 1,000 to 10,000 milligrams per liter of dissolved solids. The reservoirs receive recharge at an annual rate that is estimated to exceed 1 million acre-feet--chiefly as seepage from consolidated rocks in the adjacent mountains, canals, ditches, and irrigated land, directly from precipitation, and from streams. Discharge, which occurs chiefly from springs, as seepage to streams, by evapotranspiration, and withdrawal from wells, was estimated to be about 1.1 million acre-feet during 1980. Withdrawal from wells, which began within a few years after the arrival of the Mormon pioneers in the Salt Lake Valley in 1847, had increased to about 320,000 acre-feet during 1979. (USGS)
W86-02843

GROUND-WATER RESOURCES OF NORTHERN UTAH VALLEY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02844

GROUND WATER HYDROLOGY OF THE ELIZABETHTOWN AREA, KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
D. S. Mull, and M. A. Lyverse.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4057, 1984. 61 p, 14 fig, 8 tab, 27 ref.

Descriptors: *Groundwater, *Groundwater movement, *Karst hydrology, *Water quality, *Aquifer testing, *Carbonate aquifers, Water level fluctuations, Flow nets, Bacterial analysis, *Kentucky, Hardin County.

The principal aquifer in a 52 square mile karst area in north central Kentucky is the St. Louis Limestone of Mississippian age. Unconsolidated residuum and surficial deposits of slumped material may store water and recharge the underlying limestone aquifer. Precipitation averages 49 inches annually; 6 inches recharges ground-water reservoirs. The shallow ground-water velocity ranged from 0.30 to 1.40 feet per second. Flow net analysis indicates that about 2 million gallons of water per day flows through a 1.8 mile wide section of the aquifer. A water-level contour map indicates that the hydraulic gradient averages 40 feet per mile and that the water levels near the city supply wells have not lowered in 10 years. The effects of three faults on the ground-water flow system is shown as ponding on the upthrown side of the faults. Caliper logs suggest that shallow ground-water flow occurs in sheet-like openings within 100 feet of land surface. The openings range in height from 1 inch or less to 6 feet. A test well penetrated 5 zones of horizontal openings. The specific capacity ranged from 11.5 to 12.1 gallons per minute per foot of drawdown after 12 and 72 hours of pumping at 280 to 510 gallons per minute. Water in 28 wells and springs meets most drinking water standards and generally is a very hard calcium bicarbonate type. Heavily pumped industrial and public-supply wells tend to yield water with high values of specific conductance and sulfate. Coliform bacteria varied widely in rural wells and the city springs. Seven wells had no coliform bacteria. (USGS)
W86-02845

PALEOZOIC ARTESIAN AQUIFERS IN THE TEN SLEEP AREA OF THE BIGHORN BASIN, NORTH-CENTRAL WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
M. E. Cooley.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-621, 1985. 74 p, 18 fig, 9 tab, 20 ref.

Descriptors: *Confined aquifers, *Artesian pressure, Geohydrologic units, *Well yield, *Groundwater availability, Potentiometric level, Flowing wells, Water supply, Water quality, *Wyoming, Bighorn Basin, *Paleozoic aquifers, Rocky Mountain Region.

Major Paleozoic artesian aquifers in the southeastern Bighorn Basin of Wyoming area, in descending order, the Tensleep Sandstone; the Madison Limestone and Bighorn Dolomite, which together form the Madison-Bighorn aquifer; and the Flathead Sandstone. Operating yields commonly are more than 1,000 gallons per minute from flowing wells completed in the Madison-Bighorn aquifer. The initial test of one well indicated a flow of 14,000 gallons per minute. Wellhead pressures range from less than 50 to more than 400 pounds per square inch. Transmissivities are 500-1,900 feet squared per day for the Madison-Bighorn aquifer and 90-325 feet squared per day for the Tensleep and Flathead Sandstones. Despite extensive development for irrigation there have been few decreases in pressure. Some decreases in pressure have occurred in wells completed in the Flathead Sandstone. Fractures along linear structural features result in significant secondary permeability and allow upward interformational movement of water that affects the altitude of the potentiometric surfaces in the Tensleep Sandstone and Madison-Bighorn aquifer. Upward-moving water from the Tensleep and other formations discharges at the land surface as springs along or near these lineations. Water from the aquifers generally contains minimal concentrations of dissolved solids and individual constituents but has excessive hardness. The water is satisfactory for irrigation and other purposes when hardness is not a detrimental factor. Wellhead temperatures range from 11 degrees to 27.5 degrees C, giving a geothermal gradient of about 0.44 degrees C per 100 feet. (USGS)
W86-02847

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE HIGH PLAINS AQUIFER IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING--GEOHYDROLOGY,

Geological Survey, Lakewood, CO. Water Resources Div.
E. D. Gutentag, F. J. Heimes, N. C. Krothe, R. R. Luckey, and J. B. Weeks.
Available from Distribution Branch, USGS, 604 South Picket St., Alexandria, VA 22304. USGS Professional Paper 1400-B, 1984, 63 p, 27 fig, 12 tab, 178 ref.

Descriptors: *Groundwater, Geology, Hydrology, *Hydrogeology, *Aquifers, *High Plains, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, Wyoming.

The High Plains aquifer underlies about 174,000 square miles in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. This aquifer is the principal source of water in one of the Nation's major agricultural areas. The High Plains aquifer mainly consists of hydraulically connected geologic units of late Tertiary or Quaternary age. The Tertiary Ogallala Formation, which underlies 134,000 square miles, is the principal geologic unit in the aquifer. Regionally, the High Plains aquifer is a water-table aquifer consisting mostly of 1,000 feet and an average of 200 feet. The aquifer contains about 3.25 billion acre-feet of drainable water. About 66 percent of the water in storage is in Nebraska and about 12 percent is in Texas. New Mexico, the State with the smallest water resource in the High Plains, has only 1.5 percent of the volume of water in storage. About 95 percent of all water pumped from the High Plains aquifer is used for irrigation. In 1978, an estimated 170,000 wells pumped 23 million acre-feet of ground water to irrigate 13 million acres. The quality of water in the aquifer generally is suitable for irrigation use, but in many places the water does not meet drinking-water standards. Excessive concentrations of dissolved solids, fluoride, chloride, and sulfate occur in parts of the aquifer in all States. The volume of water in storage in the aquifer has decreased about 166 million acre-feet since ground-water development began. About 70 percent of the depletion has occurred in Texas and about 16 percent in Kansas. (USGS)
W86-02850

USE OF A DIGITAL MODEL TO DETERMINE THE EFFECTS OF PROPOSED PUMPING FROM THE PRINCIPAL ARTESIAN AQUIFER, SAVANNAH, GEORGIA, AREA,

Geological Survey, Doraville, GA. Water Resources Div.
R. B. Randolph, and R. E. Krause.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4064, 1984. 26 p, 12 fig, 1 tab, 19 ref.

Descriptors: *Groundwater, *Computer simulation models, *Confined aquifers, *Aquifer characteristics, Carbonate rocks, Management alternatives, *Mathematical models, Model studies, Simulation analysis, Finite difference analysis, Atlantic Coastal Plain, *Georgia, South Carolina, Recharge-discharge relations, Steady-state flow.

A two-dimensional finite-difference model of the principal artesian aquifer in the Savannah, Georgia, area, originally developed by Counts and Krause (1976), has been expanded and refined. The model was updated and the grid redesigned to provide more current and accurate detail for ground-water resources management alternatives. Improvements in the definition of the flow system were made possible by the acquisition of additional data in the area and by recently completed regional models that include the area. The model was initially calibrated by using the estimated predevelopment potentiometric surface of 1880. The flow system under predevelopment conditions was sluggish and only 100 cubic feet per second (65 million gallons per day) flowed through the model area. It was then tested for acceptance by using the May 1980 potentiometric surface and corresponding pumping stress of approximately 85 million gallons per day in the Savannah, Georgia-Hilton Head Island, South Carolina, area. The flow through the system under 1980 conditions was about 390 cubic feet per second (250 million gallons per day) and the vertical inflow from the overlying surficial aquifer more than doubled due to formerly rejected recharge that now flows vertically into the aquifer. Calibration was accurate + or - 10 feet. The absolute error per node was 3.4 feet. A hypothetical 25-percent increase in pumpage over the entire area was used to represent a gradual growth in commercial and municipal pumpage over the next 20 to 30 years. The increase produced a maximum decline of 30 feet below the existing water level of 135 feet below sea level at the center of the cone of depression in Savannah, and a 5-foot decline at a radius of 20 miles from the center of the cone of depression. (USGS)
W86-02851

HYDROLOGY OF THE SOUTHERN PARTS OF OKALOOSA AND WALTON COUNTIES, NORTHWEST FLORIDA, WITH SPECIAL EMPHASIS ON UPPER LIMESTONE OF THE FLORIDAN AQUIFER,

Geological Survey, Tallahassee, FL. Water Resources Div.
D. E. Barr, L. R. Hayes, and T. Kwader.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4305, 1985. 66 p, 29 fig, 6 tab, 22 ref.

Descriptors: *Geohydrology, Water supply, *Aquifers, *Confining bed, Water quality, *Specific capacity, Potentiometric level, Drawdown, Water level, Saline-water intrusion, Limestone, Transmissivity, *Florida, Okaloosa County, Walton County, *Floridan aquifer, Fort Walton Beach, Water-level declines, Sand-and-gravel aquifer.

Increasing population in southern Okaloosa and Walton Counties have resulted in regional declines in the potentiometric surface of the upper limestone of the Floridan aquifer. Water levels have declined as much as 160 feet since 1940, and during peak seasonal demand as much as 190 feet. The Pensacola clay confining bed inhibits interchange of water between the Floridan aquifer and the surficial sand-and-gravel aquifer. The latter aquifer is of secondary importance as a public supply source. The Bucatunna clay confining bed separates the Floridan into upper and lower limestone units; the Floridan is underlain by the relatively impermeable Lisbon/Tallahatta confining unit. The Floridan aquifer dips south to the Gulf of Mexico, and is recharged by rainfall in northern Okaloosa and Walton Counties and in Alabama. The regional gradient of the potentiometric surface of the upper limestone, and presumably that of the lower limstone also, is south. Pumpage was variable in 1978; from 10.9 to 19.0 million gallons per day in January and June, respectively. Saline water in the upper limestone of the Floridan aquifer is less than 10 milligrams per liter inland but may be more than 150 milligrams per liter along the coast. Lower limestone water may exceed 250 milligrams per liter chloride. (USGS)
W86-02853

AVAILABILITY AND QUALITY OF WATER FROM THE BEDROCK AQUIFERS IN THE RAPID CITY AREA, SOUTH DAKOTA,

Geological Survey, Rapid City, SD. Water Resources Div.
K. D. Peter.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4022, 1985. 34 p, 12 fig, 3 tab, 6 ref.

Descriptors: *Groundwater, *Water quality, *Groundwater data, Hydrologic data, Data collections, Aquifers, *South Dakota, Rapid City.

An evaluation made in cooperation with the U.S. Bureau of Reclamation of the availability and quality of water from the bedrock aquifers in the Rapid City area, South Dakota, concluded that Madison aquifer has the greatest potential for additional development of the three major aquifers investigated (the Inyan Kara, the Minnelusa, and the Madison). Ground-water availability and quality were evaluated on the basis of unit thickness and depth, potentiometric-surface altitudes and gradients, estimated recharge and discharge rates, estimated aquifer transmissivities and storage coefficients, reported yields of existing wells, and concentrations of ions in the water that may affect its use as a community supply. The Inyan Kara aquifer has the least potential for additional development because of reported small well yields, the proximity of the outcrop, and concentration of radium-226 exceeding 5 picocuries per liter. The Minnelusa aquifer is unsuitable for development in the eastern two-thirds of the study area because the concentrations of dissolved solids and sulfate commonly exceed the recommended maximum level for community water supplies. The Madison aquifer has the greatest potential for additional development because it has the greatest recharge rate, has areas with significant fracture permeability, yields as much as 900 gallons per minute to wells, and has satisfactory water quality, though it is hard (hardness 120 to 180 milligrams per liter) to very hard (hardness greater than 180 milligrams per liter). (USGS)
W86-02854

PERCENTAGE CHANGE IN SATURATED THICKNESS OF THE HIGH PLAINS AQUIFER, WEST-CENTRAL KANSAS, 1980 TO AVERAGE 1982-84,

Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02855

OREGON GROUND-WATER QUALITY AND ITS RELATION TO HYDROGEOLOGIC FACTORS–A STATISTICAL APPROACH,

Geological Survey, Portland, OR. Water Resources Div.
T. L. Miller, and J. B. Gonthier.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4242, 1984. 88 p, 28 fig, 25 tab, 15 ref.

Descriptors: *Groundwater, Water quality, Statistical analysis, Flow system, *Hydrogeology, *Oregon, *Groundwater quality.

An appraisal of Oregon ground-water quality was made using existing data accessible through the U.S. Geological Survey computer system. The data available for about 1,000 sites were separated by aquifer units and hydrologic units. Selected statistical moments were described for 19 constituents including major ions. About 96 percent of all sites in the data base were sampled only once. The sample data were classified by aquifer unit and hydrologic unit and analysis of variance was run to determine if significant differences exist between the units within each of these two classifications for the same 19 constituents on which statistical moments were determined. Results of the analysis of variance indicated both classification variables performed about the same, but aquifer unit did provide more separation for some constituents. Samples from the Rogue River basin were classified by location within the flow system and type of flow system. The samples were then analyzed using analysis of variance on 14 constituents to determine if there were significant differences between subsets classified by flow path. Results of this analysis were not definitive, but classification as to the type of flow system did indicate potential for segregating water-quality data into distinct subsets. (USGS)
W86-02860

GENERAL DESCRIPTION OF THE GEOHYDROLOGY AND BURIAL TRENCHES AT THE LOW-LEVEL RADIOACTIVE WASTE BURIAL FACILITY NEAR BARNWELL, SOUTH CAROLINA,

Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02862

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS–FISCAL YEARS 1983 AND 1984,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02865

SIMULATION OF AN AQUIFER TEST ON THE TESUQUE PUEBLO GRANT, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
G. A. Hearne.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Supply Paper 2206, 1985. 24 p, 17 fig, 3 tab, 14 ref.

Descriptors: *Aquifer tests, *Hydrogeology, *New Mexico, Hydraulic conductivity, Storage, Water yield, Specific yield, Mathematical models, *Simulation analysis.

An aquifer test was designed and conducted in the anisotropic dipping beds of the Tesuque Formation on the Tesuque Pueblo Grant, New Mexico. The three-dimensional digital model used to analyze the test approximated the response to the test. The analysis of the geohydrology of the test site in combination with the model calibration has provided estimates of average aquifer characteristics for the group of beds penetrated at the test site; the hydraulic conductivity parallel to the beds is about 2 feet per day, the hydraulic conductivity normal to the beds is about 0.0001 foot per day or lower, the specific yield is about 0.15, and the specific storage is about 0.000001 per foot. (USGS)
W86-02866

GEOHYDROLOGY AND CHEMICAL QUALITY OF WATER IN UPPER JURASSIC AND LOWER CRETACEOUS ROCKS, WESTERN KANSAS,

Geological Survey, Lakewood, CO. Water Resources Div.
J. Kume.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4045, 1984. 54 p, 20 fig, 6 tab, 40 ref.

Descriptors: Geologic units, Sandstones, *Aquifers, Subsurface maps, *Kansas, *Water quality, *Groundwater, *Irrigation water, Upper Jurassic rocks, Lower Cretaceous rocks, Dakota aquifer, Cheyenne aquifer, Jurassic aquifer.

Fresh and saline water occur in Upper Jurassic and Lower Cretaceous rocks in western Kansas. The maximum thickness of the Jurassic aquifer is about 50 feet. During 1981, water levels ranged from 255 to 1,160 feet below land surface; the static heads ranged from about 2,400 to 3,100 feet above sea level and the hydraulic gradient ranged from 16 feet per mile toward the northeast to 40 feet per mile toward the north. The water is moderately saline, very hard, a sodium sulfate or sodium chloride type, and unsuitable for drinking and irrigation. The maximum thickness of the Cheyenne aquifer is about 190 feet. During 1981, water levels ranged from 267 to 375 feet below land surface; the static heads varied from less than 2,300 to more than 3,200 feet above sea level; and the hydraulic gradient was 8 feet per mile toward the east. The water is fresh to moderately saline, soft to very hard, a sodium sulfate or sodium, bicarbonate type, and suitable to unsuitable for drinking and irrigation. The maximum thickness of the Dakota aquifer is about 150 feet. During 1982, water levels ranged from 24 to 604 feet below land surface; the static heads ranged from about 2,100 to 3,200 feet above sea level; and the hydraulic gradient was 11 feet per mile toward the east and northeast. The water is fresh to slightly saline, soft to very hard, and suitable to unsuitable for drinking and irrigation. (USGS)
W86-02868

ANALYSIS OF THE CARMEL VALLEY ALLUVIAL GROUND-WATER BASIN, CALIFORNIA, USING DIGITAL FLOW MODEL TECHNIQUES,

Geological Survey, Sacramento, CA. Water Resources Div.
G. W. Kapple, H. T. Mitten, T. J. Durbin, and M. J. Johnson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4280, 1984. 45 p, 14 fig, 1 pl, 6 tab, 45 ref.

Descriptors: Groundwater, Groundwater management, *Hydrologic models, Groundwater basins, *California, *Finite-element method, Computer models, Carmel Valley drainage basin, *Groundwater flow model, Digital models, Aquifers.

A two-dimensional, finite-element, digital model was developed for the Carmel Valley alluvial ground-water basin in California, using measured, computed, and estimated discharge and recharge data. Discharge data included evapotranspiration by phreatophytes, and agricultural, municipal, and domestic pumpage. Recharge data included river leakage, tributary runoff, and pumping return flow. Recharge from subsurface boundary flow and rainfall infiltration was assumed to be insignificant. From 1974 through 1978, the annual pumping rate ranged from 5,900 to 9,100 acre-feet per year, and the pumpage return flow ranged from 900 to 1,500 acre-feet per year. The aquifer properties of transmissivity (about 5,900 feet squared per day) and of the storage coefficient (0.19) were estimated from and average alluvial thickness of 75 feet and from less well-defined data on specific capacity and grain-size distribution. Calibration of the values for hydraulic conductivity and storage coefficient for the lower valley accounted for the smaller grain size there. The river characteristics were based on field and laboratory analyses of hydraulic conductivity and on survey data. The model is intended principally for simulation of flow conditions using monthly time-steps. Time variations in transmissivity and in short-term, high-recharge potential are included in the model. (USGS)
W86-02869

EFFECTS OF ARTIFICIAL RECHARGE ON THE BIG SIOUX AQUIFER IN MINNEHAHA COUNTY, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02870

HYDROGEOLOGIC SETTING EAST OF LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
J. B. Foster, G. Garklavs, and G. W. Mackey.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4183, 1984. 20 p, 13 fig, 7 ref.

Descriptors: *Geohydrologic units, *Stratigraphy, *Illinois, *Radioactive waste, *Waste disposal, Groundwater, Groundwater pollution, Water pollution sources, Strip mines, *Glacial aquifer.

Core samples from 45 test wells and 4 borings were used to describe the glacial geology of the area east of the low-level radioactive-waste disposal site near Sheffield, Bureau County, Illinois. Previous work has shown that shallow ground water beneath the disposal site flows east through a pebbly-sand unit of the Toulon Member of the Glasford Formation. The pebbly sand was found in core samples from wells in an area extending northeast from the waste-disposal site to a strip-mine lake and east along the south side of the lake. Other stratigraphic units identified in the study area are correlated with units found on the disposal site. The pebbly-sand unit of the Toulon Member grades from a pebbly sand on site into a coarse gravel with sand and pebbles towards the lake. The Hulick Till Member, a key bed, underlies the Toulon Member throughout most of the study area. A narrow channel-like depression in the Hulick Till is filled with coarse gravelly sand of the Toulon Member. The filled depression extends eastward from near the northeast corner of the waste-disposal site to the strip-mine lake. (USGS)
W86-02871

GROUND-WATER RESOURCES OF THE MATTAPOISETT RIVER AQUIFER, PLYMOUTH COUNTY, MASSACHUSETTS: SUMMARY FOR WATER-RESOURCE MANAGERS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02874

GROUND-WATER CONDITIONS AND SHALLOW TEST-WELL INFORMATION IN THE EASTERN HALF OF MERCED COUNTY, CALIFORNIA, 1977-82,

Geological Survey, Sacramento, CA. Water Resources Div.
A. L. Elliott.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4081, 1984. 56 p, 77 fig, 1 tab, 5 ref.

Descriptors: *Aquifers, *Groundwater level, Groundwater recharge, Observation wells, Potentiometric level, Test wells, Well logs, Data collections, Hydrologic data, *California, Merced.

The city of Merced, other municipalities, and irrigation in the vicinity of Merced in the San Joaquin Valley of California depend on ground water for water supply. Water-level data for 1977-81 show that there has been no significant change in water levels, indicating that during this period, recharge in the Merced area balance natural discharge and withdrawals by pumping. Lithologic logs of shallow test wells drilled around Merced indicate shallow fine-grained material in the aquifer that could interfere with surface artificial recharge to the aquifer system. Short-term and seasonal fluctuations of water levels in wells perforated at different depths and in different aquifers show dissimilar patterns in some areas. The expansion and refinement of the observation-well network will provide a data base for water-management decisions and for assessments of ground-water conditions in the future. (USGS)
W86-02876

INTERPOLATING WATER-TABLE ALTITUDES IN WEST-CENTRAL KANSAS USING KRIGING TECHNIQUES,

Geological Survey, Lawrence, KS. Water Resources Div.
L. E. Dunlap, and J. M. Spinazola.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Supply Paper 2238, 1984. 19 p, 10 fig, 18 ref.

Descriptors: *Approximation method, *Time series analysis, *Groundwater levels, *Reliability, Hydrologic data. Water distribution(Applied), Water management(Applied), Statistical methods, Kriging, *Kansas.

Kriging is a regionalization technique that incorporates autocorrelation between known data values in its estimation of values at unmeasured sites. This technique is reproducible, accepts irregularly spaced data, uses only measured values for closely surrounding points where it estimates values, is an exact interpolator at measured data points, and calculates an error of estimate. Kriging was used to interpolate water-table altitudes from 1978 and averaged 1978-80 measurements of the Ogallala aquifer in the Western Kansas Groundwater Management District No. 1. An altitude and error of estimate were provided at the center of each 1-mile section in the management district. The data were related to altitudes of the bedrock and the 1950 water table. A digital contouring procedure was used to provide maps of the water table (1978 and average 1978-80), the errors of estimate, the saturated thickness of the aquifer (1978 and average 1978-80), and the percentage changes in saturated thicknesses since 1950. Maps made by kriging compared favorably with maps contoured manually by the point-intersection technique. (USGS)
W86-02880

CHEMICAL QUALITY OF GROUND WATER IN YOLO AND SOLANO COUNTIES, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
K. D. Evenson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4244, 1985. 50 p, 19 fig, 11 tab, 26 ref.

Descriptors: Groundwater, *Irrigation water, Water quality, Water quality standards, *Groundwater quality, Data collections, *California, Yolo County, Solano County.

Ground-water-quality conditions were investigated in Yolo and Solano Counties during the summers of 1980 and 1981 by sampling 188 representative wells. Chemical analyses of the water samples show that the ground water is suitable for domestic and most agricultural purposes. Water samples from wells near the Sacramento River generally contained lower concentrations of dissolved solids and higher concentrations of trace elements than the rest of the study area. Ninety percent of the water sampled had a dissolved-solids concentration of less than 850 milligrams per liter. Chemical water types varied, with 72 percent of the wells sampled containing either sodium bicarbonate, magnesium bicarbonate, sodium-magnesium bicarbonate, or magnesium-sodium bicarbonate type water. A large part of the study area contains ground water with boron concentrations that exceed tolerance levels for many crops. Other toxic trace elements were present in negligible amounts. (USGS)
W86-02884

EXAMPLE CALCULATIONS OF POSSIBLE GROUND-WATER INFLOW TO MINE PITS AT THE WEST DECKER, EAST DECKER, AND PROPOSED NORTH DECKER MINES, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02886

SUMMARY OF WATER RESOURCES DEVELOPMENT AND HYDROLOGIC DATA OF SAIPAN, MARIANA ISLANDS,

Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02887

GEOHYDROLOGY AND GROUND-WATER QUALITY MONITORING NETWORK FOR THE LOWER MOJAVE RIVER VALLEY, CALIFORNIA,

Geological Survey, Santee, CA. Water Resources Div.
L. R. Woolfenden.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4148, 1984. 58 p, 8 fig, 10 tab, 23 ref.

Descriptors: Hydrology, Surface water, *Geohydrology, Groundwater, Groundwater quality, Land use, *Groundwater quality monitoring network, Lower Mojave River Valley, Coyote Lake Valley, Caves Canyon Valley, Barstow, San Bernardino County, *California.

A ground-water-quality monitoring network was developed for the Lower Mojave River valley to define the ground-water quality of the valley. Basin geohydrology, geology, land use and water-level and water-quality data were factors considered in developing objectives for an ideal network. These objectives were used in selecting well locations for the conceptual ground-water-quality monitoring network. The conceptual network was used as a guide in the design of the ground-water-quality monitoring network. Active monitoring sites are wells that are currently being monitored by some agency and were selected whenever possible because of budgetary constraints. In areas where no wells are currently being monitored, new well locations were selected and are considered proposed monitoring sites. A sampling regimen is also included. (USGS)
W86-02888

GEOHYDROLOGIC AND DRILL-HOLE DATA FOR TEST WELL USW H-4, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,

Geological Survey, Denver, CO. Water Resources Div.
M. S. Whitfield, W. Thordarson, and E. P. Eshom.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-449, 1984. 39 p, 26 fig, 9 tab, 7 ref.

Descriptors: *Aquifer tests, *Transmissivity, *Hydraulic conductivity, *Radioactive-tracer flow survey, *Geophysical logging, Chemical analysis, *Nevada, *Groundwater movement, Nye County, Nevada Test Site, Yucca Mountain.

Data are presented on drilling operations, lithology, geophysical well logs, sidewall-core samples, water-level monitoring, pumping tests, injection tests, radioactive-tracer borehole flow survey, and water chemistry for test well USW H-4. The well is one of a series of test wells drilled in the southwestern part of the Nevada Test Site, Nye County, Nevada, in cooperation with the U.S. Department of Energy. These test wells are part of the Nevada Nuclear Waste Storage Investigations to identify sites for storage of high-level radioactive wastes. Test well USW H-4 was drilled in ash-flow tuff to a total depth of 1,219 meters. Depth to water below land surface was 519 meters or at an altitude of 730 meters above sea level. After test pumping at a rate of 17.4 liters per second for approximately 9 days, the drawdown was 4.85 meters. A radioactive borehole-flow survey indicated that the Bullfrog Member was the most productive geologic unit, producing 36.5 percent of the water in the well. The second most productive geologic unit was the Tram Member, which produced 32 percent of the water. The water in test well USW H-4 is predominantly a soft, sodium bicarbonate type of water typical of water produced in tuffaceous rocks in southern Nevada. (USGS)
W86-02895

RESULTS OF GEOHYDROLOGIC TEST DRILLING IN THE EASTERN SNAKE RIVER PLAIN, GOODING COUNTY, IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
R. L. Whitehead, and G. F. Lindholm.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4294, 1985. 30 p, 7 fig, 4 tab, 17 ref.

Descriptors: Test holes, *Piezometers, *Water table fluctuations, *Core drilling, Confining beds, Basalts, *Borehole geophysics, Drillers' logs, Geologic control, Hydrogeology, Snake River Plain, *Idaho, Gooding County.

A 1,123-foot test hole was core drilled near Wendell, Idaho, during 1981-82 as part of the Snake River Plain regional aquifer study. An upper basalt unit, an intermediate unconsolidated sedimentary rock unit, and a lower basalt unit were penetrated by the test hole. Drilling verified that the upper several hundred feet of high-resistivity material, as determined by surface electrical soundings, is basalt. Core examination, laboratory analysis, and correlation with other drill holes indicated that the basalt is typical of Quaternary basalt of the Snake River Group. Quaternary basalt in the test hole is 200 feet thick. Correlation with other drill holes and comparison with rock outcrops near the Snake River and in the Snake River canyon suggest that the underlying sediments and lower basalt unit are parts of the Tertiary and Quaternary Glenns Ferry Formation and Tertiary Banbury Basalt. Piezometers in the hole verify upward movement of water in a major discharge area for the regional aquifer. Hydraulic head in the bottom of the hole is about 155 feet higher than the water table. Lithologic sequence in the test hole correlates well with sequences in deep drill holes at scattered locations on the plain. (USGS)
W86-02896

GEOHYDROLOGY OF THE CENTRAL MESILLA VALLEY, DONA ANA COUNTY, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
C. A. Wilson, and R. R. White.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 82-555, 1984. 144 p, 16 fig, 5 tab, 11 ref.

Descriptors: Deep wells, Irrigation wells, Observation wells, *Groundwater, Aquifers, *Aquifer characteristics, Water quality, Transmissivity, Drawdown, Hydraulic conductivity, Drains, *New Mexico, Mesilla Valley, Elephant Butte Irrigation District, Rio Grande.

Five large-capacity irrigation wells, with depths ranging from 370 to 686 feet, were drilled by the Elephant Butte Irrigation District between 1973 and 1975, in the Mesilla Valley about 7 miles south of Las Cruces, New Mexico. These were the first deep wells in the area, and their installation provided an opportunity to conduct extensive aquifer tests under relatively undisturbed conditions. The deep irrigation wells are perforated in the Santa Fe Group of Miocene to Pleistocene Age. The Santa Fe Group is composed of interfingering and alternating beds of clay, silt, sand, and small gravel. In the area of these wells, the upper part of the saturated zone contains slightly saline water to a depth of about 100 to 175 feet below the water table, underlain by a freshwater zone extending to depths greater than 1,200 feet. As water is pumped from the freshwater zone, leakage occurs from above and below the perforated interval. At one of the irrigation district wells, slightly saline water moved downward because of a lack of confining layers in the aquifer. At three other wells, the surface casing was not set deep enough and slightly saline water moved into the top of the perforations, downward in the casing, and into the freshwater part of the aquifer. (USGS)
W86-02898

AQUIFER TESTS IN WEST-CENTRAL FLORIDA, 1952-76,

Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Wolansky, and M. A. Corral.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4044, 1985. 127 p, 11 fig, 3 tab, 35 ref.

Descriptors: *Aquifer characteristics, Aquifers, Transmissivity, Storage coefficient, Leakage, Groundwater, *Florida, *Hydrogeology, *Floridan aquifer, Intermediate aquifer, Surficial aquifer, Confining beds, Leakance.

The ground-water system in west-central Florida is composed of, in descending order, the surficial (usually unconfined) aquifer, intermediate aquifer and confining beds, Floridan aquifer, and lower confining bed. Aquifer test data were analyzed to determine transmissivity, storage coefficient, leakance, and vertical hydraulic conductivity of the aquifers and confining beds. Transmissivities obtained from 29 aquifer tests range from 1,900 to 920,000 feet squared per day for parts of the Floridan aquifer, about 740 to 7,800 feet squared per day for the intermediate aquifer, and about 220 to 600 feet squared per day for the surficial aquifer. Storage coefficients obtained from aquifer tests range from 0.00013 to 0.0015 for the Floridan aquifer, 0.00005 to 0.00017 for the intermediate aquifer, and 0.004 to 0.02 for the surficial aquifer. The values of leakance obtained from aquifer tests range from 0.00005 to 0.009 feet per day per foot for the Floridan and 0.0002 to 0.0007 feet per day per foot for the intermediate aquifer. (USGS)
W86-02899

EFFECTS OF FRACTURING ON WELL YIELDS IN THE COALFIELD AREAS OF WISE AND DICKENSEN COUNTIES, SOUTHWESTERN VIRGINIA,

Geological Survey, Richmond, VA. Water Resources Div.
W. G. Wright.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4061, 1985. 21 p, 7 fig, 4 tab, 11 ref.

Descriptors: *Groundwater, *Fracture permeability, *Aquifer testing, Coal mining, *Virginia, *Hydrogeology, *Injection testing, Lineaments.

Fracturing associated with lineaments are the primary influence on yields from wells in the coalfields of southwestern Virgnia. Graphical comparison of yield from wells shows that wells located in valleys with lineaments produce larger quantities of water than wells in valleys without lineaments. Pumping tests at wells located in valleys with lineaments indicate transmissivities as high as 598 ft2/d, caused principally by secondary permeability. Analysis of data collected from packer-injection tests in a test hole located on a ridge indicate relatively large hydraulic conductivities ranging from 2x10(sup -2) to 1x10(sup -1) feet per day in upper parts of the test hole, compared to values typical of unfractured rocks in the study area. Fracturing due to stress relief contribute to these large values. Yields from wells located on lineaments are consistently higher than well yields from wells in unfractured rock in the study area, but well yields from wells placed randomly in areas suspected of having stress relief fractures cannot be predicted. (USGS)
W86-02900

GROUND WATER IN THE DICKSON AREA OF THE WESTERN HIGHLAND RIM OF TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
M. W. Bradley.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 82-4088, 1984. 42 p, 27 fig, 10 tab, 18 ref.

Descriptors: *Groundwater, *Geohydrology, Groundwater availability, Carbonate rocks, Well data, Groundwater data, Western Highland Rim, *Tennessee, Mississippian formations.

A hydrologic study of the Dickson, Tennessee, area provided additional information on the occurrence of ground water in the Mississippian carbonate rocks of the western Highland Rim. Twenty-six test wells were drilled to determine the occurrence of ground water in relation to topographic position, regolith thickness, streamflow gains or losses, and the lithology of the underlying formations. Yields to 26 test wells ranged from 0 to about 300 gal/min and averaged about 68 gal/mi. Nine wells yielded 80 to about 300 gal/min; their specific capacities ranged from about 0.71 to 12.7 (gal/min)/ft of drawdown. Seven of these nine wells yielded water from solution openings in the Warsaw Limestone. The other two wells yielded water from gravel and sand in the regolith. Yield-specific-capacity tests were made on two wells. One well was pumped at an average rate of 350 gal/min for 72 hours with 39.77 feet of drawdown. The second well was pumped for 8 hours at 120 gal/min with 20.86 feet of drawdown. The water from both wells was generally of good quality. Dissolved solids concentrations were less than 200 mg/L. (USGS)
W86-02901

RECONNAISSANCE OF GROUND-WATER RESOURCES IN THE LOWER GUNNISON RIVER BASIN, SOUTHWESTERN COLORADO,

Geological Survey, Grand Junction, CO. Water Resources Div.
T. Brooks, and D. J. Ackerman.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4185, 1985. 30 p, 5 fig, 6 tab, 17 ref.

Descriptors: Aquifers, *Groundwater availabilty, *Water quality, *Alluvial aquifers, Geohydrology, Springs, Wells, Mancos Shale, Mesaverde Formation, Dakota Sandstone, Lower Gunnison River basin, Montrose County, Delta County, Mesa County, *Colorado.

Information about ground-water quantity and quality in the lower Gunnison River basin assists in developing, appropriating, and managing the basin's water resources. Hydrogeologic data are presented for 51 wells and 61 springs. Chemical analyses are given for 34 wells and 17 springs. Drillers' reports for 71 wells are included. Springs normally discharge from short alluvial flow systems and commonly are less saline than well water. These springs are a calcium magnesium bicarbonate water type. Spring discharges of as much as 200 gallons per minute were measured. The most productive wells in the study area are completed in alluvium, with reported yields of as much as 750 gallons per minute for an irrigation well. Alluvial gravels are most productive. Specific-conductance values of water samples from alluvial deposits ranged from 80 to 32,200 micromhos per centimeter at 25 Celsius. The Mancos Shale and Mesaverde Formation include aquifers with large areal extents. Reported yields of wells completed in the Mesaverde Formation range from 0.7 to 24 gallons per minute. The Dakota Sandstone, Morrison Formation, and Entrada Sandstone include potential aquifers of lesser extent. Reported yields of wells completed in the Dakota Sandstone range 5 to 14 gallons per minute in the study area. Specific-conductance values of water samples from the Mesaverde Formation ranged from 325 to 5,390 micromhos per centimeter at 25 Celsius. Insufficient data prevented water-quality analysis of other rock units. (USGS)
W86-02902

COMPILATION OF SELECTED HYDROLOGIC DATA FROM THE MX MISSILE-SITING INVESTIGATION, EAST-CENTRAL NEVADA AND WESTERN UTAH,

Geological Survey, Carson City, NV. Water Resources Div.
R. L. Bunch, and J. R. Harrill.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-702, 1984. 123 p, 2 fig, 48 ref.

Descriptors: *Springs, *Water level, *Water quality, Discharge measurement, *Great Basin, *Nevada, *Utah, Hydrologic data.

Construction, water-level, and water-quality data for wells and site-description, discharge, and water-quality data for springs and streams in 37 hydrographic areas in Nevada and Utah are presented in the report. These data are grouped in tables, by area. Additional tables contain a summary of data and aquifer-test results for wells in valley-fill deposits at 42 sites in Nevada and Utah and for wells in carbonate rocks at five sites in Nevada. The data in the report were gathered by Ertec Western, Inc., or their subcontractors, for the U.S. Department of the Air Force as part of the MX missile-siting project and were originally presented in a number of individual reports. (USGS)
W86-02903

HYDROLOGIC SETTING OF MIRROR LAKE, WEST THORNTON, NEW HAMPSHIRE,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W86-02905

DESIGN OF A GROUND-WATER QUALITY MONITORING NETWORK FOR THE SALINAS RIVER DRAINAGE BASIN, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02909

GROUND-WATER WITHDRAWALS FROM THE COASTAL PLAIN OF NEW JERSEY, 1956-1980,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02911

HYDROLOGY OF AREA 56, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02913

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE NORTHERN GREAT PLAINS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING--FRESHWATER HEADS AND GROUND-WATER TEMPERATURES IN AQUIFERS,

Geological Survey, Lakewood, CO. Water Resources Div.
D. H. Lobmeyer.
Available from Dist Branch, USGS 604 S. Pickett St Alexandria, VA 22304. USGS Professional Paper 1402-D, 1985. 11 p, 7 fig, 27 ref.

Descriptors: Water temperatures, *Groundwater, Aereal hydrology, Potentiometric levels, *Great Plains, Montana, North Dakota, South Dakota, Wyoming, *Regional analysis, Geohydrologic units, Powder River basin, Williston basin, Tertiary aquifer, Upper Cretaceous aquifer, Lower Cretaceous aquifer.

Potentiometric surfaces of the Tertiary aquifer, the Upper Cretaceous aquifer, and the Lower Cretaceous aquifer in the Northern Great Plains of Montana, North Dakota, South Dakota, and Wyoming generally follow land-surface gradients except in areas where geologic structure or lithologic change cause large differences in transmissivity, flowpath, or both. Ground-water temperatures generally are controlled by the burial depth of the aquifer. Actual-equilibrium water temperatures are estimated to range from about 7 to about 174C. No areally extensive temperature anomalies were detected. Water temperatures in the Upper Cretaceous and Lower Cretaceous aquifers were mapped. Potentiometric surfaces referred to pure water at 4C are mapped for the Tertiary aquifer, the Upper Cretaceous aquifer, and the Lower Cretaceous (Dakota) aquifer in the Northern Great Plains. Water temperatures also were mapped for the Upper Cretaceous aquifer and the Lower Cretaceous aquifer. (USGS)
W86-02914

RECONNAISSANCE EVALUATION OF CONTAMINATION OF THE ALLUVIAL AQUIFER IN THE EAST POPLAR OIL FIELD, ROOSEVELT COUNTY, MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02915

GROUND-WATER WITHDRAWALS AND CHANGES IN THE WATER LEVELS IN THE HOUSTON DISTRICT, TEXAS, 1975-79,

Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02918

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, 1930,

Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02919

2G. Water In Soils

UTILIZATION OF THERMAL EMITTANCE DATA TO MONITOR SOIL MOISTURE AND SUBSURFACE GROUNDWATER,

South Dakota State Univ., Brookings. Dept. of Physics.
For primary bibliographic entry see Field 2F.
W86-02429

RELATIONSHIP BETWEEN SOIL MOISTURE STORAGE AND DEEP PERCOLATION AND SUBSURFACE RETURN FLOW,

Texas Water Resources Inst., College Station.
J. L. Nieber.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211688/AS, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, 1984. 88 p, 3 tab, 43 fig, append 19 ref. B-248-TEX(1). 14-34-0001-1269.

Descriptors: *Return flow, *Percolation, *Soil moisture, Simulation study, Finite element analysis, Richards equation, *Texas.

A simulation study was performed to analyze the relationship between the volume of moisture stored in a soil profile and the rate of percolation and subsurface return flow. The simulation study was derived on the basis of the Richards equation. The one-dimensional form of the Richards equation was used for the subsurface return flow process. In each case the Richards equation was transformed to a set of nonlinear algebraic equations using the finite element method to transform the space derivatives and the finite difference method to transform the time derivatives. The system of nonlinear algebraic equations were solved using the Gaussian elimination procedure and an under-relation procedure. To characterize the percolation and subsurface return flow processes a sensitivity analysis was performed by varying parameters of the soil systems. It was found that the relationships between stored soil moisture and deep percolation and between stored soil moisture and subsurface return flow each form hysteresis loops. The percolation loops were most sensitive to soil texture class, and water application rate and relatively insensitive to soil layering, evapotranspiration, and water table depth. The subsurface return flow loops were sensitive to soil texture, soil slope angle, length of the soil slope relative to soil depth, and water application rate and relatively insensitive to soil layering. The resulting percolation and subsurface return flow characteristics suggest the possibility of utilizing the derived characteristics in the physical representation of these processes in comprehensive hydrologic models.
W86-02439

ACID PRECIPITATION: COMPOSITIONAL CHANGES DURING THROUGHFALL; SOIL WATER,

Vermont Univ., Burlington. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W86-02457

ADAPTING THE WATER MANAGEMENT SIMULATION MODEL DRAINMOD FOR THE GREAT LAKES REGION,

Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
G. E. Merva, T. L. Loudon, and P. N. Brink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214807/AS, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report. Michigan Institute of Water Research, East Lansing, September, 1984. 55 p, 10 fig, 2 tab, 30 ref. USGS G849-06.

Descriptors: *Mathematical models, *Soil water movement, *Computer programs, Water management, Model, Simulation, Drainage, Subirrigation, Michigan.

A soil water simulation management model, DRAINMOD, developed at North Carolina State University was tested and adapted for use in the North Central Region of the United States, particularly Michigan. DRAINMOD is capable of characterizing the response of the soil water regime to various combinations of surface and subsurface water management. The program was converted from mainframe FORTRAN into BASIC for use on a micro-computer to improve ease in use and increase its availability to contractors, consultants, and agency people. Appropriate modifications to the model, made in close coordination with agricultural engineers in the North Central Region were made to the model so that it could be utilized for design and analysis of drainage and subirrigation systems applicable in the North Central region. Data from a field in Tuscola county, Michigan, was obtained and a 15 year simulation was run to assess the performance of the model, to demonstrate its use, and to compare the predicted results obtained with farmer's subirrigation practices. Use of the model can improve understanding and provide for more rational design of subsurface drainage and subirrigation systems.
W86-02483

FACTORS INFLUENCING, INFILTRATION, FLOW, INSTABILITY, AND MOVEMENT OF TOXICS IN LAYERED FIELD SOILS,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W86-02527

LATERAL MOISTURE MOVEMENTS IN UNSATURATED ANISOTROPIC MEDIA,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
A. Giorgini, M. Bergman, J. Pravia, and A. Hamidi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225860/AS, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No. 169, September, 1984. 105 p, 25 fig, 1 tab, 108 ref, append. USGS G841-03.

Descriptors: *Infiltration, Percolation, Storm Seepage, *Path of pollutants, *Soil water movement, *Unsaturated flow, *Indiana, Finite difference analysis.

Traditionally, in the area of water resources, interests are focused on contamination of groundwater basins and surface water basins, and the subsequent distribution of those contaminants in our environment. In the study presented in this report, it is emphasized that the contamination processes involve, additionally, the vadose zone below the soil surface. In this respect, the classical approach, which assumes only vertical infiltration, is abandoned and a more comprehensive theory which includes inclination of the soil surface and anisotropic hydraulic conductivity, is developed. For these more general conditions, an infiltration model is presented, which is in form and structure similar to the equation of solely vertical infiltration. It is shown that, under particular conditions which are chosen so as to emphasize the importance of the problem, lateral infiltration occurs and that it may be more dominant than vertical infiltration. Because the proposed infiltration model is similar in form and structure to the vertical infiltration model, a numerical solution of the latter is presented by means of an explicit finite difference scheme. The boundary conditions constraining the solution are relaxed with respect to soil moisture content at the surface for the beginning of the infiltration process. This condition supports the philosophy underlying this study, namely the formulation of a general infiltration model as opposed to a simple vertical infiltration model.
W86-02562

CHARACTERIZING WATER MOVEMENT IN THE WEATHERED ZONE OF GLACIAL TILLS UNDER CONTINUOUS IRRIGATION,

South Dakota State Univ., Brookings. Water Resources Research Inst.
For primary bibliographic entry see Field 2F.
W86-02626

EVALUATION OF 0.1 N NAHCO3 EXTRACTION FOR DETERMINATION OF AVAILABLE NITROGEN,

Delaware Univ., Newark. Dept. of Plant Science.
L. J. Cotnoir, and M. R. Teel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101227/AS, Price codes: A03 in paper copy, A01 in microfiche. Delaware Water Resources Center, Technical Completion Report, Newark, July 1983. 42 p, 2 fig, 18 tab, 57 ref. A-049-DEL(1).

Descriptors: *Agricultural runoff, *Groundwater pollution, *Soil chemistry, *Fertilizers, Crop yield, Nitrogen, Nitrates, Organic matter, Agricultural chemicals, Crop production, Nitrogen compounds.

Soil samples from research plots exhibiting variations in residual soil N were used to determine whether extraction with 0.01 NaHCO3 could be used as a reliable and rapid method for measuring available soil N. In order to determine the variation in N released, samples were incubated for a two month period and NO3 production was measured. UV absorptive values of NaHCO3 extracts were weakly correlated with NO3 production after varying periods of incubation. Values from the incubation determinations and NaHCO3 extractions were regressed against organic matter, leaf N content of corn and corn yields. NaHCO3 extracts were positively and significantly correlated to leaf N, positively but not significantly correlated to soil organic matter, and not correlated to corn yields. Soil organic matter was positively and significantly correlated to corn yields. NO3 production on incubation was positively and significantly correlated to soil organic matter for the final two weeks of incubation but not for the earlier periods of incubation. There was a positive but not significant correlation between the amount of NO3 produced on incubation and leaf N and corn yield. The highest degree of correlation was between corn leaf N and corn yield. The N content of corn leaves at the time of tasseling was the best predictor of corn yields. Neither the amount of NO3 produced by incubation nor the amount of organic matter extracted with NaHCO3 were reliable indicators of soil N availability or predictors of corn yields. (Author)
W86-02703

2H. Lakes

EVALUATION OF NITROGEN AND PHOSPHORUS ENRICHMENT USING IN SITU ENCLOSURE BAGS WITH TEMPORAL INDIGENOUS PHYTOPLANKTON POPULATIONS,

Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
R. L. Meyer, and W. R. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211787/AS, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project Completion Report, Pub. No. 110, Sept. 1984. 33 p, 7 tab. USGS G-829-04.

Descriptors: *Nitrogen, *Phosphorus, *Arkansas, Enclosures, Lakes, Phytoplankton, Algae, Standing crop, Limiting factors, Eutrophication, Bioassay.

An in situ experimental procedure and protocol was developed to evaluate nitrate and phosphate enrichment using isolated indigenous phytoplankton assemblages during different seasons. Results of the comparison of the parameters-temperature, pH, alkalinity, conductivity, and dissolved oxygen between the open water and enclosed systems indicated that there was no significant influence of the physicochemical factors on the isolated biological processes. Growth responses were measured by turbidity, biomass and chlorophyll-a, the most sensitive being chlorophyll-a. Additions of nitrate and phosphate were added in known concentrations and in different magnitudes of concentration based upon ambient conditions and ratio. During the fall, phosphorus influenced phytoplankton growth, whereas in the spring, both nutrients effect growth response equally, and in the summer nitrate had the greatest influence. Based upon the results of these experiments a sampling regime for physicochemical parameters and growth response is recommended.
W86-02449

HYDRILLA MANAGEMENT IN NORTH CAROLINA,

North Carolina State Univ. at Raleigh. Dept. of

Zoology.
R. G. Hodson, G. J. Davis, and K. E. Langeland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215044/AS, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report No. 217, North Carolina Water Resources Research Institute, Raleigh, August 1984. 63 p, 8 fig, 9 tab, 28 ref. USGS G860-03.

Descriptors: *Aquatic weed control, *Aquatic weeds, *Herbicides, *Water management, *Hydrilla, Water level fluctuations, Weed control, Carp, Tilapia, Grass carp. *North Carolina.

Studies of the phenology and management of hydrilla were conducted in lakes and ponds in Wake County, North Carolina during July 1982-July 1984. Growth of hydrilla began in late March to early April when water temperature was 11-13C. Standing crop biomass peaked in September at 180 to 375 g m-2 dry weight. No plant beds overwinter in North Carolina. Hydrilla reproduces asexually by tubers, turions, plant fragments and stolons. Tubers, which form in the hydrosoil, are the primary means for hydrilla to overwinter in North Carolina. Grass carp (Ctenopharyngodon idella) controlled hydrilla when stocked at 50 or more per hectare. Areas stocked with grass carp in spring 1983 had no measurable biomass in September 1983 or June 1984. Redbelly tilapia (Tilapia zilli) stocked at 700 and 2800/ha reduced attached biomass by 50% but produced a substantial amount of floating fragments. Herbicide control of hydrilla was variable among different herbicide treatments, location of treatments and time of application. Diquat + copper and copper alone gave partial and temporary control in some plots in June. Very good control was observed in Reedy Creek Lake but not in Lake Anne after June treatments with endothal. None of the August or September treatments were successful. Poor control with herbicides was thought to be due to one or more of several factors such as absorption by suspended clay and organic particulates, depth and dilution. Drawdown treatments were completely ineffective in controlling hydrilla.
W86-02507

ANALYSIS OF THE WATER BALANCE OF B. EVERETT JORDAN LAKE INCLUDING ESTIMATES OF FLOWS BETWEEN SEGMENTS,

North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 4A.
W86-02686

ASSESSING HABITAT SUITABILITY FOR WALLEYE (STIZOSTEDIAN VITREUM) AND POSSIBLE SPECIES INTERACTIONS WITH SALMONID FISHES,

Idaho Univ., Moscow. Dept. of Fish and Wildlife.
D. H. Bennett, and T. J. McArthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249092/AS, Price codes: A04 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow Completion Report, January, 1985, 62 p, 3 fig, 5 tab, 43 ref. USGS G839-07. 14-08-0001-G839.

Descriptors: *Idaho, *Computer models, Exotic fishes, *Fish habitat, Mathematical models.

Exotic fishes and their interactions with resident fish communities have been a concern of fisheries managers for years. Focusing on walleye (Stizostedion vitreum) as an exotic fish, discriminant and loop analyses were used to assess habitat suitability and possible interactions with salmonid fishes. Results corroborate previous field observations and published literature.
W86-02688

TROPHIC STATE INDEX FOR THE LOUISIANA COASTAL ZONE,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
A. S. Witzig, and J. W. Day.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101292/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Report to the Louisiana Water Resources Research Institute, Baton Rouge, April 1983. 35 p, 4 fig, 9 tab, 32 ref. A-047-LA(2).

Descriptors: *Louisiana, *Trophic level, Multivariate analysis, *Chemical properties, *Eutrophication, Nitrogen, Phosphorus, Chlorophyll, Statistical methods, Water quality, Turbidity, Statistical models, Mathematical studies, Estuaries.

A multivariate trophic state index (TSI) was developed from an investigation of water chemistry in the Barataria basin Louisiana, based on a principal component analysis of 4 variables (total organic N, total P, secchi depth and chlorophyll a) for 23 sampling stations in the Barataria basin. A cluster analysis of the same 4 variables and stations defined 3 groups of stations with similar trophic characteristics. By comparison with other trophic classifications, these groups represent mesotrophic to very eutrophic water quality. The TSI was tested with several sets of independently collected data: water chemistry data collected in the middle portion of the Barataria basin; data from Lake Pontchartrain, Louisiana, and surrounding wetlands; and primary productivity measurements in the Barataria basin. Carlson's (1977) trophic state indices for secchi depth, chlorophyll a and total P were also calculated from the original set of data for comparison with the multivariate TSI. The results of the first 3 comparisons were very satisfactory in that they illustrated the practical application of the TSI as well as natural variation in trophic state due to changing environmental conditions. Although Carlson's indices were highly correlated with the multivariate TSI, the discrepancy between the chlorophyll a index and the others indicate that this more simple method is not appropriate for the highly turbid waters of the Barataria basin. (Author)
W86-02710

FATE OF PHOSPHORUS IN SECONDARILY TREATED WASTEWATER APPLIED TO A FRESHWATER MARSH,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5E.
W86-02720

RELATIONSHIP BETWEEN CHEMICALLY DETERMINED AND BIOLOGICALLY AVAILABLE FORMS OF PHOSPHORUS IN LAKES AND STREAMS,

Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-02721

INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY, VOLUME 2--HYDROLOGIC ANALYSIS,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02777

CHEMICAL AND BIOLOGICAL QUALITY OF SELECTED LAKES IN OHIO, 1978 AND 1979,

Geological Survey, Columbus, OH. Water Resources Div.
C. G. Angelo, and J. D. Youger.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-249, 1985. 294 p, 65 fig, 147 tab, 54 ref.

Descriptors: *Lakes, *Reservoirs, *Water quality, Hydrologic data collections, Chemical properties, Physical properties, Algae, Bacteria, Limnology, *Ohio.

Twenty-eight Ohio lakes were sampled by the U.S. Geological Survey and the Ohio Environmental Protection Agency for water-quality characteristics during 1978 and 1979. Chemical, physical, and biological data were collected at specific points in the water column. Selected physical and chemical data were also collected in the principal inflows. The lakes were predominately hard to very hard water, although several soft-water lakes were found in southeastern Ohio. Calcium, bicarbonate, and sulfate were the principal constituents. Specific conductance ranged from 103 to 2,250 micromhos per centimeter. Thirteen lakes had trace-element concentrations above the limits for exceptional warmwater habitat recommended by the Ohio Environmental Protection Agency. Seasonal thermal gradients developed in most lakes deeper than 17 feet. Anaerobic or nearly anaerobic conditions were observed during the summer sampling of the bottom waters of all lakes having suitable thermal gradients. Many anaerobic zones contained hydrogen sulfide and high concentrations of ammonia. All lakes were evaluated and classified by Carlson's trophic state index. Most lakes were classified as eutrohic. Fecal coliform counts were within Ohio standards, although high feca coliform and fecal streptococcus counts were observed after significant runoff. (USG)
W86-02786

WATER-QUALITY CHARACTERISTICS OF ABHA RESERVOIR, ABHA, SAUDI ARABIA,

Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02820

GAZETTEER OF SURFACE-MINE LAKES, EASTERN INTERIOR COAL PROVINCE, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02831

PHOSPHORUS LOADING TO MCGRATH AND ELLIS PONDS, KENNEBECK COUNTY, MAINE,

Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02859

ESTIMATED WATER AND NUTRIENT INFLOWS AND OUTFLOWS, LAKE COCHITUATE, EASTERN MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02904

HYDROLOGIC SETTING OF MIRROR LAKE, WEST THORNTON, NEW HAMPSHIRE,

Geological Survey, Lakewood, CO. Water Resources Div.
T. C. Winter.
Available from OFSS, USGS Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4266, 1984. 61 p, 33 fig, 5 tab, 27 ref.

Descriptors: *Limnology, Water budget, *Groundwater movement, Evaporation, *Groundwater-surface-water relationships, *Hydrogeology, *New Hampshire, Mirror Lake.

The drainage basin of Mirror Lake, New Hampshire is characterized by high knobs and ridges and steep land slopes. The lake is situated in the lower part of the basin, largely within glacial drift. Drift in most of the Mirror Lake drainage basin is till, which is as much as 50 meters thick, Crystalline bedrock underlying the drift is composed of schist, slate, and quartz monzonite of earliest Devonian age. These rocks are intensely folded and contain numerous fractures. Three small streams flow into Mirror Lake. Streamflow discharge into Mirror Lake differs between the two largest subbasins. Basin NW, which has a more round shape and thicker glacial drift than basin W, has greater stream discharge as well as greater sustained base flow. Ground water moves into most parts of

Mirror Lake, and losses to ground water occur principally on the southeast side. Water-level data from piezometers and bedrock wells indicate dynamic ground-water movement within the fractured bedrock underlying Mirror Lake. These data also indicate very active interchange of ground water between bedrock and the overlying glacial drift. There are particularly strong hydraulic head gradients from the bedrock into the drift in the area between Mirror Lake and Hubbard Brook. (USGS)
W86-02905

2I. Water In Plants

WETLANDS FOREST COMMUNITIES AS INDICATORS OF FLOODING POTENTIAL IN BACKWATER AREAS OF RIVER BOTTOMLANDS,

Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 4C.
W86-02445

EFFECT OF HYDROPERIOD ON FLOODPLAIN FOREST PRODUCTION,

Georgia Univ., Athens. Inst. of Ecology.
J. B. Birch, and J. L. Cooley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214583/AS, Price codes: A06 in paper copy, A01 in microfiche. Technical Completion Report, Georgia Water Resources Research Center, Atlanta, May 1983. 98 p, 5 tab, 57 fig, 63 ref. OWRT B-155-GA(1). 14-34-0001-1216.

Descriptors: *Biomass, Flood adapted, *Flood plains, *Forests, *Hyroperiod, Moisture limited, Oxygen limited, *Productivity, *Subsidies, Subsidy-stress, Georgia.

Floodplain forest biomass production followed a bimodal gradient from the wettest to driest sites. The wettest sites were continually flooded and supported a bicultural water tupelo-baldcypress forest that was highly adapted through an extensive water-root system to constant flooding and periodic flushing by riverine floods. The wood production (6379 kg/ha/yr) of this forest was among the highest of the floodplain forests studied. The next wettest site was flooded much of the year, had waterlogged soil for much of the rest of the year, and had a drained soil surface for extended periods. This tupelo-baldcypress, 'root oxygen limited,' forest did not have a water-root system and had the lowest biomass production (3553 kg/ha/yr) of any of the forests studied. The sites that were flooded during some portion of the year but well drained during most of the growing season while maintaining a relatively available soil moisture level were the most productive (6883 kg/ha/yr) floodplain forests. The forest that was only slightly flooded each year by the highest floods had a much lower biomass production (4623 kg/ha/yr) than the heavily flooded and well drained forest. Sites subjected to intermediate levels of flooding and well drained soils had an intermediate level of biomass production (an average of 5240 kg/ha/yr). The upland hardwood, 'moisture limited' forest that is no longer flooded had a low biomass production (3677 kg/ha/yr) similar tt of the waterlogged soil, tupelo-baldcypress forest.
W86-02462

CHAPARRAL MANAGEMENT EFFECTS ON WATER AND THE ENVIRONMENT,

California Univ., Davis. Dept. of Agronomy and Range Science.
J. W. Menke, M. J. Singer, and R. R. Curry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225944/AS, Price codes: A04 in paper copy, A01 in microfiche. California Water Resources Center, Davis Completion Report, Sept. 1984. 50 p, 2 ref. USGS G830-22.

Descriptors: *Chaparral, *Literature review, *Vegetation effects, *Fire, *Vegetation regrowth, *Environmental effects, Reforestation, Revegetation, Watershed management, Watersheds, Incineration.

The document is a summary of a detailed survey of the literature on shrublands in California. It summarizes the results of a multi-disciplinary project to define what is currently known about shrubland vegetation management and what additional research is needed to properly assess the social and environmental effects of such management. Fire is the most important management tool, and therefore receives the most emphasis in the publication. A general treatment of management procedures and a description of the biogeography and prehistory of shrublands are presented in the initial chapters. The effects of shrubland management (primarily by fire) are presented next, with chapters on the effects on vegetation, on soils, on water yield and water quality, on streams (with particular emphasis on the organisms that live in the streams), and on wildlife. This is followed by a chapter on shrubland ecosystem dynamics. The final chapters in the document deal with management concerns, which include management of shrublands for livestock forage, the effects of burning on air quality, the economics and policy of shrubland management, and fire behavior and burning technology. (Snyder-California)
W86-02570

2J. Erosion and Sedimentation

FLOW PROPERTIES OF THE MT. ST. HELENS MUDFLOW MATERIAL,

Washington Univ., Seattle. Dept. of Geological Sciences.
J. D. Smith, T. Dunne, and L. H. Fairchild.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211829, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, 1983. 74 p, 19 fig, 8 tab, 16 ref. C-00235-V(1). 14-34-0001-1411.

Descriptors: *Mudflows, *Volcanoes, *Washington, *Mt. St. Helens, *Toutle River, Sediments, Rheology, Viscosity, Yield strength.

Field measurements of average velocity and discharge of Toutle River lahars of May 18, 1980, are described and interpreted. North and South Fork lahars showed strong differences in timing, discharge, and attenuation. The South Fork lahar had a short duration annd high peak discharge which declined strongly down-valley. The North Fork lahar had much lower peak discharge and longer duration but suffered little attenuation. Field measurements on the North Fork lahar indicated a sediment concentration of approximately 65% by volume, and yield strength of 2100-2600 g/cm-sq S at or near peak flow. Videophotography suggested that flow was laminar where the lahar was undisturbed. Equivalent data could not be collected for the South Fork. Experimental lahars were run down a linear flume of rectangular cross section under one-dimensional flow conditions. Results showed a strong sensitivity of rheological properties to small changes in sediment concentration. The sediment in the experimental lahars was taken from deposits of the North Fork lahar 15 km from the lahar source and modified to remove clasts larger than 23 mm. A Bingham constitutive equation, comprising Bingham viscosity and yield strength, was chosen to represent lahar rheological properties. Results of the experiments showed that yield strength varied from 800 to 2800 g/cm-sq S for a 2.3% change in sediment concentration, and viscosity varied from 40 to 500 g/cm-s. Vertically subdivided samples taken from the moving flow to detect vertical stratification of the flows do not support a conclusion that the sediment was stratified.
W86-02453

LONG TERM SEDIMENT DEPOSITION IN THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,

Georgia Univ., Athens. Inst. of Ecology.
R. Lowrance, and J. Cooley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216950/AS, Price codes: A06 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 03-84, Georgia Institute of Technology, Atlanta, July 1984, 92 p, 2 tab, 1 fig, 51 ref. USGS G-836(05).

Descriptors: *Georgia, *Coastal plain watersheds, *Sediment transport, Water quality, Riparian ecosystems, Nonpoint source pollution, *Erosion, History of agriculture, *Sedimentation.

Sediment deposition over the past 100 years was measured on a coastal plain agricultural watershed. Watershed K, part of the Little River Research Watershed in Turner County, Georgia is 1666 ha comprised of 34 percent row crops, 59 percent forest, 2 percent pasture, and 5 percent other lands. The Wiregrass Bioregion, where the watershed is located, was settled in 1860-1890. Significant agricultural development did not begin until the 1880's. Three approaches were used to estimate long term sediment deposition: (1) determine the changes in depth to argillic horizon along transects from fields to streams; (2) estimate 10 year upland erosion with the Universal Soil Loss Equation and use a sediment delivery ratio to calculate mass of deposition; and (3) use radiometric dating techniques to estimate the ages of deposited materials. Estimates from the radiometric dating ranged from 0.8 to 3.4 cm/yr or about 128 Mg.ha-1.yr-1 to 544 Mg.ha-1.yr-1. Estimates of changes in depth to the argillic horizon along nine transects yielded a mean of 51.7 mg.ha-1.yr-1 with a range of 7.6 to 92.1 Mg.ha-1.yr-1. The average annual rate for the estimate of gross erosion minus sediment delivery was 34.8 Mg.ha-1.yr 1. From these data, we conclude that the average annual rate of sediment deposition on Watershed K during 1880-1979 was 35 to 52 Mg.ha-1.yr-1. The actual quantities at any one point can range much higher, perhaps up to 550 Mg.ha-1.yr-1. These data suggest that riparian ecosystems are important sinks for agricultural chemicals (nutrients and pesticides) associates with these sediments.
W86-02526

PREVENTION OF GULLY FORMATION AND ASSOCIATED WATER DEGRADATION IN WEST TENNESSEE,

Tennessee Water Resources Research Center, Knoxville.
C. H. Shelton, C. D. Tyler, and R. D. VonBernuth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217735/AS, Price codes: A03 in paper copy, A01 in microfiche. Research Report No. 102, September 1984. 39 p, 30 ref, 9 fig, 10 tab. USGS G870-04.

Descriptors: *Gully erosion, Rainfall, Rainfall simulators, *Soil erosion, *Sheet erosion, Soil density, Soil stability, *Tennessee.

A transportable non-intermittent rainfall simulator capable of producing intensities ranging from 76 to 168 mm/h with a minimum distribution uniformity of 84 percent was developed. Drop sizes, terminal velocities and impact angles were close to those of natural rainfall. In a test invoiving five cropping/tillage systems, maximum sediment concentration and total sediment yield ranged from 756 ppm and 0.04 t/ha, respectively, for a no-till system to 56,728 ppm and 4.00 t/ha for a conventionally-tilled system. In tests conducted to separate sheet erosion from rill and gully erosion, soil loss due to rill and gully was as much or more than that from sheet erosion. Sheet erosion tended to stabilize in time as soil became compacted, but rill and gully erosion continued. The depth of the gully was proportional to the time the gully was subjected to erosion, but inversely proportional to soil density.
W86-02538

STREAMBANK EROSION PROTECTION AND CHANNEL SCOUR MANIPULATION USING ROCKFILL DIKES AND GABIONS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W86-02665

WIND AND WIND WAVE SEDIMENT TRANSPORT IN LARGE LAKES AND RESERVOIRS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
W. G. McDougal, and C. P. Lee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-247989/AS, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-99, Corvallis, September 1984. 26 p, 8 fig, 14 ref. USGS G864-08. 14-08-0001-G0864

Descriptors: *Wind waves, *Sediment transport, Erosion, *Bank erosion, *Beach erosion, Mathematic models, *Lakes, Reservoirs, Water currents.

A simple model had been proposed to examine the effect of wind and wind waves on shoreline erosion for large rivers and lakes. The technique employed for estimating waves is that developed by the U.S. Army Corps of Engineers for coastal zones. The solution for the combined wind and wave setup is based on radiation stress concepts, as is the generation of the longshore current. The sediment transport model is based on energetics. And finally, the shoreline evaluation model is based on conservation of sediment. The methodology and numerical results were produced for the first four tasks. Only the methodology was outlined for the fifth task. Without the completion of the fifth task, it is difficult to quantify the effects of wind wave erosion on the shoreline. However, it is clear that the sediment transport is increased in a narrow band along the water line. Whether this sediment transport is of sufficient magnitude or duration to cause significant erosion remains unanswered.
W86-02678

BANK EROSION CONTRIBUTION TO STREAM SEDIMENT LOAD,

Iowa Inst. of Hydraulic Research, Iowa City.
A. J. Odgaard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101375/AS, Price codes: A06 in paper copy, A01 in microfiche. Iowa Water Resources Research Institute, Ames, Publication No. IIHR 280, August, 1984. 92 p, 24 fig, 20 tab, 26 ref, 3 append. USGS G-842-04. 14-08-0001-G-842.

Descriptors: *Iowa, *Stream bank erosion, *Mathematical models, Geomorphology, Alluvial River, *Sediment load, Bank erosion, Sediment transport, Suspended load.

Soil loss by instream bank erosion is analyzed. A conceptual model is developed which relates the rate of bank retreat to primary stream flow variables. Rates and processes of bank erosion are studied along two major rivers in Iowa. The study includes analysis of historical records (airphotos, maps, and streamflow records), field measurements, and laboratory soil tests. The data thus obtained are used, together with published data to calibrate the bank-erosion model, which is then used to estimate the rate at which bank material is being removed from the banks of other major streams in Iowa. These estimates are compared with the rate of suspended-sediment transport in the streams as determined from sediment-discharge data and stream-gaging records. It is estimated that 45 percent of the suspended sediment leaving the State of Iowa through its rivers originates from instream bank erosion along the main river channels.
W86-02718

SEDIMENT CONCENTRATIONS AND LOADS IN THE LOXAHATCHEE RIVER ESTUARY, FLORIDA, 1980-82,

Geological Survey, Miami, FL. Water Resources Div.
W. H. Sonntag, and B. F. McPherson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4157, 1984. 30 p, 6 fig, 8 tab, 17 ref.

Descriptors: *Sediment transport, *Suspended load, *Bed load, Particle size, *Loxahatchee River estuary, *Florida.

This study was conducted to estimate the magnitude of sediment loads and the general spatial and temporal patterns of sediment transport in the Loxahatchee River estuary, Florida. Mean concentrations of suspended sediment generally were higher in the Jupiter Inlet area than in the remainder of the embayment area. Concentrations of suspended sediment varied with season and weather conditions. Concentrations in selected tributaries following Tropical Storm Dennis in August 1981 immediately increased as much as 16 times over concentrations before the storm. Suspended-sediment loads from the tributaries were also highly seasonal and storm related. During a 61-day period of above-average rainfall that included Tropical Storm Dennis, 5 major tributaries discharged 926 tons (short) of suspended sediment to the estuary, accounting for 74 percent of the input for the 1981 water year and 49 percent of the input for the 20-month study period. Suspended-sediment loads at Jupiter Inlet and at the mouth of the estuary embayment on both incoming and outgoing tides far exceeded tributary loads, but the direction of long-term, net tidal transport was not determined. (USGS)
W86-02797

SEDIMENT DATA FOR GEORGIA STREAMS, WATER YEARS 1958-82,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02821

ANNUAL SUSPENDED-SEDIMENT LOADS IN THE COLORADO RIVER NEAR CISCO, UTAH, 1930-82,

Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from OFSS, USGS, Box 25425, Lakewood, Co 80225. USGS Water-Resources Investigations Report 85-4011, 1984. 19 p, 7 fig, 2 tab, 12 ref.

Descriptors: Sedimentation, Sediment transport, *Sediment discharge, *Sediment loads, Sediment, *Sediment rates, *Sediment yield, *Colorado River, Cisco, *Utah.

The Colorado River upstream of gaging station 09180500 near Cisco, Utah, drains about 24,100 square miles in Utah and Colorado. Altitudes in the basin range from 12,480 feet near the headwaters to 4,090 feet at station 09180500. The average annual precipitation for 1894-1982 near the station was 7.94 inches. The average annual precipitation near the headwaters often exceeds 50 inches. Rocks ranging in age from Precambrian to Holocene are exposed in the drainage basin upstream from station 09180500. Shale, limestone, siltstone, mudstone, and sandstone probably are the most easily eroded rocks in the basin, and they contribute large quantities of sediment to the Colorado River. During 1930-82, the U.S. Geological Survey collected records of fluvial sediment at station 09180500. Based on these records, the mean annual suspended-sediment load was 11,390,000 tone, ranging from 2,038,000 tons in water year 1981 to 35,700,000 tons in water year 1938. The minimum daily load of 14 tons was on August 22, 1960, and the maximum daily load of 2,790,000 tons was on October 14, 1941. (USGS)
W86-02828

SEDIMENT CHARACTERISTICS OF TENNESSEE STREAMS AND RESERVOIRS,

Geological Survey, Nashville, TN. Water Resources Div.
S. W. Trimble, and W. P. Carey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-749, 1984. 32 p, 6 fig, 4 tab, 26 ref.

Descriptors: *Sediment yields, *Sediment transport, *Sediment concentrations, *Reservoir deposition, Trap efficiency, *Tennessee.

Measured suspended-sediment data and reservoir sedimentation data have been analyzed to determine sediment yields and transport characteristics of Tennessee streams. Measured suspended-sediment is mostly silt and clay size material even in the sand-bed channels of western Tennessee. Unmeasured load accounts for less than 10 percent of the total sediment load in western Tennessee. Unmeasured load in middle and eastern Tennessee streams is believed to be only a small percentage of total load because bed material is generally coarse and quite variable. Sediment of total load because bed material is generally coarse and quite variable. Sediment yields for middle and eastern Tennessee basins generally are less than 800 tons per square mile per year ((tons/mi2)/yr), however, highly disturbed basins can have yields from 1,000 to 3,000 (tons/mi2)/yr. Yields for the heavily agricultural and channelized basins of western Tennessee generally range from 700 to 1,000 (tons/mi2)/yr. Yields for the Hatchie River in western Tennessee are less than 200 (tons/mi2)/yr reflecting the lack of floodplain agriculture and channelization. (USGS)
W86-02829

VELOCITY PROFILE, WATER-SURFACE SLOPE, AND BED-MATERIAL SIZE FOR SELECTED STREAMS IN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02852

STREAM CHANNEL RESPONSE TO THE JANUARY 3-5, 1982 STORM IN THE SANTA CRUZ MOUNTAINS, WEST CENTRAL CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
K. M. Nolan, D. C. Marron, and L. M. Collins.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-248, 1984. 48 p, 29 fig, 3 tab, 21 ref.

Descriptors: *Geomorphology, *Channel morphology, *California, Landslides, Sediment discharge, *Storm runoff, Santa Cruz Mountains, Channel changes, San Lorenzo River.

Intense rainfall on January 3-5, 1982 in the Santa Cruz Mountains, California caused high streamflow and widespread landsliding. Generalized channel response in the studied basins included scour in steep, low-order channels and moderate fill in higher order channels. Large volumes of channel fill were noted along some channels but this was limited to reaches that received large volumes of colluvium from debris flows and streamside debris slides. The local nature of these effects on channel geometry contrasts with widespread depositional effects observed following major storms in steep terrain in other parts of California. The morphology of most intermediate and high-order channels in the study area appear to have been formed at least as much by events with moderated recurrence intervals as by extreme events. Along low-order channels that were scoured and along isolated reaches of some intermediate and high-order channels where fill was severe, however, storm effects will probably persist for long periods of time. Since the localized effects of high magnitude storms can persist longer than the recurrence interval of the storms themselves, channel morphology throughout the area probably reflects the effects of a number of storms. (USGS)
W86-02858

STREAMFLOW AND SEDIMENT DATA COLLECTED AT SEVEN STREAM-GAGING STATIONS IN THE JAMES RIVER BASIN DOWNSTREAM FROM FORESTBURG, SOUTH DAKOTA, FROM OCT 1, 1982 - SEP 30, 1983,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02912

2K. Chemical Processes

PASSIVE FILMS ON IRON: THE MECHANISM OF BREAKDOWN IN CHLORIDE-CONTAINING SOLUTIONS,

Texas A and M Univ., College Station. Dept. of Chemistry.
For primary bibliographic entry see Field 8G.
W86-02438

GROUNDWATER QUALITY AND MINERAL DEPOSITS RELATIONSHIPS IN THE OZARK MOUNTAINS,

Arkansas Univ., Fayetteville. Dept. of Geology.
K. F. Steele.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211779/AS, Price codes: A04 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project Completion Report, Pub. No. 109. 59 p, 10 fig, 15 tab. USGS G-829-03.

Descriptors: *Manganese, *Springs, *Water chemistry, Groundwater, Water quality, Mineralization, Trace elements, *Arkansas, Lead, Uranium.

Ninety-nine groundwater sites were sampled in northern Arkansas in order to determine the effect of local manganese, phosphate, pyrite, lead-zinc and uranium mineralization on the groundwater chemistry. Most of this study (75 springs) was concentrated in the Batesville manganese district. Hydrogeochemical exploration for these types of manganese deposits appears possible with 44 percent of the springs within 2000 feet of mineralization having anomalous metal concentrations (especially manganese). Because only a few springs were sampled in the remaining areas, the results are not conclusive; however, only the pyrite and small lead-zinc deposit would appear worthy of additional investigation. None of the springs appeared to have geothermal water. Eighteen of the springs exceed U.S. Public Health Service drinking water limits, but most only exceed manganese or iron limits. One spring exceeded the drinking water limits for lead. Thus, these carbonate spring waters are generally of good chemical quality.
W86-02448

CHARACTERIZATION OF ALUMINUM CHEMISTRY FOR ACID PRECIPITATION,

Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
For primary bibliographic entry see Field 2B.
W86-02458

GEOCHEMISTRY OF SALINE LAKES OF THE NORTHEASTERN YUKON FLATS, EAST CENTRAL ALASKA,

Alaska Univ., Fairbanks. Dept. of Geology and Geophysics.
D. B. Hawkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214708/AS, Price codes: A03 in paper copy, A01 in microfiche. Alaska Institute of Water Resources Completion Report I84.16, January 1985. Fairbanks, 30 p, 2 tab, 6 fig. USGS G827-04.

Descriptors: *Evaporites, Trona, *Hydrogeochemistry, Chemical divides, Muscovite, *Alaska, Water chemistry.

Above the Arctic Circle in the Yukon Flats of northeastern Alaska, shallow, brackish-water ponds are rimmed with evaporite minerals such as trona (NaHCO3-Na2 CO3). These ponds form in an area of Alaska characterized by an extreme continental climate with about six inches of precipitation annually. Evaporite formation occurs because evaporation exceeds inflow. In this study, the hydrogeochemistry of the waters of the Yukon Flats was investigated to determine the origin of the ponds and evaporite minerals. The ponds are brackish Mg-Na-HCO3-Cl waters. The nearby freshwater lakes and rivers are Ca-HCO3 waters. In the rivers, m Ca(+2) J 2m HCO3, and SO4 is relatively abundant. In the freshwater lakes, m Ca(+2) O 2m HCO3, and SO4 is almost absent. The pond-water compositions are such that trona and associated minerals must result on complete evaporation. Consideration of the Harvie-Eugster model for evaporite mineral formation suggests that were the river water to evaporate, sulfate minerals such as gypsum should result. No sulfates are observed in these evaporites. Evaporation of the freshwater lakes will first precipitate calcite and ultimately form trona. The change in relative concentrations of Ca(+2), HCO3, and SO4 in going from river water to lake water is critical and indicates that sulfate reduction accompanied by bicarbonate formation is an essential process that produces an excess of HCO3 over Ca(+2). This ultimately leads to the formation of trona. Once the chemical signature of the freshwater lakes is established, then trona must result on complete evaporation, as explained by the chemical divides of Harvie and Eugster.
W86-02473

WATERSHED INTERACTIONS AFFECTING POND ACIDIFICATION,

New Hampshire Univ., Durham. Water Resources Research Center.
D. C. Buso, S. W. Bailey, S. F. Baird, J. W. Hornbeck, and C. W. Martin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214955/AS, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, (1984). 61 p, 20 fig, 8 tab, 79 ref. USGS G856-04.

Descriptors: *New Hampshire, *Acid rain, *Water pollution effects, Watersheds, Ponds, Aluminum.

Watershed history and geochemistry, and pond response to snowmelt were studied at six remote ponds in the White Mountains of New Hampshire. Changes in pond chemistry have resulted from watershed disturbances, particularly forest fires and beaver activities. These factors need to be considered in any evaluation of pond susceptibility to acidification. The relationships of pond chemistry to the hydrology and geochemistry of their watersheds were studied at Black and Cone Ponds. Deeper soils and more weatherable minerals in the watershed produces longer flow paths, higher pH, more basic cations, higher alkalinity, and lower SO 4 2- in the inlet stream of Black Pond. In contrast, the watershed at Cone Pond contained shallowere soils with minerals more resistant to weathering, producing shorter glow paths, lower pH, fewer basic cations, no alkalinity, and higher SO4 2- in theinlet stream. Acidic Cone Pond was intensively samples in late winter to follow changes in water chemistry that resulted from 'acid pulses' during snowmelt. During thaws the mass of H+ hydragenion in the pond increased but large changes wer not permanent and were confined to surface waters. Under conditions of winter stratification the bottom 2 m became much less acidic because of anoxic SO reduction. Characterization of acid buffering capacity of a pond should be based on detailed knowledge of watershed disturbances, hydrology, mineralogy, and pond chemistry.
W86-02498

KINETIC STUDY OF THE EFFECTS OF ACID RAIN ON TRACE METAL UPTAKE,

Maine Univ. at Orono. Dept. of Chemistry.
H. H. Patterson, D. Huizenga, and T. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215143/AS, Price codes: A05 in paper copy, A01 in microfiche. Maine Water Resources Institue Completion Report, Orono, November 1984. 72 p, 19 fig, 4 tab, 23 ref. USGS G846-05.

Descriptors: *Acid rain *Adsorption, *Chromium, Kinetics, *Maine, *Path of pollutants, Rate of pollutants, Water chemistry, Groundwater pollution.

The technique of chemiluminescence has been used to study the rate of reaction of the model species Cr(III) with an iron oxide surface as a function of pH. Both adsorption and desorption studies indicate that the mechanism of reaction of Cr(III) with iron oxide is similar to that observed for reactions of Cr(III) with anions in solution. Chemiluminescence experiments have also been done to determine the rate of reaction of Cr(III) with simple carboxylic acids such as oxalic acid, salicylic acid, and acetic acid, as well as with humic acid samples. At low pH oxalic acid and humic react at a similar rate but at higher pH (>5) differences in these two systems occur. Carboxylate groups in humic acid that ionize at higher pH are more reactive than those which ionize at lower pH either because of nearby functional groups or because of a specific geometry. Synchronous scan fluorescence spectroscopy was used to probe the binding of a variety of metal species with model systems and with humic and fulvic acid samples. The three different emission peaks for humic acid can be correlated with different molecular weight components. The highest energy peak is probably derived from benzene derivatives while the longest wavelength peak is associated with an eight pi-bond conjugated species which is sensitive to metal binding. The purpose of these studies is to compare the binding of a model metal species, such as Cr(III), with iron oxide, simple carboxylic acids and humic acid samples. These results should provide insight into the dynamic pathways of metals in aqueous systems and the effects of acid rain, or pH changes, on these pathways.
W86-02517

PROCESSES CONTROLLING THE COMPOSITION OF INFILTRATING WATER IN FORESTED MOUNTAIN WATERSHEDS,

Wyoming Univ., Laramie. Coll. of Arts and Sciences.
J. I. Drever, and A. E. Blum.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-226306/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Wyoming Water Research Center, Laramie, August 1984. 54 p, 5 tab, 13 fig, 32 ref. USGS G879-04.

Descriptors: *Wyoming, *Water chemistry, *Forest hydrology, *Surface-groundwater relations, *Acid rain, Soil chemistry, Infiltration, Weathering, Nutrients.

Chemical weathering in a high-elevation pine forest was studied by analysis of percolating soil solutions and associated solid phases. In the shallow soil (above 40 cm), soil-water chemistry is controlled by biological processes-uptake by plants and decay in the litter layer. Below 40 cm mineral weathering becomes more important as a control, but solution compositions are so variable in space and time that it is impossible to define a simple weathering stoichiometry. Kaolinite is forming in the upper part of the soil profile and smectite in the lower part, although solution compositions indicate that kaolinite should be the more stable phase at all depths. Dissolved organic carbon (DOC) values are high (average 38 mgC/l) in the forest floor litter, and decrease with depth in the mineral soil. In clay-rich, low-permeability soil the DOC loss and acquisition of cations take place close to the surface, whereas in more permeable soild DOC transport and chemical weathering extend to greater depths. There is some enhanced transport of Al Fe as a result of complexing by organic acids. The mechanisms by which DOC is removed from solution are not clear.
W86-02577

NEW APPROACHES FOR ON-LINE STRIPPING ANALYSIS OF TRACE METALS IN NATURAL WATERS,

New Mexico State Univ., Las Cruces. Dept. of Chemistry
J. Wang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229797/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, New Mexico Water Resources Research Institute, Las Cruces, October 1984. 21 p, 13 fig, 10 ref. USGS G858-03.

Descriptors: *Water chemistry, *Water analysis, *New Mexico, Trace metals, *Chemical analysis, Natural waters, Flow system.

This report summarizes progress made on developing new methodologies for on-line measurements of trace metals in natural waters using stripping analysis. Such measurements have the advantage of giving immediate answers, and avoids the errors and delays associated with laboratory measurments. Dualworking electrode cells have been designed to eliminate problems due to dissolved oxygen, intermetallic compounds, and overlapping peaks. The large hydrogen background current that obscures the zinc peak has been corrected using the medium-exchange approach. A new scheme for on-line measurement of arsenic using a gold working electrode has been developed. New detector configurations based on supplementary forced-convection have been found useful for enhancing the sensitivity. Additional improvement in the sensitivity has been achieved using the subtractive mode that corrects for all background current contributions. Flow injection systems permit automated quantitation of trace metal at the ppb level at a rate of 24 samples per hours.
W86-02608

ADSORPTION OF METAL IONS AND MINERAL COMPLEXES ON MINERALS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
J. G. Dillard, D. L. Crowther, and C. V. Schenck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242931/AS, Price codes: A07 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin No. 141, June, 1984. 133 p, 29 fig, 32 tab, 46 ref. OWRT B-119-VA.

Descriptors: *Adsorption, *Montmorillonite, *Manganese, *Cobalt, Amino acids, X-ray spectroscopy, Electrophoresis, Metal complexes, Clay minerals, Substrates, Hydrolysis, Oxidation, Chemical analysis, Chemical structure, Organic compounds, Ions, Minerals.

Certain substrates, including natural water systems, act as a sink for metal ions. A better description of the bonding of metal ions with minerals is important for understanding both the chemical processes of metal ion-mineral interactions and the influence of mineral substrates on the concentration of metal ions in natural water systems. This study investigated the reactions of cobalt(II) and cobalt(III) organic complexes with montmorillonite and synthetic birnessite (Mn02) surfaces. These solid materials were selected as typical of minerals which interact with metal ions and organic-metal complexes in natural water systems. The studies provided a detailed chemical description of the nature of the surface species. Surface characterization included x-ray photoelectron spectroscopy, electrophorectic mobility, and infrared and visible spectroscopy. Results described the chemical oxidation state of the adsorbed metal and gave the chemical stoichiometry of the surface adsorbates. Evidence showed that metal complexes interacted with clay mineral surfaces through dissociative hydrolytic processes, and metal ion and metal-ion complexes probable reaction processes for the dissociative hydrolytic processes. Elucidation of the detailed surface chemistry is useful in modeling and understanding the specific interactions that occur when metal ions and metal-organic compounds react with mineral substrates.
W86-02662

ACID RAIN BUFFERING POTENTIAL IN OREGON CASCADE LAKES: SECONDARY MINERAL SOLUBILITY CONTROL OF SOLUTION IONIC COMPOSITION,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02667

FEASIBILITY OF DIRECT UTILIZATION OF SELECTED GEOTHERMAL WATER FOR AQUACULTURE OF MACROBRACHIUM ROSENBERGII,

Boise State Univ., ID. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2F.
W86-02691

SELECTIVE ISOLATION OF DISSOLVED ORGANIC MATTER FROM AQUATIC SYSTEMS,

Illinois State Water Survey Div., Champaign.
J. R. Tuschall, and G. George.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249688/AS, Price codes: A03 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, Research Report No 190, June 1984. 40 p, 7 fig, 7 tab, 55 ref. USGS G840-05. 14-08-0001-G840.

Descriptors: Amino acids, Ammonia, *Analytical techniques, *Anion exchange, Bogs, Carbon, Cation exchange, Chemical properties, Chromatography, *Decomposing organic matter, Dissolved organic matter, DON, Fluorometry, Fulvic acids, Humates, Humic acids, Humus, Isolation, *Lakes, Liquid chromatography, Nitrogen, *Organic matter, Ponds, *Separation techniques, Streams, *Surface waters, Swamps, *Water chemistry, Wetlands, XAD resins.

A chromatographic ion-exchange procedure for fractionation, isolation and concentration of dissolved organic matter (DOM) in surface waters was developed and applied to samples from Illinois lakes. Recoveries of DOM from five humic-containing (colored) surface waters were in excess of 90%. A series of experiments using model compounds demonstrated that the mechanism of sorption of the acidic fraction, and of its recovery by controlled desorption, is simple ion exchange. Hydrophobic (nonpolar) interactions did not affect sorption processes. Filtered water samples were applied to a fractionation scheme to separate the DOM into anion exchanged (acidic), cation exchanged (basic) and nonexchanged (neutral) fractions. Of the DOM, most of the dissolved organic carbon and a large portion of dissolved organic nitrogen (DON) in all samples was recovered in the acidic fraction, with the neutral fraction containing most of the remaining DOM. The cationic (at pH 3) fraction contained a lower portion of the DOM than expected. DON was monitored throughout the fractionation scheme by a sensitive fluorescence method developed in this study and generally applicable to measuring small samples containing low concentrations of DON found in natural waters. This fractionation scheme is a useful tool for researchers studying the chemical nature of dissolved organic matter, which affects water quality in many ways.
W86-02700

ADSORPTION OF METAL IONS AND MINERAL COMPLEXES ON MINERALS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
J. G. Dillard, D. L. Crowther, and C. V. Schenck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101342/AS, Price codes: A07 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin No 141, June, 1984. 133 p, 29 fig, 32 tab, 46 ref. B-119-VA.

Descriptors: *Adsorption, *Montmorillonite, *Manganese, *Cobalt, Amino acids, X-ray spectroscopy, Electrophoresis, Metal complexes, Clay minerals, Substrates, Hydrolysis, Oxidation, Chemical analysis, Chemical structure, Organic compounds, Ions, Minerals.

Certain substrates, including natural water systems, act as a sink for metal ions. A better description of the bonding of metal ions with minerals is important for understanding both the chemical processes of metal ion-mineral interactions and the influence of mineral substrates on the concentration of metal ions in natural water systems. This study investigated the reactions of cobalt(II) and cobalt(III) organic complexes with montmorillonite and synthetic birnessite (MnO2) surfaces. These solid materials were selected as typical of minerals which interact with metal ions and organic-metal complexes in natural water systems. The studies provided a detailed chemical description of the nature of the surface species. Surface characterization included x-ray photoelectron spectroscopy, electrophoretic mobility, and infrared and visible spectroscopy. Results described the chemical oxidation state of the adsorbed metal and gave the chemical stoichiometry of the surface adsorbates. Evidence showed that metal complexes interacted with clay mineral surfaces through dissociative hydrolytic processes, and metal ion and metal-ion complexes oxidized when adsorbed on the MnO2 surface. Further, the study presented probable reaction processes for the dissociative hydrolytic processes. Elucidation of the detailed surface chemistry is useful in modeling and understanding the specific interactions that occur when metal ions and metal-organic compounds react with mineral substrates. (McWilliams-VWRRC)
W86-02715

RECONNAISSANCE OF TOXIC SUBSTANCES IN THE JORDAN RIVER, SALT LAKE COUNTY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02766

WATER-QUALITY CHARACTERISTICS OF STREAMS IN THE PICEANCE CREEK AND YELLOW CREEK DRAINAGE BASINS, NORTHWESTERN COLORADO,

Geological Survey, Meeker, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02767

RECONNAISSANCE OF CHEMICAL QUALITY OF SURFACE WATER IN THE UPPER VIRGIN RIVER BASIN, UTAH, ARIZONA, AND NEVADA,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02768

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
T. H. Thompson, R. Chappell, J. B. Gonthier, and W. D. McFarland.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-C, 1984. 5 p, 13 ref.

Descriptors: *Groundwater, Water quality data, *Groundwater quality, *Basin and Range province, *Oregon, *Maps, *Dissolved solids.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps at a scale of 1:500,000 that describe the ground-water quality of the Oregon portion of the Basin and Range province. The first map shows the areal distribution of dissolved solids in water in the basin-fill deposits. The second map shows the areal distribution of the dominant chemical type of ground water in the basin-fill deposits. (USGS)
W86-02800

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
T. H. Thompson, R. Chappell, J. R. Harrill, and A. H. Welch.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4119-C, 1984. 11p, 4 fig, 49 ref.

Descriptors: *Groundwater, *Water quality data, *Groundwater quality, Aquifers, *Basin and Range province, *Nevada, *Maps, *Dissolved solids.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps at a scale of 1:500,000 describing the ground-water quality of the Nevada part of the Basin and Range province. The first map shows the areal distribution of dissolved solids of ground water in the basin-fill deposits. Data from selected points are also shown in both basin-fill and consolidated rock. The second map shows the areal distribution of the dominant chemical type of ground water in the basin-fill deposits. Data from selected points are also shown in both basin-fill and consolidated rock. (USGS)
W86-02801

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
T. H. Thompson, J. A. Nuter, and A. H. Welch.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4122-C, 1984. 7 p. 4 fig, 28 ref.

Descriptors: Groundwater, Water quality data, *Groundwater quality, Hydrogeology, *Basin and Range Province, *Utah, *Maps, *Dissolved solids.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range Province. The report consists of two maps at a scale of 1:500,000 describing the ground-water quality of the Utah part of the Basin and Range Province. The first map shows the areal distribution of dissolved solids of ground water in the basin-fill deposits. The second map shows the areal distribution of the dominant chemical type of ground water in the basin-fill deposits. (USGS)
W86-02802

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, ARIZONA,

Geological Survey, Lakewood, CO. Water Resources Div.
T. H. Thompson, J. A. Nuter, and T. W. Anderson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4114-C, 1984. 7 p, 4 fig, 24 ref.

Descriptors: *Groundwater, Water quality data, *Groundwater quality, *Basin and Range Province, *Arizona, Hydrogeology, *Maps, *Dissolved solids.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range Province. The report consists of two maps at a scale of 1:500,000 describing the ground-water quality of the Arizona portion of the Basin and Range Province. The first map shows the areal distribution of dissolved solids of ground water in the basin-fill deposits. The second map shows the areal distribution of the dominant chemical types of ground water in the basin-fill deposits. (USGS)
W86-02803

PARTIAL COMPILATION AND REVISION OF BASIC DATA IN THE WATEQ PROGRAMS,

Geological Survey, Menlo Park, CA. Water Resources Div.
D. K. Nordstrom, S. D. Valentine, J. W. Plummer, and B. F. Jones.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4186, 1984. 18 p, 1 fig, 6 tab, 44 ref.

Descriptors: *Computer programs, *Thermodynamics, *Experimental data, Data collections, *Water chemistry, Water quality, Aluminum hydrolysis, Ion pairs, Ferrous, Ferric gibbsite.

Several portions of the basic data in the WATEQ series of computer programs (WATEQ, WATEQF, WATEQ2, WATEQ3, and PHREEQE) are compiled. The density and dielectric constant of water and their temperature dependence are evaluated for the purpose of updating the Debye-Huckel solvent parameters in the activity coefficient equations. The standard state thermodynamic properties of the Fe2+ and Fe3+ aqueous ions are refined. The main portion of this report is a comprehensive listing of aluminum hydrolysis constants, aluminum fluoride, aluminum sulfate, calcium chloride, magnesium chloride, potassium sulfate and sodium sulfate stability constants, solubility product constants for gibbsite and amorphous aluminum hydroxide, and the standard electrode potentials for Fe (s)/Fe2+(aq) and Fe2+(aq)/Fe3+(aq). (USGS)
W86-02816

QUALITY OF WATER FROM BEDROCK AQUIFERS IN THE SOUTH CAROLINA PIEDMONT,

Geological Survey, Columbia, SC. Water Resources Div.
G. G. Patterson, and G. G. Padgett.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resource Investigations Report 84-4028, 1984. 24 p, 15 fig, 8 ref.

Descriptors: *Groundwater, *Geochemistry, *Water quality, Crystalline rocks, Bedrock, *Hydrologic maps, Geology, *South Carolina, Piedmont.

The geographic distributions of 12 common water-quality parameters of ground water from bedrock aquifers in the Piedmont physiographic province of South Carolina are presented in a series of maps. The maps are based on analyses by the South Carolina Department of Health and Environmental Control of water samples taken during the period 1972 to 1982 from 442 public and private wells developed in the Piedmont. In general, alkalinity, hardness, and concentrations of sodium, magnesium, and chloride were higher in the Carolina Slate Belt than they were in the other geologic belts of the Piedmont. (USGS)
W86-02823

QUALITY-ASSURANCE DATA FOR ROUTINE WATER ANALYSIS IN THE LABORATORIES OF THE U.S. GEOLOGICAL SURVEY FOR WATER-YEAR 1983,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02834

OCCURRENCE OF NATURAL RADIUM-226 RADIOACTIVITY IN GROUND WATER OF SARASOTA COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02861

GEOHYDROLOGY AND CHEMICAL QUALITY OF WATER IN UPPER JURASSIC AND LOWER CRETACEOUS ROCKS, WESTERN KANSAS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02868

STATISTICAL SUMMARY OF DAILY VALUES DATA AND TREND ANALYSIS OF DISSOLVED-OXYGEN DATA AT NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN) STATIONS,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02873

2L. Estuaries

NUTRIENT ASSIMILATION CAPACITY OF SHALLOW COASTAL LAKES,

Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 5C.
W86-02547

EFFECT OF SALTWATER INTRUSION ON SOIL ERODIBILITY OF ALABAMA MARSHLAND,

Auburn Univ., AL. Dept. of Civil Engineering.
C. R. Jenkins, and R. K. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219053/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Alabama Water Resources Research Institute, Auburn, September 1984. 37 p, 24 ref, 1 fig, 5 tab. USGS G880-05.

Descriptors: *Erosion, *Salinity, *Marshlands, *Saltwater intrusion, Cohesive soil, Straight channel flumes, Coagulation, Soil stability, Double-layer theory, Specific chemical interaction, *Alabama.

A straight-channel, branch-scale, recirculating flume was found to satisfactorily measure the gross effect of increasing total salt concentration on cohesive soil erodibility at a high degree of statistical significance. Remolded cohesive marshland soils from South Alabama demonstrated increased stability and resistance to erosion with increases in eroding fluid total salt concentration. The mechanism which controls this phenomenon remains unclear. Further research is needed to definitively establish the effects of double layer compaction, specific chemical interaction, and osmotic swelling on the soil stability.
W86-02552

CHANNEL AND FLOW RELATIONSHIPS IN TIDAL SALT MARSH WETLANDS,

California Univ., Berkeley. Dept. of Geology and Geophysics.
L. B. Leopold, L. Collins, and M. Inbar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225902/AS, Price codes: A02 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Davis, September 1984. 15 p, 6 fig, 1 tab, 4 ref. USGS G830-06.

Descriptors: *Channel morphology, *Salt marshes, *Wetlands, *Tidal marshes, *Sloping waves, Channels, Marshes, Velocity, Sediment, Vegetation, Spartina, *California.

In a natural tidal channel in Tule Slough, Petaluma Marsh bordering the Petaluma River north of San Pablo Bay, synoptic measurements of stage annd velocity were made at 7 locations along the 3 mile length of the channel. The purpose was to measure gage height and velocity simultaneously at several points along the channel and at different tide cycles. From such synoptic measurements water surface slope could be computed for different reaches of the channel from head to mouth. The data show that the curve of slope with time is not sinusoidal as had been previously reported. Rather slope remains constant in some reaches for many hours. Velocity is closely associated with slope in the reach. The hydraulic geometry of this pickleweed estuary differs from any previously reported. It is postulated that the important differences between this and spartina marshes is due to the type of sediment available to build and maintain the marsh. Petaluma Marsh is underlain by very fine clay mixed with peat or organic humus. The texture of the sediment and character of the vegetation lead to peculiar channel morphology and hydraulic action. As a result of the study it is suggested that the character of channels in other pickleweed marshes be compared with that of Spartina marshes. These differences could have significance in the task of restoring diked or

drained marshes in the Pacific Coast area. (Snyder-California)
W86-02566

SEDIMENT-WATER COLUMN EXCHANGES OF NUTRIENTS AND OXYGEN IN THE TIDAL JAMES AND APPOMATTOX RIVERS,

Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W86-02660

SEDIMENT CONCENTRATIONS AND LOADS IN THE LOXAHATCHEE RIVER ESTUARY, FLORIDA, 1980-82,

Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02797

HYDROLOGY OF MAJOR ESTUARIES AND SOUNDS OF NORTH CAROLINA,

Geological Survey, Raleigh, NC. Water Resources Div.
G. L. Giese, H. B. Wilder, and G. G. Parker.
Available from Dist Branch, USGS 604 S. Pickett St., Alexandria, VA 22034. USGS Water-Supply Paper 2221, 1985. 108 p, 1 pl, 96 fig, 14 tab, 79 ref.

Descriptors: *North Carolina, *Estuaries, *Sounds, Bays, Hydrology, Marshes, Rivers, Streamflow, Tides, *Saline water intrusion, *Water quality.

Hydrology-related problems associated with North Carolina's major estuaries and sounds include contamination of some estuaries with municipal and industrial wastes and drainage from adjacent, intensively farmed areas, and nuisance-level algal blooms. In addition, there is excessive shoaling in some navigation channels, salt-water intrusion into usually fresh estuarine reaches, too high or too-low salinities in nursery areas for various estuarine species, and flood damage due to hurricanes. The Cape Fear River is the only major North Carolina estuary having a direct connection to the sea. Short-term flow throughout most of its length is dominated by ocean tides. Freshwater entering the major estuaries is, where not contaminated, of acceptable quality for drinking with minimum treatment. However, iron concentrations in excess of 0.3 milligrams per liter sometimes occur and water draining from swampy areas along the Coastal Plain is often highly colored, but these problems may be remedied with proper treatment. Nuisance-level algal blooms have been a recurring problem on the lower estuarine reaches of the Neuse, Tar-Pamlico, and Chowan Rivers where nutrients (compounds of phosphorous and nitrogen) are abundant. The most destructive blooms tend to occur in the summer months during periods of low freshwater discharge and relatively high water temperatures. Saltwater intrusion occurs from time to time in all major estuaries except the Roanoke River, where releases from Roanoke Rapids Lake and other reservoirs during otherwise low-flow periods effectively block saline water from the estuary. New shoaling materials found in the lower channelized reaches of the Cape Fear and Northeast Cape Fear Rivers are primarily derived, not from upstream sources, but from nearby shore erosion, from slumping of material adjacent to the dredged channels, from old spoil areas, or from ocean-derived sediments carried upstream by near-bottom density currents. (USGS)
W86-02842

SEAWATER INTRUSION INTO COASTAL AQUIFER IN WASHINGTON, 1978,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02882

SALINITY CHARACTERISTICS AND DISTRIBUTION AND EFFECTS OF ALTERNATIVE PLANS FOR FRESHWATER WITHDRAWAL, LITTLE MANATEE RIVER ESTUARY AND ADJACENT AREAS OF TAMPA BAY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
M. Fernandez.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4301, 1985. 45 p, 22 fig, 10 tab, 14 ref.

Descriptors: *Saline-freshwater interface, *Estuaries, Regression analysis, *Saline water intrusion, Plant populations, *Florida, *Little Manatee River, Estuarine indicator plants, Riverine indicator plants.

The Little Manatee River, a coastal stream that empties into Tampa Bay, Florida, may be used as a source of freshwater. Reduction of streamflow will result in upstream movement of saltwater in the stream. Data on streamflow, tide stage, and specific conductance describe the salinity distribution of the estuary. Vertical conductivity profiles indicate that the river is vertically homogeneous during low flow. The maximum upstream location of the saltwater-freshwater interface (800 micromhos) in the river was described by multiple regression analysis involving mean daily streamflow and high-high tide. The coefficient of determination is 0.94 with a root mean square error of + or - 0.4 mile. The location on the river where the estuarine system ends and the riverine system begins is at about 9.9 miles above the reference station at Shell Point. Duration analysis of conductivity indicates that the maximum upstream location of the interface exceeded 9.7 miles about 17 percent of the days for the period of study. Reduction by 50 percent of streamflow for the 90day, 2-year and 20-year recurrence-interval low flow would relocate the maximum intrusion of the interface at the 2-year and 20-year flows upstream by 0.7 and 0.2 mile, respectively. (USGS)
W86-02883

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

INVESTIGATION OF METHODS FOR THE IMPROVEMENT OF THE ABSORPTION FREEZE PILOT PLANT OPERATION,

Burns and Roe Industrial Services Corp., Paramus, NJ.
For primary bibliographic entry see Field 5D.
W86-02422

NOVEL POLYMERS IN ASYMMETRIC AND COMPOSITE MEMBRANES,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
I. Cabasso, D. Vofsi, H. Tsai, T. Makenzie, and E. Gardiner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233955/AS, Price codes: A09 in paper copy, A01 in microfiche. Final Report, 1984. 141 p, 55 fig, 22 tab, 37 ref, append. OWRT C-10012-S(1). 14-34-0001-1442.

Descriptors: *Desalination, Hollow fibers, *Membranes, *Reverse osmosis, Polysulfone, Cellulose acetate, Cellulose triacetate, Poly(vinyl pyrrolidone), Polyphosphonate, Polymer blends, Alloys.

Several aspects of reverse osmosis membrane polymers were investigated, including successful production of polysulfone and cellulose triacetate hollow fiber membranes and cellulose acetate, poly(phenylene oxide phosphonate) and related polymer blend membranes. This report covers research on some outstanding problems concerning the compatibility of polysulfone with poly(vinyl pyrrolidone), hydrolysis and durability of PPN/CA membrane, identification of cellulose acetate structures that would yield compatible alloy membranes, and durability problems of cellulose triacetate hollow fibers operating under stress for sea water desalination. Included in this report are complete descriptions and evaluations of the synthesis and membrane casting method of novel polymers, poly(phosphono acetal) and several polyelectrolyte membranes, some of which display high flux and salt separation in initial RO-testing and will be studied further.
W86-02656

NONFOULING COATINGS FOR THIN FILM COMPOSITE MEMBRANES,

FilmTec Corp., Minneapolis, MN.
J-Y. Koo, J. M. Reitz, J. E. Cadotte, and R. J. Petersen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-247971/AS, Price codes: A06 in paper copy, A01 in microfiche. Final Report, March 1985. 96 p, 13 fig, 33 tab, 20 ref. 14-08-0001-22888.

Descriptors: *Reverse osmosis, *Semipermeable membranes, *Fouling, Permselective membranes, Membrane processes, Desalination.

Polymers containing sulfonate groups were synthesized and evaluated as fouling-resistant coatings for reverse osmosis membranes. The FilmTec FT-30 membrane was used as the substrate. Best results were obtained with a coating of poly(sodium stryenesulfonate-co-chloromethyl-styrene) cross-linked with an acid catalyst. In laboratory tests with feedwaters containing tannic acid, this coating showed much lower fouling rates compared with uncoated FT-30 controls. However, initial membrane fluxes were also lowered considerably just by the act of applying this coating, so that comparative fluxes of the final fouled membranes were not particularly different. For example, using a standardized test condition (200 psi, 25C, 0.2 percent sodium chloride feed containing 500 ppm tannic acid, pH adjusted with phosphoric acid, 18 hour test), uncoated FT-30 controls exhibited a typical initial flux of 15 gfd and final flux of 5.5 gfd; coated membranes showed a typical initial flux of 11 gfd and a final flux of 6.0 gfd. Similar behavior was observed in spiral element trials on humic-acid-laden river water. Overall results indicated that a sulfonate-rich hydrophilic coating on a reverse osmosis membrane did not confer a significant level of resistance toward fouling by humic or tannic acid colloids.
W86-02677

DEVELOPMENT OF A LOW PRESSURE HOLLOW FIBER REVERSE OSMOSIS MEMBRANE UTILIZING INTERNAL FLOW FOR USE ON A LOW SALINITY WATER,

Romicon, Inc., Woburn, MA.
J. G. Vouros, and A. J. Testa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126141/AS, Price codes: A07 in paper copy, A01 in microfiche. Final Report, (1985). 117 p, 49 tab, 27 fig. 14-34-0001-0445.

Descriptors: *Reverse osmosis, *Membranes, *Desalination, Thin film composite membrane, Hollow fibers, *Acrylic membrane, Chlorine resistance.

An acrylic membrane prepared by crosslinking hydroxyethyl methacrylate-methacrylic acid copolymer on a flat sheet microporous support exhibited excellent chlorine resistance, 95% sodium chloride rejection and 20 gal/ft2-day flux at 250 psi pressure. Polysulfone hollow fibers utilizing internal flow with inside diameters of 1.1 mm have been developed as composite membrane supports to operate continuously at 250 psi pressure. The acrylic thin film composite membrane was deposited on the inside surface of these polysulfone fiber supports and produced a composite membrane that yielded excellent chlorine stability, 70% sodium chloride rejection and 20 gal/ft2-day flux at 250 psi operating pressure. This membrane also exhibited cleanability via Romicon's conventional permeate backflushing and reverse flow techniques without experiencing performance degradation.
W86-02724

FOULING OF REVERSE OSMOSIS SYSTEMS,

Massachusetts Inst. of Tech., Cambridge. Dept. of

Mechanical Engineering.
R. F. Probstein, and R. D. Cohen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126182/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Report, November 8, 1985. 34 p, 15 fig, 3 tab, 14 ref. 14-08-0001-g-1058.

Descriptors: *Reverse osmosis, *Fouling, *Membrane fouling, *Colloidal fouling, *Flux decline, *Laminar flow, Foulant growth, Permeation velocity, Transmembrane flux, Ferric hydroxide fouling, Cellulose acetate membranes, *Desalination.

A theoretical model of the fouling of reverse osmosis membranes by colloidal material has been developed for laminar flow and compared with the experimental results of fouling of cellulose acetate membranes by colloidal ferric hydroxide. The model is one-dimensional, based on the observation that laminar flow does not affect the foulant growth behavior. A fast initial reaction dominated fouling regime is predicted, followed very shortly in time by a much slower flux driven deposition, as confirmed experimentally by a slow linear flux decline. The data have also shown that if the ferric hydroxide is stabilized the flux decline rate is linear in the feed concentration, as predicted by the model. An unstable solution leads to a non-linear dependence of foulant deposition on foulant feed concentration. An important experimental finding is that there exists a threshold transmembrane velocity, on the order of 0.0005 cm/sec, below which no flux decline or fouling is observed. The origin of this threshold velocity is believed to result from surface charge and double layer interactions. The important conclusion is that in reverse osmosis systems fouling may be prevented simply by stabilizing the colloid solution and operating below the threshold permeation velocity.
W86-02728

3B. Water Yield Improvement

COMPARISON OF FRESHWATER USE CUSTOMS ON ULITHI ATOLL WITH THOSE OF SELECTED OTHER MICRONESIAN ATOLLS,

Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
R. A. Stephenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227338/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 51, August 1984. 33 p, 1 fig, 5 tab, 14 ref. USGS G837-03.

Descriptors: *Water use, *Water allocation, *Drought, *Atolls, *Social aspects, *Tropical regions, Rural areas, Water harvesting, Catchments areas, Water storage, Dug wells.

Freshwater catchment, storage, and distribution systems, along with fresh water use customs, in particular areas of Micronesia are discussed. Special attention is paid to Ulithi Atoll in the Western Caroline Islands. The average annual rainfall on atoll islands of Micronesia is high (over 100 inches). There are also significant groundwater resources. However, severe water shortages are often experienced, especially during the dry season. Water use customs that differ from those of Western nations often account for these difficulties. The field work was undertaken at a time of drought conditions on Ulithi, at the end of the dry season in June, 1983. True freshwater shortages were apparent, but Ulithians carried out a variety of coping strategies that made the impact of the drought less severe. These included a strong sense of community spirit, with the sharing of community resources as an everyday way of life. In this way, Ulithi differed from the communities of Laura and Nama studied earlier by the same research team.
W86-02598

IMPACT OF IMPROVED AGRICULTURAL WATER USE EFFICIENCY ON RESERVOIR STORAGE IN SUB-HUMID AREAS,

Kansas State Univ., Manhattan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W86-02648

EFFECTS OF VARIOUS FACTORS ON THE SIZING OF RAIN WATER CISTERN SYSTEMS,

Caribbean Research Inst., St. Thomas, VI.
H. H. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233724/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 19, Virgin Islands Water Resources Center, St. Thomas, Sept 1984. 31 p, 11 fig, 2 tab, 29 ref, 2 append. USGS G875-06. 14-08-0001-G-875.

Descriptors: *Rain water harvesting, *Cisterns, Water tanks, Rain water, Water harvesting, *Virgin Islands.

The sizing of rain water cistern systems is properly done by considering several factors. Among these are rainfall frequency, duration and magnitude, demand on the system, characteristics of the catchment area, and the reliability level desired. Models developed in this study consider these factors. Results of simulation varying all of these factors show the changes in volume storage which must be provided. The models demonstrate their usefulness in the proper sizing of cistern systems to satisfy the peculiarities of specific situations.
W86-02650

3C. Use Of Water Of Impaired Quality

COMPARISON OF METABOLIC INHIBITORS, FILM-FORMING ANTITRANSPIRANTS, AND MICROJECT IRRIGATION FOR WATER USE EFFICIENCY OF RABBITEYE BLUEBERRIES,

Tuskegee Inst., AL. Dept. of Agricultural Sciences.
For primary bibliographic entry see Field 3D.
W86-02433

EVALUATION OF DRAINAGE TILE TO ALLEVIATE SALT BUILDING IN HEAVY SOILS IRRIGATED WITH BRACKISH WATER AND CROPPED WITH RICE AND SOYBEANS,

Arkansas Univ., Fayetteville. Dept. of Agronomy.
T. C. Keisling, J. T. Gilmour, H. D. Scott, A. M. Sadeghi, and R. E. Baser.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211795, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project Completion Report, Publication No. 111, August, 1984, 31 p, 4 tab, 6 fig. USGS G-829-07.

Descriptors: *Tile drainage, *Saline soils, *Drainage, Salinity, Mathematical models, Rice, Soybeans, Arkansas, Irrigation.

The use of tile drains for alleviating soluble salt accumulation on silt loam soil was investigated during 1984. Although the chemical analyses of the floodwater and tile drainage water were very similar, suggesting that floodwater was moving to the tile drain, the overall results so far indicate that this is not a feasible solution owing to lack of significant drainage. Application of DRAINMOD utilizing soil and weather data from Arkansas showed no significant effluent from the tile drains for our experimental site during rice production. This was attributed to the extremely slow saturated hydraulic conductivity values for this particular soil. However, more observations (concerning the operation of the tile field) are needed before it can be concluded that tile drain fields are not a viable solution to the problem.
W86-02450

ECOPHYSIOLOGICAL BASIS OF SALT TOLERANCE IN DISTICHLIS SPICATA: BACKGROUND FOR DOMESTICATION,

New Mexico State Univ., Las Cruces. Dept. of Biology.
G. L. Cunningham, P. R. Kemp, E. B. Allen, A. M. Cromer, and J. F. Reynolds.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215010/AS, Price codes: A06 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Technical Report No. 175, Las Cruces, March 1983, 100 p, 18 fig, 24 tab, 84 ref. OWRT B-063-NMEX(1). 14-34-0001-0273.

Descriptors: Photosynthysis, *Salinity, *Grasses, Temperature, Sodium Chloride, Growth, Biomass, *New Mexico.

Ditichilis spicata is a highly productive salt-tolerant grass species with considerable potential for domestication as a forage crop on saline soils. It is broadly distributed throughout North America in a variety of coastal and inland habitats. Effective efforts to domesticate D. spicata will require an ability to predict its primary production under a range of environmental and cultural practices to which it might be subjected. Ecotypic differences among populations from contrasting environments might make it necessary to match the physiological adaptations selected in particular natural environments with the environments and culture conditions under which it might be grown. Two coastal and two inland populations were evaluated for differential response to salinity level and temperature. Ecotypic variations with regard to growth, photosynthetic ability, biomass allocation and leaf chemical composition were found. Populations were also found to differ in their responses to the principal anion in the growth substrate. Modeling of photosynthetic response to growth salinity, temperature and light revealed the manner in which these variables influence productive capacity. Studies of the influence of mycorrhizae on growth and physiological function indicated that they are not essential to the ability of D. spicata to tolerate salinity.
W86-02504

TREATMENT METHODS FOR REUSE OF MUNICIPAL SEWAGE EFFLUENT FOR MINERAL FLOTATION IN THE MINING INDUSTRY,

Arizona Univ., Tucson. Dept. of Civil Engineering.
P. H. King, G. L. Amy, G. Chandler, T. L. Young, and G. E. Cronk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227221/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical completion report, Arizona Water Resources Research Center, Tucson, December 1984. 52 p, 8 fig, 13 tab, 2 append. C-10138-R. 14-34-0001-1473 (1).

Descriptors: *Arizona, *Wastewater treatment, *Water reuse, Tertiary treatment, *Mineral flotation, Industrial use.

Efficient reuse of treated effluent from municipal wastewater systems is a key to effective water quality management in the arid southwestern United States. One potentially beneficial reuse target is the copper mining industry of southern Arizona. However, previous studies have indicated that some relatively undefined organic constituents of municipal sewage effluent are detrimental to copper and molybdenum recoveries in the froth flotation process. This process recovers minerals from ores and separates them into their respective fractions. This research was aimed at evaluating the feasibility of conventional secondary and selected tertiary treatment processes in removing organics from effluent. The effect of each treatment process on copper and molybdenum recovery was observed, first using single-cycle laboratory scale flotation tests, and then seventeen locked-cycle tests in which recycling of process water was inherent in the system. Three ore batches, eight secondary effluent samples, and five tertiary treatment schemes were investigated in the single-cycle test, and results were compared with those obtained using groundwater and projected Colorado River water. In addition, four model organic compounds were analyzed to determine the nature of those materials which present particular problems

in mineral recovery. In the locked-cycle tests, particular attention was given to the three most successful tertiary treatment processes, including foam fractionation, activated carbon adsorption, and ion exchange treatment. The results of the study demonstrate the technical feasibility of substituting tertiary-treatment wastewater for high quality groundwater. Activated carbon was the most successful tertiary process studied.
W86-02587

3D. Conservation In Domestic and Municipal Use

COMPARISON OF METABOLIC INHIBITORS, FILM-FORMING ANTITRANSPIRANTS, AND MICROJECT IRRIGATION FOR WATER USE EFFICIENCY OF RABBITEYE BLUEBERRIES,
Tuskegee Inst., AL. Dept. of Agricultural Sciences.
F. M. Basiouny.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-204006/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, December 1984. 62 p, 89 ref, 8 tab, 8 fig. 14-34-0001-0510.

Descriptors: *Abscisic acid, *Phenyl mercuric acetate, *Stomatal diffusive resistance, *Transpiration, *Relative humidity, *Fruit quality criteria.

Two metabolic inhibitors abscisic acid (ABA) and phenyl mercuric acetate (PMA), antitranspirant materials Clear Spray (CS) and Vapor Gard (VG), and microjet irrigation system were used on two rabbiteye blueberries cv. 'Tifblue' and 'Woodard'. The objective of this experiment was to study the effects of using the above materials in increasing yield, improving quality and water use efficiency of blueberry. Application of ABA, PMA, CS and VG, separately or in combination, with the microjet irrigation system significantly increased the water use efficiency of rabbiteye blueberries. The spray materials increased stomatal diffusive resistance, reduced transpiration and increased leaf temperature. Total soluble solids, pH, berry weight, volume, and yield were significantly increased.
W86-02433

DEVELOPMENT AND MANAGEMENT OF WATER FACILITIES FOR SMALL COMMUNITIES: PROCEEDINGS OF A CONFERENCE,
Virginia Water Resources Research Center, Blacksburg.
For primary bibliographic entry see Field 6B.
W86-02657

POLICY ANALYSIS OF RESERVOIR OPERATION, VOLUME I: EXECUTIVE SUMMARY; VOLUME II: COMPONENT STUDIES,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 6A.
W86-02730

3E. Conservation In Industry

INVESTIGATION OF POSSIBLE CYCLES OF CONCENTRATION IN INDUSTRIAL COOLING TOWERS USING VARIOUS COMBINATIONS OF TREATMENT PROCESSES TO RENOVATE MUNICIPAL WASTEWATER FEED,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W86-02423

INDUSTRIAL WATER REUSE WITH COUPLED-TRANSPORT MEMBRANES,
Bend Research, Inc., OR.
For primary bibliographic entry see Field 5D.
W86-02425

3F. Conservation In Agriculture

DEVELOPMENT OF A PREDICTIVE IRRIGATION SCHEDULING INDEX USING ELECTROPHYTOGRAMS,
Arizona Univ., Tucson. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 4A.
W86-02424

INCREASING ECONOMIC EFFICIENCY OF WATER USE FOR IRRIGATION IN THE UPPER MIDWEST,
Minnesota Univ., St. Paul. Water Resources Research Center.
R. R. Eidman, D. J. Bosch, E. E. Gill, and C. C. Shaeffer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203958/AS, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report, St. Paul, 1985, 121 p. OWRT B-158-Minn. 14-34-0001-1236.

Descriptors: *Irrigation water use, *Irrigation efficiency, *Minnesota, Economic aspects, Water use.

This study develops a more extensive methodology for evaluating irrigation strategies than previously existed. Near optimal strategies are identified given the level of soil water and weather information. The irrigation strategies are evaluated with reference to a benchmark strategy. The comparison is made within a whole-farm context considering the irrigator's risk performances, random ouput prices, and income taxes. Stochastic dominance with respect to a function is used to determine the value of the additional information and the related optimal irrigation strategy. Near optimal irrigation strategies were identified for alternative levels of information for corn and soybean production in southwestern Minnesota. The estimated value of perfect information on soil water and weather is $6.59 per acre for a risk neutral irrigator with low equity and 55 percent of that value can be obtained with currently recommended (but not widely used) programs of irrigation scheduling. The value is greater for risk averse and less for risk perferring irrigators. Adoption of near optimal strategies based on better information would also reduce average water use 13 to 17 percent. The methodology also has potential for use in evaluating the profitability of irrigation investments as illustrated in the study.
W86-02428

SPRINKLER IRRIGATION AS AN ENERGY AND WATER SAVING APPROACH TO RICE PRODUCTION AND MANAGEMENT OF RICELAND PESTS,
Texas Water Resources Inst., College Station.
G. N. McCauley, L. R. Hossner, and D. M. Nesmith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203982/AS, Price codes: A11 in paper copy, A01 in microfiche. Technical Completion Report, TR-134, March 1985. 243 p, 149 tab, 16 fig, 5 append. USGS B-254-TEX(1). 14-34-0001-1282.

Descriptors: *Texas, Rice, Water, Energy, *Sprinkler irrigation, Texas Coastal Prairie, Water conservation, Cultivars, Flood irrigation.

Rice is currently produced on about 400,000 acres in the Texas Coastal Prairie and uses 1.8 million acre-feet of water or 13 percent of Texas' renewable water resources. The Texas Coastal Prairie has been experiencing rapid population and industrial growth with increased demands on the area water. Continued rice production will require water conservation practices. This research evaluated the potential water conservation of sprinkler irrigated rice production as related to potential production of commercial cultuvars with various moisture stress levels, the sprinkler irrigation adaptability of 10 major soil series, and increased infiltration by adjuvants. Some cultivars did exhibit resistance defined as sustained production under reduced water supply. However these cultivars were not the most productive. Highest yielding cultivars under flood irrigation were also the highest yielding with sprinkler irrigation. The medium grains appear better adapted. The adjuvants tested did increase the infiltration of the Nada soil. Yield levels within 15 percent of those from flood irrigations were achieved. However, the high levels of adjuvants used were phytotixic to the rice. Lower rates or other adjuvants might be better adapted. Soil water infiltration as determined by rainfall simulator did reveal differences in infiltration rates of the soils tested. The clay soils had the highest saturated infiltration rate. The fine sandy loam soils developed a crust after initial applications which reduced later infiltration rates. All soils could be sprinkler irrigated but soils such as the Nada fine sandy loam had a saturated infiltration of less than 0.65 cm per hour which could be prohibitive to a commercial rice production.
W86-02431

LOW ENERGY IRRIGATION FOR THE PACIFIC NORTHWEST,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
T. S. Longley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211662/AS, Price codes: A05 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute Completion Report, Moscow, March, 1985. 63 p, 22 fig, 12 tab, 16 ref. B-056-IDA(1). 14-34-0001-1218.

Descriptors: *Irrigation efficiency, Energy, Irrigation, *Sprinkler irrigation, Drip irrigation, Trickle irrigation, *Idaho.

Basin tillage (surface storage enhancement by soil roughening) has been shown to be effective in controlling runoff from small grain plots irrigated with application rates up to 115 mm/hr and total applications up to 75 mm with a single line of low pressure spray sprinklers. A grain stand reduction problem encountered with the use of basin tillage was overcome with modification of the hanger arrangement on the double disc openers on the drill. After these modifications, basin tilled treatments of spring wheat produced stands and yields not significantly different from conventional tillage. Runoff measurements indicated that no runoff occurred using reservoir tillage, and from 10 to 60 percent of the water applied left the field with conventional tillage. Microclimate measurements were made 15, 27 and 40 m downwind of an operating low pressure sprinkler lateral on a number of different days with varying wind conditions. Marked decreases in vapor pressure deficit (VPD) were consistently observed at the 15 m position relative to conditions 9 m upwind of the system. This reduction in VPD resulted primarily from a reduction in dry bulb temperature. Windspeed did not appear to affect the magnitude and spatial distribution of these changes. Replicated evapotranspiration (ET) measurements were made on four crop species (alfalfa, dry beans, wheat and potatoes) which showed small but significant reductions in ET at the 15 m position for all species but dry beans, which showed a substantial decrease. For alfalfa, ET was significantly increased 27 and 40 m downwind of the system.
W86-02437

DESIGN AND MANAGEMENT OF IRRIGATION PROJECTS FOR THE SUSTAINED BENEFIT OF WILDLIFE: A BIOECONOMIC ANALYSIS OF THE EAST HIGH AREA OF THE COLUMBIA BASIN PROJECT,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6G.
W86-02440

IDENTIFICATION OF CRITICAL WATER LEVELS IN FLOODED RICE FIELDS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
C. L. Griffis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211753/

AS, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project completion Report, Pub. No. 107, Sept. 1984. 22 p, 1 fig. USGS G-829-02.

Descriptors: *Mathematical models, Irrigation, Rice, Microcomputer, *Arkansas.

A mathematical model was developed to simulate the transient hydrology of a flooded rice field. With the model, users can determine the critical interlevee areas in which to monitor the water levels so that the irrigation well can be turned on at the critical low water level, and turned off at the critical high water level, in order to maximize water application efficiency. Sensitivity analysis performed with the model showed that it will be necessary to calibrate the model for each specific field. A calibration procedure has been developed.
W86-02446

WATER AND ENERGY CONSERVATION THROUGH IRRIGATION SCHEDULING,

Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
V. F. Bralts, and T. L. Loudon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214567/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Michigan Institute of Water Research, 29 p, 5 fig, 41 ref, East Lansing, Sept (1984). USGS G849-05.

Descriptors: *Michigan, *Irrigation scheduling, Crop coefficients, Sprinkler irrigation, Water use efficiency, Evapotranspiration.

Over the past five years, irrigated areas have increased substantially in Michigan and in other midwestern states. Existing water balance models used for irrigation scheduling have been largely developed for application in the arid to semi-arid west. The procedures in these models for estimating evapotranspiration (ET) using crop coefficients, effective rainfall and deep percolation estimates were inadequate for application to areas with significant growing season rainfall. The overall goal of this research was to develop improved methods for scheduling the timing and amount of water used for irrigation in the more humid areas to the midwest. To address the need for improved crop coefficients a technique for using a portable chamber to measure actual ET in the field was developed and compared to ET measured by a weighing lysimeter. In addition an interactive microcomputer program was developed which includes historic rainfall probabilities in irrigation scheduling forecasts. The results of this research should serve as a basis for the future development of local crop coefficients and the further development of improved irrigation scheduling techniques for field crops in Michigan and other midwestern states where supplemental irrigation is practiced.
W86-02460

ADAPTING THE WATER MANAGEMENT SIMULATION MODEL DRAINMOD FOR THE GREAT LAKES REGION,

Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W86-02483

ECOPHYSIOLOGICAL BASIS OF SALT TOLERANCE IN DISTICHLIS SPICATA: BACKGROUND FOR DOMESTICATION,

New Mexico State Univ., Las Cruces. Dept. of Biology.
For primary bibliographic entry see Field 3C.
W86-02504

OPTIMIZATION OF IRRIGATION TECHNIQUES TO REDUCE WATER NEEDS FOR FIELDS WITH IRREGULAR BOUNDARIES,

Auburn Univ., AL. Dept. of Agricultural Engineering.
E. W. Rochester.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219046/AS, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, Alabama Water Resources Research Institute, Auburn, September 1984. 65 p, 28 fig, 3 tab, 26 ref, 1 append. USGS G880-04.

Descriptors: *Sprinkler irrigation, *Alabama, *Irrigation efficiency, *Boundaries, *Linear programming, Optimization, Water conservation, Water use, Water distribution, Irrigation, Water management, Water use efficiency, Simulation analysis, Irrigation water, Computer models, *Mathematical models.

A technique was developed to optimally position center-pivot irrigation systems in fields with irregular boundaries. The technique utilizes a discrete approximation of the field and boundaries by utilizing a matrix of points for the evaluation of water application. The matrix of points encompasses the field and boundaries and includes surrounding points. An accounting technique is utilized to determine application uniformity and distribution. Two strategies were utilized for the optimum positioning of center-pivot irrigation systems. In strategy 1, the maximum number of center-pivot irrigation systems is placed inside a field boundary with the restriction that there be no overlap or water applied outside the field boundary. Strategy 2 was to minimize deviations from one application. Bivariate linear programming was used as the optimization technique.
W86-02551

ECONOMIC APPROACH TO THE ESTIMATION OF A DYNAMIC PRODUCTION FUNCTION FOR AN IRRIGATED CROP,

California Univ., Davis. Dept. of Agricultural Economics.
J. M. Antle, and S. A. Hatchett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225936/AS, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Davis Completion Report, Sept. 1984, 28 p, 3 tab, 22 ref. USGS G830-05.

Descriptors: *Economic aspects, *Crop production, Irrigation, Model studies, Statistical models, Wheat, *Irrigation efficiency.

The objectives of the research was to develop an economic model of irrigated crop production which incorporates the dynamic response of the crop to water and the farmer's irrigation decision-making process over time. An appropriate statistical model is developed to estimate the parameters of the response (production) function. The model and methodology are applied to the case of irrigated wheat production in the Imperial Valley of California. The estimated model shows that water productivity changes substantially in the growing stages. The implications for optimal water use are therefore substantially different than those of a static response model. (Snyder-California)
W86-02569

IMPLICATIONS FOR TOTAL WATER DEMAND FROM THE ADOPTION OF DRIP IRRIGATION IN WESTERN AGRICULTURE,

California Univ., Santa Barbara. Dept. of Economics.
M. F. Caswell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225951/AS, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Davis Completion Report, Sept. 1984. 40 p, 8 tab, 52 ref. USGS G830-04.

Descriptors: *Water demand, *Drip irrigation, *Trickle irrigation, *Mist irrigation, *Irrigation practices, *Water costs, Water conservation, Potential water supply, *California.

Data gathered on irrigation technology choices for the major perennial crops grown in six counties of the Central Valley of California were analyzed to study the effect of the adoption of low-volume irrigation systems on agricultural water demand. The probabilities of adoption for both sprinkler and drip irrigation technologies were estimated as a function of water costs, regional differences, water sources, and crop characteristics. The results were used to simulate the effects of water price increases on the relative share of each irrigation technology and the average water use per acre. The final stage of the analysis was to calculate the aggregate water demand for fruit and nut crops in each of the six counties. This demand was determined for current water costs in each area and then for price increases of $20 and $50 an acre-foot. Study results show that for perennial crops alone, almost 200,000 acre-feet of water would be saved if there were a $50 an acre-foot increase in the price of water. (Snyder-California).
W86-02571

SCHEDULING IRRIGATION WITH A HIGH SPEED CENTER PIVOT TO REDUCE HEAT AND MOISTURE STRESS IN CORN,

Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
B. L. Blad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227270/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, September 1984. 15 p, 4 tab, 5 ref. USGS G854-07. 14-08-0001-G854.

Descriptors: Water conservation, *Irrigation effects, *Irrigation practices, *Moisture stress, Air temperature, *Crop response, Heat balance, Humidity, Nebraska, *Irrigation scheduling, *Center pivot irrigation.

Sprinkler irrigation reduces air temperature and increases relative humidity by evaporative cooling in and above the canopy. Experiments needs to be conducted to observe if these effects are beneficial to plants, especially during periods of heat and moisture stress caused by high temperatures. Reduction of actual plant temperature, distribution of water on plant, and amount of water present also need to be investigated. Research began in 1983 near Grant, NE with Pioneer 3727 corn. Atmospheric data were measured with instruments located on opposite sides of a 120-acre field and data were stored on cassettes by a data micrologger. The field was irrigated by a high-speed center pivot; tests applied 1 mm of water over a 10-minute period. Plant temperatures were measured by a copper-constantan thermocouple inserted into the growing point of the corn plant. Canopy air temperatures decreased 3-5 degrees C and relative humidities increased 12-15% for 30-45 minutes; above canopy air temperatures lowered 1-2 degrees C, and relative humidities raised 6-10%. Variable plant temperatures and a concern for water distribution warranted further studies near Tryon, NE in 1984. Data were collected in similar fashion; however, irrigation was applied with a solid set irrigation system at a rate equal to the center pivot. Improved plant thermocouples showed expected plant temperatures without irrigations. Extension of this research is planned and suggested based on applications to water resource problems.
W86-02592

MAXIMIZING WATER USE EFFICIENCY OF LIMITED IRRIGATION PLUS NATURAL PRECIPITATION USING CONSERVATION CROPPING SYSTEMS,

Nebraska Univ., North Platte. Dept. of Agronomy.
G. W. Hergert, N. L. Klocke, G. A. Wicks, P. T. Nordquist, and P. H. Grabouski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227288/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, September 1984. 7 p, 3 tab. USGS G854-09. 14-08-0001-G854.

Descriptors: *Water utilization, *Nebraska, *Irrigation efficiency, Conservation, Groundwater, *Crop rotations, Crop production, Effective precipitation, Cultivation, Soil erosion, No-till farming.

The overall objective of this project was to determine the production potential of corn, wheat and soybeans which received no irrigation, limited irrigation (6 inches) and full irrigation in a residue management/no-till farming system. Specific objectives were: (1) to determine the yield potential of grain cropping systems by maximizing storage of natural precipitation and increasing the water use efficiency from limited irrigation; (2) to develop technologies to improve cultural practices that may be needed to adopt these cropping systems; and (3) to estimate the economic impact for producers who shift from fully-irrigated systems to proposed limited irrigation systems. Five crop rotations using the three crops in each of the three moisture regimes were compared. Because of limited time, the 1984 crops have not been harvested. Preliminary data from the dryland and limited irrigation blocks for 1982 and 1983 show: (1) soil moisture conserved by this no-till system may be sufficient to sustain continuous dryland farming in this area; (2) timely application of 6" of water to the rotations gave yield increases above dryland of 20 bushel wheat/A, 30 bushels of corn/A and 30 bushels of soybeans/A; (3) commercially available planters for corn and soybeans can be modified to work well in this system; and (4) crop rotations can reduce some disease problems and decrease reliance on chemicals.
W86-02593

ASSESSMENT OF THE EFFECTIVENESS OF TECHNOLOGY TRANSFER METHODS LEADING TO THE ADOPTION OF A NEW IRRIGATION DESIGN,

Texas Water Resources Inst., College Station.
L. E. Ruesink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232767/AS, Price codes: A03 in paper copy, A01 in microfiche. Research Project Completion Report, July, 1984. 38 p, 8 tab, 2 fig, 2 append, 20 ref. USGS G-871-22. 14-08-0001-G-871.

Descriptors: *Technology transfer, Effectiveness, *Irrigation design, Evaluation.

Texas irrigators have been hard hit by soaring energy costs and declining groundwater in recent years. To survive, they must find ways to reduce energy and water demands in their operations. A new concept in irrigation design now available to Texas irrigators has the potential of significant savings in both water and energy requirements. The system, labeled the Low Energy Precision Application (LEPA) System, distributes water directly to the furrow at very low pressure through drop tubes from an overhead frame. A survey of change agents such as county agricultural agents; local, state, and federal irrigation specialists; and irrigation equipment deals and company representatives helped compile as complete a list as possible of irrigators who used the new irrigation method in 1983. Change agents also identified channels through which information on the technology had been disseminated. The most effective methods of technology transfer, according to a survey of irrigators who have adopted some form of the concept, are the research agency and farm publications as initial sources of information. Irrigators surveyed named irrigation equipment dealers and company representatives as the most important channel leading to adoption and the source they would most likely recommend to others interested in adoption. Identification and evaluation of the channels which convinced a widespread, independent group of irrigators to modify their conventional application methods should help future change agents develop more effective programs for technology transfer.
W86-02621

ANALYSIS OF THE ECONOMICS OF IRRIGATION PUMPING AND DISTRIBUTION EFFICIENCES IN NEVADA,

Nevada Univ., Reno. Dept. of Agricultural Economics.
T. R. Harris, M. K. Glover, and C. R. Ulrich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232791/AS, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, Publication 43012, Nevada, Water Resources Research Center, Reno. 44 p, 15 fig, 9 tab, 22 ref. USGS G855-03. 14-08-0001-G-855.

Descriptors: *Nevada, Alfalfa, Irrigation, *Irrigation pump efficiency, Low pressure system, Existing irrigation system cost generator, Microcomputer, Accelerated cost recovery system, *Computer programs, *Irrigation cost efficiency, Economics.

Irrigated agriculture in Nevada is a major segment of the states' agricultural sector. However with increasing fuel costs, the efficient application of water is desired. Two methods of improved irrigation practice were investigated: increasing pumping plant efficiency and conversion of low pressure irrigation. To determine the costs of declining pumping plant efficiencies, a microcomputer program was developed which determined the amount of additional hours required to pump a given quantity of water or the decline in water applied for a constant hours available for pumping at lower pumping plant efficiency. The change in net returns for an alfalfa producer in Diamond Valley, Nevada, was derived for a 72%, 57%, and 46% efficient pumping plant. Also the costs of converting a high pressure irrigation system to a low pressure system were estimated. With the 1981 tax bill, the Accelerated Cost Recovery System was enacted which could effect investments in upgrading irrigation systems. Through an investment simulation model, it was found that an investment to upgrade a 48% efficient pumping plant to 72% efficiency was very profitable under the ACRS depreciation procedure where expensing was allowed.
W86-02624

ASSESSING WATER-SHORTAGE RISK OF RESERVOIRS BY STOCHASTIC SIMULATION,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 4D.
W86-02639

IMPACT OF IMPROVED AGRICULTURAL WATER USE EFFICIENCY ON RESERVOIR STORAGE IN SUB-HUMID AREAS,

Kansas State Univ., Manhattan. Dept. of Civil Engineering.
J. K. Koelliker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233039/AS, Price codes: A04 in paper copy, A01 in microfiche. Kansas Water Resources Research Institute Completion Report, Manhattan, 1984. 59 p, 12 tab, 11 fig, 21 ref, 5 append. USGS G843-02.

Descriptors: *Kansas, Water yield, Streamflow, Reservoirs, Soil conservation, *Water conservation, Agricultural runoff, Computer models, Simulation analysis, Water use efficiency.

Surface water yield from semiarid and subhumid regions of the Great Plains have been decreasing since the 1950s. Changes in agricultural technology on non-irrigated areas including practices which permanently retain water (ponds and level terraces) and increase infiltration (residue management) are the main factors. Development of irrigation from surface water supplies and withdrawals of groundwater from alluvial aquifers are also important. This work used methodology developed previously to estimate the effects of agricultural technology developments, particularly on non-irrigated areas, to reduce streamflow in a subhumid region. Current net reduction in the lower portion of the Republican River basin was estimated to be 15 percent of total potential streamflow and will increase to 22 percent by 2025. About 25 percent of the gross reduction in surface runoff from these areas is expected to subsequently become streamflow or to satisfy depletions of streamflow. Continued development of irrigation will be a greater factor in overall streamflow reduction in this area. Water supply capability of Milford Reservoir is declining and will continue to decline because of agricultural technology in its drainage basin. Currently, the sustainable draft capacity is estimated to be about 75 percent of its original design capacity. By 2000 and 2025 it is expected to decrease to 60 and 50 percent, respectively, of the original design capacity.
W86-02648

METHODOLOGY TO INCREASE PRECISION IN MEASUREMENT OF IRRIGATION EFFICIENCY,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 6D.
W86-02649

FEASIBILITY OF SUBIRRIGATION SYSTEMS ON CLAYPAN SOILS IN THE MIDWEST,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W86-02697

EVALUATION OF 0.1 N NAHCO3 EXTRACTION FOR DETERMINATION OF AVAILABLE NITROGEN,

Delaware Univ., Newark. Dept. of Plant Science.
For primary bibliographic entry see Field 2G.
W86-02703

IRRIGATION SCHEDULING PROCEDURES WITH LIMITED WATER FOR IMPROVED WATER USE EFFICIENCY FOR CORN AND SOYBEANS, 1982-1984 STUDIES,

Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
G. E. Meyer, P. E. Fischback, and J. A. Lamb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126174/AS, Price codes: A09 in paper copy, A01 in microfiche. Final Report, June 1985. 172 p, 26 fig, 23 tab, 95 ref, 6 append. C-90281-C. 14-34-0001-1465.

Descriptors: *Irrigation requirements, Irrigation efficiency, Computer models, *Simulation analysis, Crop yields, Corn, Soybeans, Nebraska.

A 3-year irrigation scheduling study using computer control, computer simulation, field and growth chamber studies was conducted. Microprocessor hardware and software aided both field irrigation scheduling and growth chamber studies of corn and soybeans using simulated weather sequences to mimic field conditions. Corn yields of 11,000 Kg/ha (170 bu/ac) were grown with only 22 cm of supplemental irrigation during a dry summer of 1984 with frequent well-timed irrigation events on relatively poor-drained soils at Mead, Nebraska. Irrigation scheduling of field soybeans did not significantly improve yields (3,000 Kg/ha) in any of the years, although results in plant growth chambers indicated that soybeans are very sensitive to moisture stress. From simulation studies using physiological plant growth models, it was concluded that crop performance levels in the fields may be only at 30 to 40 percent of their physiological potential using current production systems.
W86-02727

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DEVELOPMENT OF A PREDICTIVE IRRIGATION SCHEDULING INDEX USING ELECTROPHYTOGRAMS,

Arizona Univ., Tucson. Dept. of Electrical Engineering.
W. G. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-157832, Price codes: A02 in paper copy, A01 in microfiche.

Research Project Technical Completion Report, Arizona Water Resources Research Center, Tucson, September 1984, 12 p, 4 fig, 1 tab, 2 ref. USGS G828-05.

Descriptors: *Irrigation efficiency, *Instrumentation, Electrochemistry, Potentiometric level, Electrodes, *Irrigation scheduling, Plant growth, *Arizona, Telemetry.

An irrigation management instrument system was tested using electrochemical and biophysical sensors placed directly on the plant in the field. The sensors were calibrated at different water regimes in furrow and drip irrigated cotton. Plant water status was directly monitored with a probe in the plant. Stem diameter measurements used electromechanical transducers attached to plants. A telemetry system was developed to transfer the signal from the field to the grower's headquarters. These methods can probably be adapted for field use in irrigation management.
W86-02424

LOW ENERGY IRRIGATION FOR THE PACIFIC NORTHWEST,

Idaho Univ., Moscow. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W86-02437

PHYSICAL MODEL STUDIES TO VERIFY A NUMERICAL MODEL OF FLOOD ROUTING,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2E.
W86-02486

HYDRILLA MANAGEMENT IN NORTH CAROLINA,

North Carolina State Univ. at Raleigh. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-02507

QUANTITATIVE ASPECTS OF WATER RESOURCE MANAGEMENT,

Missouri Univ.-Rolla. Dept. of Civil Engineering.
C. D. Morris, J. W. Hood, and J. A. Ferguson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230092/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1984. 41 p, 2 tab, 7 fig, 11 ref, append, USGS G-852-03. 14-08-0001-G-852.

Descriptors: Hydrology, Stochastic, Modelling, Rainfall, Water resources, Water supply, Management, *Water resources management, *Rainfall-runoff relationships.

A stochastic model is developing to define a hydrologic extreme and describe the likelihood of occurrence of various drought situations. The purpose of the study is to define drought probabilities so management strategies may be developed to minimize the impact to the study area of Springfield, Missouri, or generally in the State of Missouri. Daily rainfall data were obtained for the study area and a time series analysis was performed to evaluate the temporal structure of the data. From this, a stochastic model is developed that enables researchers to synthesize up to 500 years of daily rainfall data. The Water Supply Model currently used for planning is reviewed and altered for comparison with runoff models developed specifically for this application One model uses multiple linear regression to predict low flow on the James River. Water supply reservoir inflows are calculated using the Soil Conservation Service curve number approach to estimate lake inflow volumes from stochastically generated rainfall values. Finally, conclusions are drawn relative to the adequacy of Springfield's water supply and to the relevance of this technique to other study areas.
W86-02617

ANALYSIS OF THE WATER BALANCE OF B. EVERETT JORDAN LAKE INCLUDING ESTIMATES OF FLOWS BETWEEN SEGMENTS,

North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249076/AS, Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No. 221, April, 1985. 26 p, 10 fig, 4 tab, 3 ref.

Descriptors: *Storage capacity, *Stream discharge, *Reservoir stages, Flow, Reservoir releases, Reservoir yield, B. Everett Jordan Reservoir, *North Carolina.

B. Everett Jordan Lake, a recently completed multipurpose reservoir located in the north central Piedmont of North Carolina, has a unique hydrologic structure that makes prediction of internal flows within the reservoir especially difficult. This report contains estimates of these flows for the period October 1, 1982, to September 30, 1983. Estimates are based on mass balance equations for each of the four segments within the lake. A comparative analysis of daily, monthly, and annual storage changes as calculated from deviation changes and mass balances for the lake as a whole indicates that errors are within the limits of accuracy reported for stream flows.
W86-02686

POLICY ANALYSIS OF RESERVOIR OPERATION, VOLUME I: EXECUTIVE SUMMARY; VOLUME II: COMPONENT STUDIES,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 6A.
W86-02730

TECHNIQUES FOR ESTIMATING MAGNITUDE AND FREQUENCY OF FLOODS ON STREAMS IN INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02780

METHOD FOR ESTIMATING MEAN AND LOW FLOWS OF STREAMS IN NATIONAL FORESTS IN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02824

AVAILABILTY OF NATURAL AND REGULATED STREAMFLOWS FOR INSTREAM USES DURING HISTORICAL DROUGHTS, LOWER NEOSHO RIVER, SOUTHEASTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02838

SPIRIT LAKE DAM-FAILURE FLOOD ROUTING ASSESSMENT,

Geological Survey, Tacoma, WA. Water Resources Div.
D. L. Kresch.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 82-770, 1985. 8 p, 2 tab, 1 ref.

Descriptors: *Flood routing, *Dam failure, *Washington, Spirit Lake, *Mount St. Helens, Streamflow, Floods, Peak discharge.

Potential clear-water floodflows resulting from uncontrolled breaching by Spirit Lake of a debris dam deposited by the May 18, 1980, eruption of Mount St. Helens, Washington, were evaluated. U.S. Geological Survey dam-break model K-634 was utilized, first to compute clear-water flood hydrographs for various hypothetical breach scenarios, and then to hydraulically route them downstream to the mouth of the Toutle River. Dam-break computations were obtained for 12 breach-development scenarios. Eight of the scenarios modeled breaches caused by overtopping of the June 1982 crest of the debris dam, while the other four modeled breaches resulting from overtopping of the debris dam at a possible future crest altitude of 3,490 feet. Equal numbers of scenarios, six each, were modeled for breach development durations of 0.25 hour and 1.0 hour. Peak discharges and times of arrival at selected locations for scenarios with breach development durations of 1.0 hour are presented in tables. Peak discharges computed for dam-break scenarios with breach crest widths of 400 feet are almost twice the magnitude of those computed for scenarios identical in all other respects, but with widths of 200 feet. Peak discharges computed for breaches caused by overtopping of the debris dam at an altitude of 3,531.8 feet were generally found to be roughly five times greater than those caused by overtopping at an altitude of 3,490 feet, if the breaches had identical crest elevations and crest widths. Decreases in peak discharge from Spirit Lake to the mouth of the Toutle River ranged from 16 to 26 percent for the scenarios modeled. This lack of significant attenuation is primarily due to the large volume and surface area of Spirit lake (in excess of 360,000 acre-feet and 3,000 acres, respectively, for all scenarios modeled), which result in the continued discharge of high flows long after breach development is complete. The degree of attenuation is also minimized by the generally steep narrow valleys through which the North Fork Toutle and Toutle Rivers flow. Elapsed time from beginning of breach development to arrival of peak discharges at the mouth of the Toutle River ranged from 4.3 to 7.4 hours for the scenarios modeled. (USGS)
W86-02846

MAGNITUDE AND FREQUENCY OF FLOODS IN ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02857

STREAM CHANNEL RESPONSE TO THE JANUARY 3-5, 1982 STORM IN THE SANTA CRUZ MOUNTAINS, WEST CENTRAL CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02858

ESTIMATION OF THE FLOW AND WATER-QUALITY CHARACTERISTICS OF ALASKAN STREAMS,

Geological Survey, Fairbanks, AK. Water Resources Div.
B. Parks, and R. J. Madison.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4247, 1985. 64 p, 21 fig, 14 tabs, 69 ref.

Descriptors: *Streamflow forecasting, *Water yield, Regional analysis, Planning, Statistical methods, Hydrologic data, Forecasting, *Alaska.

Although hydrologic data are either sparse or nonexistent for large areas of Alaska, the drainage area, area of lakes, glacier and forest cover, and average precipitation in a hydrologic basin of interest can be measured or estimated from existing maps. Application of multiple linear regression techniques indicates that statistically significant correlations exist between properties of basins determined from maps and measured streamflow characteristics. This suggests that corresponding characteristics of ungaged basins can be estimated. Streamflow frequency characteristics can be estimated from regional equations developed for southeast, south-central and Yukon regions. Statewide or modified regional equations must be used, however, for the southwest, northwest, and Arctic Slope regions where there is a paucity of data. Equations developed from basin characteristics are given to estimate suspended-sediment values for

glacial streams and, with less reliability, for nonglacial streams. Equations developed from available specific conductance data are given to estimate concentrations of major dissolved inorganic constituents. Suggestions are made for expanding the existing data base and thus improving the ability to estimate hydrologic characteristics for Alaskan streams. (USGS)
W86-02864

BASE-FLOW CHARACTERISTICS OF SEGMENTS OF THE PINEY RIVER, AND EAST AND WEST PINEY RIVERS, DICKSON AND HICKMAN COUNTIES, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02910

4B. Groundwater Management

DISCHARGE AND TRAVEL TIME DETERMINATIONS IN THE ROYAL SPRING GROUNDWATER BASIN, KENTUCKY,

Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 2F.
W86-02479

MATHEMATICAL MODELS FOR WATER RESOURCES POLICY AND MANAGEMENT WITH APPLICATION TO THE EUTAW-MCSHAN AQUIFER,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F
W86-02494

CLARIFICATION OF SURFACE WATERS FOR RECHARGE THROUGH WELLS,

California Univ., Davis. Dept. of Civil Engineering.
R. B. Krone, and R. W. Walls.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225910/AS, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center, Davis Completion Report, Sept. 1984, 25 p, 10 fig, 2 tab, 15 ref. USGS G830-02.

Descriptors: *Clarification, Clogging, *Recharge wells, *Groundwater recharge, Wells, Artificial recharge, Disposal wells.

Clogging of the well face is a major impediment to artificial recharge of confined aquifers through wells. It appears that continuous recharge requires particle-free water. The use of surface waters for such recharge, therefore, requires treatment to remove suspended material. This report describes an investigation of the novel aggregation and sedimentation process that promised to provide low cost removal of particles. Extensive testing to evaluate velocity gradients and overflow rates, using suspensions of montmorillonite and kaolipite clays, showed that changing velocity gradients over the range of 4 to 16 sec-1 had a small effect with the optimum near 8 sec-1. Increasing the overflow rate above .036 cm/sec reduced the effectiveness of the sedimentation stage. At optimum conditions the effluent concentration of montmorillonite was 7 to 14 mg/1 and the concentration of kaolinite was 20 to 30 mg/1. The aggregation and sedimentation process does not produce an effluent that is suitable for recharge through wells. A fine sand pressure filter would be required to polish the effluent before injection. (Snyder-California)
W86-02567

RECOVERY OF WATER FROM THE UNSATURATED ZONE BY AIR INJECTION: I-DESIGN OF A LARGE PHYSICAL MODEL,

Texas Water Resources Inst., College Station.
D. L. Reddell, J. L. Nieber, G. Felton, and G. Moridis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232957/AS, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, August, 1984. 84 p, 3 tab, 16 fig, 11 ref. USGS G-871-02. 14-08-0001-G-871

Descriptors: *Water yield improvement, Soil water, *Secondary recovery, Ogallala aquifer, Unsaturated zone.

'Secondary recovery' techniques (the injection of a second fluid such as natural gas or water into a reservoir under pressure) enhance oil recovery from reservoirs. Recently, air was injected into the unsaturated region above the Ogallala aquifer, and water levels in the area were raised significantly. Models describing this phenomena are needed for predictive purposes. Objectives of this research were to design a large physical model to verify numerical models, and explore similitude criteria for physical models of air-water flow in porous media. Precise similitude criteria were too restrictive; making the cost of a physical model prohibitive. Thus, a sand tank of a radial sector well 24 ft. long and 12 ft. high was designed to withstand air pressures of 100 psi. No attempt to meet the required similitude criteria was made. A two-phase oil and water numerical model from the petroleum industry was modified for air and water, and run using relative permeability vs. saturation data for sandstones from the petroleum literature. The volume of water below the water table was increased by 8% when air was injected. However, very accurate relative permeability vs. saturation data are needed for unconsolidated aquifers such as the Ogallala to obtain accurate results from the model. A permeameter to collect these data was designed and constructed; but no data were collected. A Phase II project is needed to construct the sand tank, collect permeability vs. saturation data, and make additional runs with the numerical model.
W86-02640

FEASIBILITY OF ARTIFICIAL RECHARGE TO THE HIGH PLAINS AQUIFER, NORTHWESTERN OKLAHOMA,

Oklahoma State Univ., Stillwater. Dept. of Geology.
H. White, and W. Pettyjohn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249050/AS, Price codes: A05 in paper copy, A01 in microfiche. Oklahoma Water Research Institute, Technical Completion Report, Stillwater, 1985. 88 p, 25 fig, 3 tab, 88 ref. USGS G863-04. 14-08-001-G-863.

Descriptors: *Oklahoma, *Artificial recharge, High Plains aquifer, Ground water management, Irrigation, Water supply.

The purpose of this investigation was to evaluate the potential for artificial recharge to the High Plains-Ogallala aquifer in northwestern Oklahoma. The aquifer, which extends from South Dakota to Texas, is the principal source of water supply in the Oklahoma Panhandle as well as much of the High Plains. Precipitation in northwestern Oklahoma averages about 18 inches annually as does evapotranspiration. Runoff ranges from less than 0.2 inch to nearly 0.5 inch. The effective regional ground-water recharge rate is estimated to be less than 0.2 inch per year. Despite the semi-arid climate, northwestern Oklahoma supports the most extensive agricultural activities in the State due to extensive irrigation with ground water. Irrigation since 1940, and particularly since 1960, has caused water level declines that locally exceed 150 feet. Continued agricultural prosperity in the region depends on a reduction, or halt, in the rate of water level decline. Artificial recharge, where feasible, presents a means to augment the volume of water in storage and prolong the economic life of the aquifer. While artificial recharge may be viable and beneficial on a local scale, lack of a suitably large source of recharge supply restricts application on a regional scale.
W86-02684

HYDROLOGIC AND LEGAL ASSESSMENT OF GROUND WATER MANAGEMENT ALTERNATIVES FOR IDAHO,

Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
D. R. Ralston, R. R. Broadhead, and D. L. Grant.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249084/AS, Price codes: A08 in paper copy, A01 in microfiche. Idaho Water Resources Research Institute, Moscow, Completion Report, May, 1984. 159 p, 1 fig, 10 tab, 42 ref. USGS G839-05. 14-08-0001-G839.

Descriptors: Groundwater management, Water law, Appropriation, *Conjunctive management, *Idaho, Snake River Basin.

A hydrologic and legal assessment was made of conjunctive management of surface and ground water resources of the upper Snake River Basin in Idaho. The report contains a hydrologic management classification of basins tributary to the upper Snake River and a legal examination of the uncertainties and complexities of conjunctive management of surface and ground water under the appropriation doctrine. Eleven basins tributary to the upper Snake River were selected for detailed study based upon existing data: Little Lost River, Big Lost River, Big Wood River-Silver Creek, Camas Prairia, Portneuf River, Michaud Flats, Rockland, Raft River, Rock Creek-Goose Creek, Salmon Falls Creek and Blue Gulch. The basins are classified based upon the following factors: (1) the ratio of annual basin discharge to total flow of the Snake River, (2) the ratio of annual consumptive pumpage to annual basin discharge, (3) the ratio of annual water yield to basin area, and (4) the distance that surface and ground water must flow before discharging into the Snake River. The legal uncertainties and complexities of conjunctive management examined include: (1) questions involving the magnitude and timing of the impact of junior tributary diversions upon supplies in the main source, both in private litigation between water users and in administrative regulation of water use: (2) selection of junior tributary diversions for closure when senior appropriators on the main source are not receiving their full supplies: (3) questions of burden of proof both in private litigation and in administrative regulation; and (4) the influence of policy objectives upon conjunctive management decisions. The study also focuses on a fundamental and difficult policy issue that may arise in a number of conjunctive management situations, namely, potential conflict between the policies of protecting senior vested rights and optimum development.
W86-02687

FEASIBILITY OF SUBIRRIGATION SYSTEMS ON CLAYPAN SOILS IN THE MIDWEST,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. Mostaghimi, W. D. Lembke, and C. W. Boast.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249183/AS, Price codes: A04 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, Research Report No 189, September 1984. 50 p, 15 fig, 3 tab, 33 ref. USGS G840-04. 14-08-0001-G840.

Descriptors: *Irrigation, *Drainage systems, *Illinois, *Claypan soils, Corn, Drain depth, Drain spacing, Dry days, Midwest, *Simulation model, Subirrigation, Subsurface drainage, Surface drainage, Trafficability, Water table depth, Weir depth.

This was a study to evaluate the suitability of subirrigation along with alternative soil and water management practices on claypan soil. Crop yields on these soils are usually low because of limited water management for crop production. Several years of crops, soil and weather data collected on a claypan soil in Illinois were used to study performance of subirrigation and conventional irrigation on these soils. Various drain spacings and depth combinations for both good and poor quality surface drainage were simulated. Results indicated that optimum drain spacing for subirrigation on these soils would be 6 m under good surface drainage, and a weir setting depth of 35cm on a 5-year

recurrence interval basis. However, such a close drain spacing may not be economically feasible.
W86-02697

WATER RESOURCES OF AURORA AND JERAULD COUNTIES, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
L. J. Hamilton.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4030, 1985. 58 p, 27 fig, 10 tab, 21 ref.

Descriptors: *Groundwater, *Aquifers, *Underground storage, Recharge, Drawdown, Aquifer characteristics, Water quality, Streamflow, Aurora and Jerauld Counties, *South Dakota.

Large quantities of slightly saline ground water are available for future water requirements in Aurora and Jerauld Counties, 1,236 square miles of glaciated, till-covered hills and plains in southeastern South Dakota. More than one million acre-feet of ground water is stored in five major glacial aquifers, outwash sand and gravel, beneath 340 square miles. About 58 million acre-feet is stored in bedrock, in the Niobrara marl aquifer, the Codell sandstone aquifer, and the Dakota sandstone aquifer. Recharge of aquifers by infiltration of precipitation totals 31,000 acre-feet annually. Effects of increased ground-water withdrawals generally have been small for glacial aquifers and large for some bedrock aquifers. Water levels declined 0.6 to 4 feet in glacial aquifers during 1978-80 within a mile of irrigation wells pumping 300 to 1,000 gallons per minute. In contrast, water levels declined 40 feet near a well pumping 1,500 gallons per minute from the Niobrara aquifer because of small artesian storage. Artesian pressure of the Dakota aquifer declined about 200 feet between 1909 and 1979 because of large withdrawals through flowing wells. The availability of surface water is limited because streams are ephemeral and have large flows only during spring of wet years. Most of the lakes are small, semipermanent, and shallow. Most surface water in the study area contains low concentrations of dissolved solids but most of the ground water is very hard and slightly saline. Some ground water has a very high-salinity hazard for irrigation. Water from the Niobrara and Codell aquifers also has a high sodium hazard and high boron concentrations. (USGS)
W86-02763

WATER-LEVEL DECLINES IN THE MAGOTHY AQUIFER IN SOUTHERN MARYLAND RELATED TO INCREASES IN PUMPAGE,

Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 2F.
W86-02781

ESTIMATING HIGHEST GROUND-WATER LEVELS FOR CONSTRUCTION AND LAND-USE PLANNING--A CAPE COD, MASSACHUSETTS, EXAMPLE,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02785

HYDROGEOLOGIC APPRAISAL OF A STRATIFIED-DRIFT AQUIFER NEAR SMYRNA, CHENANGO COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02793

EVALUATION OF THE HYDROLOGIC SYSTEM IN THE DICKINSON LIGNITE AREA, EASTERN SLOPE AND WESTERN STARK AND HETTINGER COUNTIES, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02796

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, PRE-1950,

Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02807

HYDROGEOLOGIC SETTING AND THE POTENTIOMETRIC SURFACES OF REGIONAL AQUIFERS IN THE HOLLANDALE EMBAYMENT, SOUTHEASTERN MINNESOTA, 1970-80,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02809

AQUIFEM-SALT: A FINITE ELEMENT MODEL FOR AQUIFERS CONTAINING A SEAWATER INTERFACE,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02822

HYDROLOGY OF THE TERTIARY-CRETACEOUS AQUIFER SYSTEM IN THE VICINITY OF FORT RUCKER AVIATION CENTER, ALABAMA,

Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02825

GEOHYDROLOGY OF TEST WELL USW, H-3, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02830

PRELIMINARY ASSESSMENT OF GROUND-WATER RESOURCES OF LAUDERDALE COUNTY, TENNESSEE,

Geological Survey, Memphis, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02833

INVESTIGATION OF GROUND-WATER RECHARGE BY INJECTION IN THE PALO ALTO BAYLANDS, CALIFORNIA--HYDRAULIC AND CHEMICAL INTERACTIONS, FINAL REPORT,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5D.
W86-02837

GROUND WATER IN UTAH'S RAPIDLY GROWING WASATCH FRONT AREA--THE CHALLENGE AND THE CHOICES,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02843

GROUND-WATER RESOURCES OF NORTHERN UTAH VALLEY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
D. W. Clark, and C. L. Appel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report, State of Utah Dept. of Natural Resources Technical Pub. 80, 1985. 115 p, 48 fig, 23 tab, 39 ref.

Descriptors: *Groundwater, *Recharge, *Groundwater movement, Discharge, *Utah, *Water quality, Hydraulic properties, Subsurface flow, Artesian wells, Irrigation hydrographs, Canal seepage, Potentiometric level, Utah County, Urban areas, Utah Valley.

An evaluation was made of the ground-water resources of northern Utah Valley, Utah, to describe the ground-water system and to document changes in ground-water conditions since 1963. The principal ground-water reservoir is in basin-fill deposits. It consists of three major confined aquifers and an unconfined aquifer in pre-Lake Bonneville, which are a lateral extension of an unconfined aquifer deposits along the mountains that adjoin the valley. The principal ground-water reservoir contains about 3.5 million acre-feet of recoverable water. The surface-water inflow in major streams to the valley is a principal source of ground-water recharge. This inflow averaged approximately 390,000 acre-feet per year during water years 1963-82. The total annual ground-water recharge is estimated to average about 200,000 acre-feet. It includes about 73,000 acre-feet of seepage from waterways and 112,000 acre-feet of subsurface inflow from the consolidated rocks of the mountains. The total annual ground-water discharge is estimated to average about 220,000 acre-feet. It includes 135,000 acre-feet discharged to waterways and springs and 68,000 acre-feet withdrawn from wells. The annual ground-water withdrawal for public supply increased from about 5,000 acre-feet during 1963 to about 20,000 acre-feet during the late 1970's. This reflected an increase in urban population from about 72,000 in 1960 to about 164,000 in 1980. A reasonable estimate for both recharge and discharge to and from the principal ground-water reservoir is about 200,000 acre-feet per year. Water levels in wells fluctuate seasonally due to changes in rates of recharge or discharge, and the greatest changes are closest to points of recharge or discharge. Since 1970, water levels have declined, despite generally greater than average precipitation, due to increased withdrawal from wells for public supply. Ground water in the study area generally is suitable for most uses. There is little evidence of change in the chemical quality between the late 1950's and 1982. (USGS)
W86-02844

GROUND WATER HYDROLOGY OF THE ELIZABETHTOWN AREA, KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02845

PALEOZOIC ARTESIAN AQUIFERS IN THE TEN SLEEP AREA OF THE BIGHORN BASIN, NORTH-CENTRAL WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02847

USE OF A DIGITAL MODEL TO DETERMINE THE EFFECTS OF PROPOSED PUMPING FROM THE PRINCIPAL ARTESIAN AQUIFER, SAVANNAH, GEORGIA, AREA,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02851

HYDROLOGY OF THE SOUTHERN PARTS OF OKALOOSA AND WALTON COUNTIES, NORTHWEST FLORIDA, WITH SPECIAL EMPHASIS ON UPPER LIMESTONE OF THE FLORIDAN AQUIFER,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02853

AVAILABILITY AND QUALITY OF WATER FROM THE BEDROCK AQUIFERS IN THE RAPID CITY AREA, SOUTH DAKOTA,

Geological Survey, Rapid City, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02854

SIMULATION OF AN AQUIFER TEST ON THE TESUQUE PUEBLO GRANT, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02866

ANALYSIS OF THE CARMEL VALLEY ALLUVIAL GROUND-WATER BASIN, CALIFORNIA, USING DIGITAL FLOW MODEL TECHNIQUES,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02869

EFFECTS OF ARTIFICIAL RECHARGE ON THE BIG SIOUX AQUIFER IN MINNEHAHA COUNTY, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
N. C. Koch.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4312, 1984. 8 p, 3 fig, 1 tab, 1 ref.

Descriptors: *Artificial recharge, *Computer models, *Aquifers, *Surface water-groundwater relationships, Minnehaha County, *South Dakota.

The Big Sioux aquifer in Minnehaha County is a water-table aquifer hydraulically connected to the Big Sioux River. A digital-computer model previously developed by the U.S. Geological Survey was used to simulate potential effects of artificial recharge on the aquifer. A simulation was made by recharging water at the rate of 870 gallons per minute for four 30-day periods. Total water recharged to the aquifer during the 120 days was 150.3 million gallons. About 24.4 million gallons of water discharged from the aquifer to the river during the 120-day recharge period and about 30 million gallons discharged from the aquifer to the river during three 30-day recovery periods, both as a result of the artificial recharge, therefore, a total of 54.4 million gallons or 36 percent of the 150.3 million gallons that was artificially recharged from the aquifer to the river. (USGS)
W86-02870

GROUND-WATER RESOURCES OF THE MATTAPOISETT RIVER AQUIFER, PLYMOUTH COUNTY, MASSACHUSETTS: SUMMARY FOR WATER-RESOURCE MANAGERS,

Geological Survey, Boston, MA. Water Resources Div.
V. de Lima, and J. C. Olimpio.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4023, 1984. 43 p, 17 fig, 5 tab, 22 ref.

Descriptors: *Glacial aquifers, *Groundwater models, *Wells, *Streamflow, *Water table, *Water level fluctuations, *Municipal pumping, Ground-water movement, Streambed infiltration, Hydrologic cycle, Basic hydrology, *Groundwater resources, Plymouth County, *Massachusetts, Simulation analysis, *Surface-groundwater relationships.

Proposed increases in municipal pumpage in the Mattapoisett River valley will triple ground-water withdrawals in the next two decades. Because of State and local concern about the long-term effects of these withdrawals on ground-water levels and streamflow, a digital ground-water-flow model was developed to assist water-resource management. Ten development scenarios representing existing and proposed withdrawals were simulated using drought conditions. Under conditions simulating 1965, the driest year of record, predicted water levels in the aquifer are as much as 9 feet lower than average. Under severely dry conditions, simulating only enough recharge to keep the river flowing with no pumping, the predicted water levels are as much as 19 feet lower than average. During the greatest pumping demands, the predicted drawdown in five wells could cause well failure. Simulated pumping demands in six scenarios use all available ground-water discharge. Under severely dry conditions, it is predicted that the downstream half of the river will stop flowing under most pumping plans. (USGS)
W86-02874

GROUND-WATER CONDITIONS AND SHALLOW TEST-WELL INFORMATION IN THE EASTERN HALF OF MERCED COUNTY, CALIFORNIA, 1977-82,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02876

EXAMPLE CALCULATIONS OF POSSIBLE GROUND-WATER INFLOW TO MINE PITS AT THE WEST DECKER, EAST DECKER, AND PROPOSED NORTH DECKER MINES, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
R. E. Davis.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4199, 1984. 31 p, 7 fig, 6 ref.

Descriptors: *Groundwater, *Influent seepage, *Strip mines, Mine drainage, Surface-groundwater relationships, Decker coal-mining area, *Montana, Tongue River Reservoir.

Proposed plans to raise the spillway of the Tongue River Dam, Montana, 14 feet would result in an increase in the reservoir stage, which will affect the amount of ground-water inflow from the reservoir to existing and proposed surface coal mine pits near Tongue River Reservoir. Example calculations are based on flow from the reservoir to the mine pits through areas approximately perpendicular to the long axis of the reservoir. The planned increase in the stage of the reservoir will result in an increase of inflow to the mine pits in most areas. The increases will be greatest where the mine pits are near the reservoir and separated from the reservoir solely by aquifer zones of relatively large hydraulic conductivity. However, the inflow determined from the calculations is subject to a large degree of error, owing to the simplified method of calculation and the assumptions used. (USGS)
W86-02886

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02889

MAPS SHOWING GROUND-WATER UNITS AND NUMBER OF LARGE-CAPACITY WELLS, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02890

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02891

MAPS SHOWING OUTCROPS OF BASALTIC ROCKS OF EARLY QUARTERNARY AND TERTIARY AGES, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02892

HYDROGEOLOGY OF THE CLIFTON PARK AREA, SARATOGA COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02894

RESULTS OF GEOHYDROLOGIC TEST DRILLING IN THE EASTERN SNAKE RIVER PLAIN, GOODING COUNTY, IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02896

AQUIFER TESTS IN WEST-CENTRAL FLORIDA, 1952-76,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02899

EFFECTS OF FRACTURING ON WELL YIELDS IN THE COALFIELD AREAS OF WISE AND DICKENSEN COUNTIES, SOUTHWESTERN VIRGINIA,

Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02900

GROUND WATER IN THE DICKSON AREA OF THE WESTERN HIGHLAND RIM OF TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02901

GROUND-WATER WITHDRAWALS FROM THE COASTAL PLAIN OF NEW JERSEY, 1956-1980,

Geological Survey, Trenton, NJ. Water Resources Div.
E. F. Vowinkel.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-226, 1984. 32 p, 8 fig, 3 tab, 38 ref.

Descriptors: *Groundwater, *Withdrawal, Coastal Plain, New Jersey, Aquifers, *Water use, Wells, *Atlantic coastal plain, *New Jersey, Potomac-Raritan-Magothy aquifer system, Atlantic City 800-foot sand, Englishtown aquifer, Kirkwood-Cohansey aquifer system.

Withdrawals and site data for wells with a pump capacity of 100,000 gallons per day or greater in the Coastal Plain of New Jersey are stored in computer files for 1956-80. The data are aggregated by computer into tables, graphs and maps to show the distribution of ground-water withdrawals. Withdrawals are reported by type of use and aquifer for each county in the Coastal Plain. Public-supply wells withdraw the largest quantity of ground water in the Coastal Plain, followed by industrial and agricultural wells. In 1980 public-supply withdrawals were about 280 million gallons per day; the maximum monthly rate was about 355 million gallons per day in July, and the lowest was about 215 million gallons per day in February. Average industrial withdrawals were about 65 million gallons per day. Ground-water withdrawals used for agriculture vary significantly during the year. In 1980, about 75 percent of the agricultural withdrawals occurred from June through September. Several aquifers are used as sources of water supply in the Coastal Plain. Five regional aquifers are the major sources of water for public-supply, industrial, or agricultural use. In decreasing order of withdrawals in 1980, in million gallons per day, they are: The Potomac-Raritan-Magothy aquifer system, 243; Kirkwood-Cohansey aquifer system, 70; Atlantic City 800-foot sand, 21; Englishtown aquifer, 12; and the Wenonah-Mount Laurel aquifer system, 5. (USGS)
W86-02911

GROUND-WATER WITHDRAWALS AND CHANGES IN THE WATER LEVELS IN THE HOUSTON DISTRICT, TEXAS, 1975-79,
Geological Survey, Houston, TX. Water Resources Div.
R. K. Gabrysch.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. Texas Department of Water Resources Report 286, 1984. 42 p, 22 fig, 4 tab, 25 ref.

Descriptors: *Groundwater, Aquifer characteristics, Aquifers, Land-surface subsidence, Saline water intrusion, Water supply, Water-level fluctuations, Groundwater pumping, *Chicot aquifer, Evangeline aquifer, Harris County, *Texas, Galveston County, *Withdrawals.

During 1975-79, total withdrawals of ground water in the Houston district decreased by 9.7 percent. This percentage represents a decrease from 505 million gallons per day during 1975, to 456 million gallons per day during 1979. The decrease resulted from an increased use of surface water that became available from Lake Livingston on the Trinity River during late 1976. During 1975-79, withdrawals of ground water decreased in the Pasadena, Katy, Baytown-La-Porte, Johnson Space Center, Texas City, and Alta Loma areas but increased in the Houston area. The decrease in withdrawals in the Kata area resulted partly from a small decrease in the acreage of rice planted, but mostly from a decrease in water needed for irrigation during 1979. The withdrawal of ground water increased in the Houston area because of the increase in population. The maximum rise of water levels in wells completed in the Chicot aquifer was 110 feet and for those completed in the Evangeline aquifer it was 150 feet. The maximum decline of water levels in wells completed in the Chicot aquifer was 60 feet; and for those completed in the Evangeline aquifer it was 70 feet. (USGS)
W86-02918

4C. Effects On Water Of Man's Non-Water Activities

OPERATION OF DETENTION FACILITIES FOR URBAN STREAM QUALITY ENHANCEMENT,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-02436

WETLANDS FOREST COMMUNITIES AS INDICATORS OF FLOODING POTENTIAL IN BACKWATER AREAS OF RIVER BOTTOMLANDS,
Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
E. E. Dale.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211746/AS, Price codes: A05 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project Completion report, Pub. No. 106, Sept. 1984. 84 p, 3 fig, 37 tab. USGS G-829-08.

Descriptors: *Bottomland hardwoods, *Flooding, *Forests, Wetlands, Arkansas flooding potential, Flood forecasting, Flood plains.

A phytosociological study was made of forest types that occur in backwater and river bottomlands of the Gulf Coastal Plain, Arkansas Valley, and Mississippi Delta Regions of Arkansas. Twenty different forest types dominated principally by a single species were identified and described. Their occurrence was then correlated with flooding conditions in their habitats and the types were arranged along decreasing moisture gradients. Those forest types tolerant of flooding or saturated soils between three months to a year or more are Taxodium distichum, Nyssa aquatica, Cephalanthus occidentalis, Salix nigra, and Planera aquatica types. Those tolerant from one to three months are Forestiera acuminata, Carva aquatica, Quercus lyrata, and Fraxinum pennsylvanica. Those tolerant between one month and two weeks are Populus deltoides, Celtis laeigata, Ulmus americana, Acer negundo, Carya illinoensis, Quercus nutallii, Liquidambar styraciflua, Quercus phellos, Quercus nigra, Carya ovata and Quercus falcata var. pagodaefolis. It is concluded that forests of the study area are similar in vegetation composition to those of wetlands in Mississippi and Louisiana and that the same types occupy comparable habitats. Principal differences are that comparable wetland types in Arkansas usually cover less area and tend to support more species characteristics of drier habitats.
W86-02445

BIOHYDROLOGY OF MOUNTAIN FLUVIAL SYSTEMS: THE YELLOWSTONE (PARTS I AND II),
Montana Univ., Missoula.
For primary bibliographic entry see Field 6G.
W86-02452

EFFECT OF SALTWATER INTRUSION ON SOIL ERODIBILITY OF ALABAMA MARSHLAND,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W86-02552

HYDROLOGIC AND WATER QUALITY IMPACTS OF PEAT MINING IN NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Forestry.
For primary bibliographic entry see Field 5B.
W86-02696

SOME HYDROLOGIC ASPECTS OF PROPOSED COAL MINING IN THE NORTH FORK OF THE FLATHEAD RIVER HEADWATERS AREA, NORTHWEST MONTANA AND SOUTH EAST BRITISH COLUMBIA,
Montana Bureau of Mines and Geology, Butte.
R. A. Nobel, W. A. Van Voast, and J. L. Sonderagger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101268/AS, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Bozeman, Report No. 146, December, 1984. 26 p, 5 fig, 4 tab, 24 ref. USGS G-853-05. 14-08-0001-G-853.

Descriptors: *Coal mines, Strip mine waste, Groundwater, Surface water, Water quality, *Acid mine water, *Leachate, Trace elements, *Flathead River, *British Columbia, *Montana.

The proposed Cabin Creek coal mine in Canada, just north of the Montana-British Columbia border, has caused considerable concern in Montana because of its potential impact on the North Fork of the Flathead River. The objective of this project was to assess the impact of mining activity at the Cabin Creek site on water quality in the Flathead River. The results of the project indicate that acid mine drainage from the Cabin Creek mine should not be a problem. Analysis of the coal samples indicated that the acid-neutralizing potential exceeded the acid producing potential. Mineralization of waters entering the North Fork could result in some degradation of water quality, as could sediment from soil disturbances. The extent of degradation will depend on mining practices and on the location of retention facilities for water and other residual materials extracted from the mine.
W86-02707

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTH-CENTRAL MISSISSIPPI, AUGUST 1984,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-327, 1985. 18 p, 5 fig, 3 tab, 8 ref.

Descriptors: *Lignite, *Water quality, *Surface water, Bottom sediments, Suspended sediments, *Coal mining effects, *Mississippi, Wilcox aquifer, Calhoun County, Lafayette County, Yalobusha County.

The U.S. Geological Survey, in cooperation with the Mississippi Department of Natural Resources, Bureau of Geology, is conducting a hydrologic data collection program in potential lignite-producing areas in Mississippi. During the last two weeks of August 1984, hydrologic data were collected at 15 stream sites that drain potential lignite mining areas in Lafayette, Calhoun, and Yalobusha Counties. Main channel widths ranged from approximately 60 feet at three streams (Coon Creek near Toccopula, Muckaloon Creek near Tula, and Hurricane Creek near Velma) to approximately 120 feet at two streams (Potlockney Creek near Tula, and Savannah Creek near Bruce). Maximum water depths ranged from less than 1.0 foot at most streams to over 5.0 feet at sites on Potlockney Creek near Tula and McGill Creek near Sarepta. Stream discharge ranged from 0.32 cubic feet per second in Persimmon Creek near Bruce to 18.5 cubic feet per second in Puskus Creek near Etta. The specific conductance of stream water ranged from 25 to 160 microsiemens and dissolved solids concentrations ranged from 22 to 91 mg/L (milligrams per liter). Most major ion concentrations were less than 10 mg/L with the exception of calcium (11 mg/L), sodium (12 mg/L) and sulfate (18 mg/L) in the water of Persimmon Creek near Bruce. Dissolved oxygen concentrations were greater than 5.0 mg/L at all but one site. Turbidity values were generally less than 50 units. Nitrate plus nitrite concentrations were equal to or less than 0.10 mg/L in all streams except in Potlockney Creek near Tula where the concentration was 0.11 mg/L. Copper and selenium concentrations in the water at all sampling sites ranged from below the detection limits (1 microgram/g) to 4 micrograms/g (micrograms per gram) and mercury concentrations in bottom material samples ranged from less than 0.01 microgram/g to 0.15 microgram/g. (USGS)
W86-02761

GROUND-WATER SYSTEM AND POSSIBLE EFFECTS OF UNDERGROUND COAL MINING IN THE TRAIL MOUNTAIN AREA, CENTRAL UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
G. C. Lines.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Supply Paper 2259, 1985. 32 p, 23 fig, 7 tab, 14 ref.

Descriptors: *Groundwater, *Dewatering, *Land subsidence, *Coal mines, *Mine water, Unconfined water, Confined water, Perched water, Hydraulic conductivity, Springs, *Utah, Drawdown, Water quality, Aquifer characteristics, Coal-mine subsidence, *Wasatch Plateau coal field.

Spring and well-test data indicate that ground water occurs in several aquifers in the Trail Mountain area. The coal-bearing Start Point-Blackhawk aquifer is regional in nature and is the source of most water in underground mines in the Wasatch Plateau coal field. In the Trail Mountain area, the Star Point-Blackhawk aquifer is overlain by one or more perched aquifers. Future underground coal mines will require dewatering when they penetrate the Star Point-Blackhawk aquifer. A finite-difference, three-dimensional computer model was used to make order-of-magnitude estimates of hypothetical mine inflows and drawdowns of potentiometric surfaces for various aquifer properties, premining hydraulic gradients, mine lengths and widths, and lengths of time. The computer simulations indicate that mine inflows could be several hundred gallons per minute and that potentiometric surfaces of the dewatered aquifer could be drawn down several hundred feet. Because the Star Point-Blackhawk aquifer is separated from overlying perched aquifers by an unsaturated zone, mine dewatering alone will not affect perched aquifers.

Mine dewatering will not significantly change water quality in the Star Point-Blackhawk aquifer. The effects of coal-mine subsidence on the ground-water system cannot be quantified. Subsidence fractures could extend from the roof of an underground mine into a perched aquifer several hundred feet above. Such fractures would increase downward percolation of water through the perching bed, and spring discharges from the perched aquifer could decrease. Also, flow through subsidence fractures could increase recharge to the Star Point-Blackhawk aquifer and increase inflow to underground mines. (USGS)
W86-02765

STATISTICAL APPROACH TO EVALUATING THE RELATION OF COAL MINING, LAND RECLAMATION, AND SURFACE-WATER QUALITY IN OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
J. Hren, K. S. Wilson, and D. R. Helsel.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4117, 1984. 36 p, 9 fig, 13 tab, 13 ref.

Descriptors: *Water quality, *Statistical analysis, *Coal mines, *Land reclamation, Analysis of variance, Regression analysis, Correlation analysis, Discriminant function analysis, *Ohio.

Base-flow data from 779 sites in Ohio's coal region were analyzed statistically to relate land use to selected water-quality characteristics. Sites were classified into five categories: unmined (100 percent unmined land), abandoned (50 percent or more abandoned surface mines), reclaimed (50 percent or more reclaimed surface mines), deep-mined (50 percent or more underground mines), and mixed (all others). Specific conductance, pH, alkalinity, acidity, sulfate, dissolved iron, total iron, and total manganese in streams draining basins in the coal region were the eight characteristics selected for analysis. (USGS)
W86-02775

RUNOFF AND CHEMICAL LOADING IN SMALL WATERSHEDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02794

QUALITY OF GROUND WATER IN MONITOR AND WILLIAMS TOWNSHIPS, BAY COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02798

U.S. GEOLOGICAL SURVEY URBAN-STORMWATER DATA BASE FOR 22 METROPOLITAN AREAS THROUGHOUT THE UNITED STATES,

Geological Survey, Lakewood, CO. Water Resources Div.
N. E. Driver, M. H. Mustard, R. B. Rhinesmith, and R. F. Middelburg.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-337, 1985. 219 p, 1 fig, 102 tab, 58 ref.

Descriptors: Water quality, *Data bases, *Urban runoff, *Urban storm runoff, *Urban hydrology, Anchorage, Alaska, Fresno, California, Denver, Colorado, Miami, Florida, Tampa, Honolulu, Hawaii, Glen Ellyn, Illinois, Baltimore, Maryland, St. Paul, Minnesota, Kansas City, Missouri, Albuquerque, New Mexico, Long Island, New York, Rochester, Durham, North Carolina, Columbus, Ohio, Portland, Oregon, Rapid City, South Dakota, Austin, Texas, Houston, Salt Lake City, Utah, Bellevue, Washington, Milwaukee, Wisconsin.

The U.S. Geological Survey has been collecting urban rainfall, runoff, and water-quality data nationally for several decades. These data have been stored in many data bases and locations. A collective urban-stormwater data base has now been assembled on magnetic tape and contains data from the U.S. Geological Survey's urban-stormwater program, that includes data from the Nationwide Urban Runoff Program. Stations having simultaneous rainfall, runoff, and water-quality data were selected for the data base. Rigorous quality-assurance procedures were followed to ensure that the data were of good quality. The resultant data base contains information for 723 storms from 99 stations in 22 metropolitan areas throughout the United States. Data for five or more storms are available for about two-thirds of the stations. This data base is available to the public in standardized format on magnetic tape. This publication explains the content and format of the tape. (USGS)
W86-02808

DATA COLLECTED BY THE U.S. GEOLOGICAL SURVEY DURING A STUDY OF URBAN RUNOFF IN BELLEVUE, WASHINGTON, 1979-82,

Geological Survey, Tacoma, WA. Water Resources Div.
J. C. Ebbert, J. E. Poole, and K. L. Payne.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-064, 1985. 255 p, 8 fig, 3 pl, 33 tab, 9 ref.

Descriptors: *Urban runoff, Detention reservoirs, *Water quality, Precipitation, Discharge measurement, Chemical analysis, Physical properties, *Water pollution sources, *Washington.

From October 1979 through January 1982 the U.S. Geological Survey conducted an urban-runoff study in Bellevue, Washington. The study, done in cooperation with the City of Bellevue, was part of the U.S. Environmental Protection Agency's National Urban Runoff program. The objectives of the study were to (1) establish a consistent and accessible data base for typical urban watersheds; (2) determine the magnitude and frequency of storm-runoff loads of water-quality constituents from three catchments in the city; (3) develop methods for estimating storm and annual loads of water-quality constituents from unsampled catchments in the study area; and (4) test the effectiveness of storm-water-quality management alternatives, such as street sweeping and detention storage, for the attenuation of constituent loads carried in storm runoff. This report presents data collected during the study period. Data include rainfall and runoff amounts, physical characteristics of the catchments, the chemical quality of storm runoff and in wet- and dry-atmospheric deposition, constituent loads in storm runoff and in wet- and dry-atmospheric deposition, and storm characteristics data, such as rainfall and runoff volumes. (USGS)
W86-02811

ANALYSIS OF URBAN RUNOFF DATA AND EFFECTS ON THE SOUTH PLATTE RIVER, DENVER METROPOLITAN AREA, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02813

RUNOFF AND WATER QUALITY CHARACTERISTICS OF SURFACE-MINED LANDS IN ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
T. P. Brabets.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4265, 1983. 78 p, 30 fig, 14 tab, 20 ref.

Descriptors: *Flow characteristics, *Streamflow, *Illinois, Surface water, Water quality, *Flood peak, *Flow duration, Variability, Data collection, Storm runoff, Coal mining, Climatic data, Specific conductivity, Sulfates, Calcium, Suspended sediments, Aluminum, Iron, Magnesium, Zinc, Trace metals, Fulton County, St. Clair County, Williamson County, *Surface mining.

Seven watersheds--three in western Illinois (Fulton County), two in south-western Illinois (St. Clair County), and two in southern Illinois (Williamson County)--were selected to assess the effect of surface mining on the quality and quantity of surface runoff. Each area had one site draining an unmined basin and a nearby site(s) draining a partly surface-mined basin. Flow-duration curves for streams draining surface-mined land had lower variability than those from unmined land. By adjusting an index of variability according to the percentage of surface-mined land in a basin, present techniques can be used to develop synthetic flow-duration curves. Surface mining changes basin characteristics so that peak flows decrease and low flows increase. Regression equations were developed relating storm runoff volume and peak discharge to basin characteristics and climatological data. Concentrations of dissolved solids, sulfate, and calcium were higher in streams draining extensively mined areas. Different mining areas of Illinois yield regional differences in concentrations of these substances. Surface-mined basins had lower suspended-sediment yields than unmined basins. (USGS)
W86-02826

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE WEST OTTER AREA, ASHLAND AND BIRNEY-BROADUS COAL FIELDS, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
N. E. McClymonds.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4087, 1984. 111 p, 16 fig, 10 tab, 33 ref.

Descriptors: Hydrology, Coal, Streamflow, Groundwater reservoirs, *Coal mining, Sandstone, Alluvium, Aquifers, Water quality, Otter Creek, Ashland coal field, Birney-Broadus coal field, *Montana, *Groundwater, *Surface mining.

Shallow aquifers exist primarily within the Tongue River Member of the Paleocene Fort Union Formation and within valley alluvium. Sandstone beds are the principal aquifers for domestic supply and livestock watering, with the Knobloch coal bed being a secondary source of supply. Surface-water resources consist principally of perennial flow in Otter Creek and intermittent flow in eight small drainage basins. The small streams are generally dry at their mouth, except after intense rainfall or sudden snowmelt. Otter Creek is used for livestock watering and, during spring floods, for irrigating alfalfa fields. The water supplied by wells generally is a sodium bicarbonate type. Dissolved-solids concentrations of water samples ranged from 480 to 3,460 milligrams per liter in sandstone beds and from 910 to 6,260 milligrams per liter in the Knobloch coal bed. Water in Otter Creek contains principally sodium, magnesium, and sulfate ions. The dissolved-solids concentration ranged from 2,050 to 2,950 milligrams per liter. Mining of the Knobloch coal bed would remove three private wells and adversely affect the yield of two other wells. After mining, water in the alluvium of Otter Creek might show long-term degradation in water quality as a result of waters leaching the soluble salts from the spoils material used to backfill the mine pits. Although mining would alter the existing hydrologic systems and remove several shallow wells, alternative ground-water supplies are available from deeper aquifers that could be developed to replace those lost by mining. (USGS)
W86-02827

GROUND-WATER RESOURCES AND POTENTIAL HYDROLOGIC EFFECTS OF SURFACE COAL MINING IN THE NORTHERN POWDER RIVER BASIN, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
S. E. Slagle, B. D. Lewis, and R. W. Lee.
Available from Dist Branch, USGS 604 S. Pickett St Alexandria, VA 22304. USGS Water-Supply Paper 2239, 1985. 34 p, 14 fig, 7 tab, 114 ref.

Descriptors: *Groundwater resources, Surface waters, *Water quality, Strip mines, Powder River Basin, Shallow groundwater, Fort Union Formation, *Coal mining effects, *Montana, *Water pollution sources.

The shallow ground-water system in the northern Powder River Basin, Montana consists of Upper Cretaceous to Holocene sedimentary rocks of the Fox Hills, Sandstone, Hell Creek, Fort Union, and Wasatch Formations, terrace deposits, and alluvium. Groundwater in the system has both localized and regional flow patterns. Most water in the shallow aquifers does not meet standards established by the U.S. Environmental Protection Agency for public supply. Average dissolved-solids concentration is 2,100 mg/L for water at depths of less than 200 feet and 1,400 mg/L for water at depths between 200 and 1,200 feet. Effects of surface mining on the water resources in the northern Powder River Basin are largely dependent on the stratigraphic location of the mine cut. Where the cut lies above the water-yielding zone the effects will be minimal. Where the mine cut intersects a water-yielding zone, effects on water levels and flow patterns locally can be significant, but they will return to approximate premining conditions after mining ceases. Mineralization of ground water near former mines may occur locally owing to the exposure of fresh mineral surfaces in the spoils. Regional effects will probably be small because of the limited areal extent of ground-water flow systems where mining can occur. Results of digital models are presented to illustrate the effects of varying hydraulic properties on water-level changes resulting from mine dewatering. During October 1, 1979 - August 31, 1980, the discharge-weighted average concentrations of dissolved solids was 195 milligrams per liter in the combined inflow to the reservoir. The smaller concentration in the outflow was due primarily to precipitation of calcium carbonate in the reservoir--about 80 percent of the decrease can be accounted for through loss as calcium carbonate. (USGS)
W86-02841

SYNTHESIZED FLOOD FREQUENCY OF URBAN STREAMS IN ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
D. A. Olin, and R. H. Bingham.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 82-683, 1982. 23 p, 13 fig, 3 tab, 19 ref.

Descriptors: Urbanization, *Urban runoff, *Flooding, *Frequency analysis, Surface waters, Analytical techniques, Parametric hydrology, Regression analysis, Hydrology, *Alabama, Flood frequency, *Urban streams.

Equations have been developed for estimating future floods for 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals on urban streams in Alabama with drainage areas of about 0.15 to 85 square miles. One equation for each recurrence interval applies statewide. The equations were derived by multiple regression analyses of flood magnitudes obtained from synthetic discharge data generated with a calibrated rainfall-runoff model and basin characteristics. The regression analyses indicated that drainage area size and percentage of the basin occupied by impervious materials are the most significant basin characteristics affecting flood frequency and magnitude of urban streams. Mathematical procedures used to analyze the observed and synthetic data are described. Also included are flood-frequency data for stations used in the analyses and computations demonstrating application of the regression equations to urban streams in Alabama. (USGS)
W86-02856

EFFECTS OF SURFACE COAL-MINE RECLAMATION ON STREAM QUALITY IN A SMALL WATERSHED NEAR NELSONVILLE, SOUTHEASTERN, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02867

EFFECTS OF RELOCATING STATE ROUTE 151 ON THE FLOOD PROFILES OF CONOTTON CREEK AND ITS TRIBUTARIES BETWEEN BOWERSTON AND SCIO, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
W. P. Bartlett, B. E. Krejmas, R. I. Mayo, and S. W. Wandle.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4130, 1984. 46 p, 10 fig, 3 tab, 10 ref.

Descriptors: *Design floods, *Flood profiles, Flood recurrence interval, *Highway relocation, Harrison County, *Ohio, Conotton Creek.

The Ohio Department of Transportation proposes to relocate an 8-mile segment of State Route 151 between Bowerston and Scio, Harrison County, Ohio. About 3.1 miles of this relocated highway will be within the flood plain of Conotton Creek or its tributaries. Water-surface profiles of the 100-year flood before and after the highway relocation are virtually the same between Bowerston and the western coorporation limits of Scio. Upstream from that point to the upper end of the study reach, the modified profile would be about 1 foot lower than for existing conditions. (USGS)
W86-02872

SUMMARY OF URBAN-RUNOFF STUDIES IN THE DENVER METROPOLITAN AREA, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02875

HYDROLOGY OF A SURFACE COAL MINED AREA IN RANDOLPH COUNTY, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02897

HYDROLOGY OF AREA 56, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
G. C. Lines.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-38, 1984. 69 p, 54 fig, 7 tab, 57 ref.

Descriptors: Water resources, *Groundwater, *Surface waters, Water quality, *Coal mines, *Utah, *Colorado, Hydrologic data, *Hydrologic impacts, Underground mines, Hydrologic studies.

Area 56 is one of 20 hydrologic areas defined in the Northern Great Plains and Rocky Mountain Coal Provinces. Area 56 includes the Wasatch Plateau, Book Cliffs, Emery, and Henry Mountains coal fields in central and southeastern Utah and west-central Colorado. All coal mined on the area during 1980, was recovered by underground mining techniques, and was mainly from the Wasatch Plateau and Book Cliffs fields. Surface mining is possible in the Emery and Henry Mountains fields. Hydrologic impacts related to coal mining in the area are due mainly to dewatering of mines and land subsidence. Dewatering of coal mines changes the flow pattern through coal-bearing aquifers, and storage in aquifers is reduced. Land subsidence and associated rock fracturing above underground mines could change the flow of springs and locally could alter surface runoff. Other impacts of mining are increases in streamflow and degradation of surface-water quality downstream from points of mine discharge. The report provides broad hydrologic information for the area, using a brief text accompanied with maps, graphs, and tables for each of a series of water-resources related topics. Sources of additional hydrologic information are identified. The report is designed to be useful to coal-mine operators, consulting engineers, and regulatory authorities. (USGS)
W86-02913

4D. Watershed Protection

PREVENTION OF GULLY FORMATION AND ASSOCIATED WATER DEGRADATION IN WEST TENNESSEE,

Tennessee Water Resources Research Center, Knoxville.
For primary bibliographic entry see Field 2J.
W86-02538

ASSESSING WATER-SHORTAGE RISK OF RESERVOIRS BY STOCHASTIC SIMULATION,

Kansas Water Resources Research Inst., Manhattan.
Y. S. Yu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232940/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1984. 40 p, 11 fig, 11 tab, 5 ref. USGS G843-05.

Descriptors: *Kansas, Reservoirs, Water shortage risk, Water use options, Conservation practices, *Water requirements, Irrigation, Fish hatcheries, Municipal supply, Water supply, Reliability, Firm yield.

The water-shortage risk of Cedar Bluff Reservoir for various water-use options has been evaluated by simulated operation of the reservoir. In the reservoir operation study, the present level monthly inflows were used. The present level inflows are equal to either the historic monthly inflows subtracted by an estimated depletion due to well development and conservation practices in place at the 1980 level or the synthetic monthly inflows subtracted the depletion. The synthetic monthly inflow series is generated by a disaggregation model. The monthly inflow series is 43 years long. The water requirements include the releases for irrigation, fish hatchery and the City of Russell. Various sizes of irrigation project investigated 6800, 3000, 2000, 1500 and 1300 acres. For each case, the reliability of the water supply, the magnitude of water shortages and the frequency distribution of the pool level in the long-term operation are determined. The results show that the firm annual yield of the reservoir is 3600 ac-ft or 300 ac-ft per month. The water supply is 100% reliable for irrigating 2000 acres of irrigated land. With additional releases for fish hatchery, the reliability of the water supply is reduced to 88%. The water supply is fully adequate for irrigating 6800 acres of land in 24 years out of 43 years of operation. The reliability is only 56%.
W86-02639

RIPARIAN ZONE SYSTEMS, USES, AND MANAGEMENT,

Oregon State Univ., Corvallis. Water Resources Research Inst.
W. D. Honey, R. J. Seidler, and P. C. Klingeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246742/AS, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Corvallis, August 1984. 69 p, 14 fig, 30 ref. USGS G864-22. 14-08-0001-G-864.

Descriptors: *Riparian land, Riparian systems, *Riparian ecosystems, *Riparian vegetation, *Riparian waters, *Riparian zones, *Riparian zone management, *Ecosystems, *Aquatic ecosystems, Aquatic environment, *Aquatic habitats, Aquatic insects, Aquatic life, Aquatc plants, Stream biota, Aquatic productivity, Management, *Watershed management, *Range management, Agriculture, Wastewater, *Oregon.

A comprehensive overview is presented of riparian zone systems, uses and management. The presentation is divided into two parts. Part I describes the

natural features and processes found in riparian zones. Included are the basic concept of a riparian zone, ecosystem organization and biological processes in the riparian zone, vegetational systems and organic matter, wildlife, chemical processes, and the fluvial processes which shape the zone. Part II describes major types of human uses of riparian zones and the management methods that have evolved to sustain such uses. Included are forestry, livestock grazing, agriculture, sand and gravel extraction, mining, dams and diversions, transportation, recreation, aesthetics, municipal and industrial requirements, and urban developments. The concepts and related information cut across traditional disciplines so that the many facets of riparian zones can be treated as a unit.
W86-02668

RIPARIAN SHRUBBY VEGETATION PROTECTION AGAINST HERBIVORE BROWSING,

Oregon State Univ., Corvallis. Dept. of Rangeland Resources.
J. C. Buckhouse.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246767/AS, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-94, Corvallis, August 1984. 8 p, 3 fig, 1 tab, 5 ref. USGS G864-04. 14-0001-08-864.

Descriptors: *Riparian vegetation, *Grazing, *Vegetation establishment, Revegetation, Bank protection, Vegetation regrowth, Animal behavior, Range management.

Vexar(R) tubing, nylon mesh netting, and big game repellent (BGR) were tested under field and 'feedlot' trial conditions to determine their effectiveness as browsing protection devices for young willows. It was found that under certain environmental conditions, willow browsing protecting devices and treatments may have some value against rodents and deer but that their long-term protection value against cattle may be slight or even negative. Under field conditions, during 1983-1984 in the absence of domestic livestock, the nylon mesh, Vexar (R) tubes, and BGR provided some browsing protection some browsing protection against beaver and deer. Browsing frequencies were 13%, 19%, and 26% respectively, compared to 45% at controls. Several problems were encountered: the nylon mesh matted to the ground following periods of snow and tended to lie prostrate in high, rushing waters; the Vexar(R) tubes withstood snow crushing but were vulnerable to peak water flows; both the netting and tubes were highly visible and subject of heavy vandalism by fishermen, trappers, and recreationists; and the longevity of BGR following precipitation is unknown. A feedlot trial was conducted during spring 1984 to determine what protection these devices might offer against livestock browsing. The Vexar(R) tubes were essentially neutral; frequency of browsing (72%) was similar to the untreated control plants (70%). The BGR offered a moderate degree of protection (60% browsing frequency). The nylon mesh netting, however, attracted the animals (91 browsing frequency).
W86-02670

ANNUAL SUSPENDED-SEDIMENT LOADS IN THE COLORADO RIVER NEAR CISCO, UTAH, 1930-82,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02828

SEDIMENT CHARACTERISTICS OF TENNESSEE STREAMS AND RESERVOIRS,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02829

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

STREPTOCOCCI AS INDICATORS OF SOURCE AND TYPE OF SURFACE WATER CONTAMINATION,

Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.
R. E. Sjogren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214526/AS, Price codes: A03 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Burlington, September, 1984. 37 p, 5 tab, 10 fig, 26 ref. USGS G873-03.

Descriptors: *Bioindicators, Surface water, Water quality, *Bacteriological indicators, *Streptococci, *Vermont.

Environmentally significant streptococci were isolated on a newly developed medium, and identified to species level using a rapid biochemical test screen composed of tubed, plate and Minitek plate system. The numbers of identified species of Streptococcus were expressed as bars in a graph whose overall appearance constituted a population profile or signature. Visual and statistical analysis of these data by sample sites indicated that this approach holds promise as a means of identifying the source and type of microbial pollution entering surface waters.
W86-02456

MERCURY IN PEAT AND ITS DRAINAGE WATERS IN EASTERN NORTH CAROLINA,

Duke Univ., Beaufort, NC. Marine Lab.
R. T. DiGiulio, D. W. Evans, and E. A. Ryan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214823, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, North Carolina Water Resources Research Institute, Report No. 218, Raleigh, September, 1984. 80 p, 6 fig, 23 tab, 114 ref. USGS G860-02.

Descriptors: *North Carolina, *Peat mining, *Drainage waters, *Mercury, *Water pollution effects, Peat, Clams, Leaching, Aquatic environment, Mine drainage.

Mercury concentrations were measured by cold vapor atomic absorption spectrophometry in samples of peat and peatland drainage waters in both the western Pamlico-Albemarle Peninsula and Croatan National Forest of eastern North Carolina. Mercury concentrations were also measured in sediments, waters, and the benthic clam, Rangia cuneata, in the Pungo River which receives drainage from the former area. Total Hg concentrations measured ranged from 40 to 193 ng/g (dry weight) in peat, less than 2 to 20 ng/g dry weight in sediments, 25 to 32 ng/g wet weight in clams and less than 2 to 23 ng/L in water. These concentrations are all at the low end of the range of Hg concentrations in uncontaminated aquatic environments which indicates the absence of any identifiable Hg pollution under current conditions. The water concentrations, in particular, were all less than the current North Carolina water quality standard of 50 ng/L. Mercury in peat, sediments and water was largely associated with and strongly bound to organic matter which would restrict its biological availability to aquatic organisms. Peatland drainage appears to contribute slightly elevated Hg concentrations to receiving waters but these remain low. Mobilization of Hg from peat to drainage waters during mining would probably be minor as indicated by both sampling in experimental mining plots and drainage canals and simulated aerobic leaching of peat with deionized water.
W86-02485

RAPID DETECTION AND IDENTIFICATION OF BACTERIA IN SEWAGE AND NATURAL WATERS BY MEANS OF TIME-RESOLVED LASER SPECTROSCOPIES,

Rhode Island Univ., Kingston. Dept. of Chemistry.
W. H. Nelson, and J. F. Sperry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214864/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, Rhode Island Water Resources Research Center, Kingston, September, 1984. 12 p, 7 fig, 4 ref. USGS G867-02.

Descriptors: *Rhode Island, *Water resources research, *Pollutant identification, *Bacteria, *Resonance Raman, *Time-resolved fluorescence, Visible, Ultra-violet spectra, Detection, Identification.

The authors have excited samples of chromobacteria containing as few as 25 organisms and have obtained excellent spectra with 488 nm excitation. Thus, they have shown that the resonance Raman method potentially is a highly sensitive means of detecting and identifying bacteria. There is potential both for remote detection and detection from complex mixtures. Fluorescence emission data have demonstrated that measurable fluorescence does not occur below 285-290 nm in all of a wide variety of cultures. This is highly significant since most bacteria are not intensely colored and cannot be studied by resonance Raman using visible light, but tend to be fluorescent in the region 300-500 nm. Results suggest that resonance Raman spectra of DNA components taken with 220-280 nm excitation will be obtained with high sensitivity and will contain a maximum amount of information which can be related to the taxonomy of the micro organisms. The time-resolved fluorescence spectra of several types of bacteria have been obtained at various emission wavelengths. Our data suggest the determination of fluorescence lifetimes will be an effective means of bacterial identification even if all the fluorescence components are not resolved.
W86-02489

CONTINUOUS SYNTHESIS OF RUNOFF FROM THE KAWISHIWI RIVER IN NORTHEASTERN MINNESOTA,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2E.
W86-02518

DEVELOPMENT OF A SIMPLIFIED CHLORINATED HYDROCARBON SCREENING TECHNIQUE FOR WATER AND SEDIMENT,

Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
P. Templet.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219038/AS, Price codes: A02 in paper copy, A01 in microfiche. Technical Completion Report, Louisiana Water Resources Research Institute, Baton Rouge, August 1984. 9 p, 1 fig, 2 tab, 20 ref. USGS G845-04.

Descriptors: *Chlorinated hydrocarbons, *Sediments, *Water analysis, *Phenols, Monitoring, *Louisiana.

The development of a simple screening technique for chlorinated hydrocarbons in water and sediment was undertaken. Extraction and concentration techniques were used as an alternative to the present costly and time consuming methods. Water samples spiked with known amounts of six chlorinated hydrocarbons were passed through Sep-Paks, a Waters Assocs. C-18 disposable column, and the adsorbed compounds eluted with methanol. The methanol extract was analyzed directly by furnace evaporation and decomposition into a microcoulometer cell and reported as total organic halide (TOX). Recoveries were variable and were a function of the Sep-Pak loading, concentration and volume of samples and type of chlorinated hydrocarbon. Chlorinated phenols exhibited the best recoveries (100%) and volatile compounds the worst (20%). The technique offers promise as a qualitative screening procedure for natural waters. Dried sediment were spiked with known amounts of the

same six chlorinated hydrocarbons, extracted with hexane and analyzed for TOX using furnace microcoulometry. Sediments run directly without the extraction step exhibited interferences from naturally occurring sulfur compounds and inorganic chlorides. The extraction step affords an additionally opportunity for a 100-fold concentration. Recoveries ranged from 100% (PCB and chlorophenols) to 20-30% (Tetrachloroethylene and chloroform) for volatile compounds. The lower recoveries may never be encountered in field samples since volatiles may have already been evaporated from the sediment or soil.
W86-02550

EFFECTS OF POLLUTION ON GROWTH OF MIDWESTERN MUSSEL SHELLS,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5C.
W86-02563

DETERMINATION OF TOXIC ORGANIC COMPOUNDS IN DISCHARGE WATER FROM HYDROSTATIC TESTING OF NATURAL GAS PIPELINES,

New Mexico State Univ., Las Cruces. Dept. of Chemistry
G. A. Eiceman, and B. Davani.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229730/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, New Mexico Water Resources Research Institute, Las Cruces, October 1984. 32 p, 14 fig, 5 tables, 10 ref. USGS G-858-04.

Descriptors: *New Mexico, *Toxic wastes, *Water pollution sources, Pipelines, *Natural gas, Organic compounds, Water pollutants, Discharge water, Hydrostatic testing.

Hydrostatic testing of natural gas pipelines may lead to production of water which is contaminated with organic compounds in a highly complex mixture. Present in this complex mixture are benzene, C-1 to C-5 alkylated benzenes, dimethyl disulfide, C-3 to C-5 alkylated dissulfides, saturated alkanes, and branched/unsaturated alkanes. Estimated minimum concentrations of benzene were 25 to 38 mg/L. In the second study, a complex mixture of polycyclic aromatic hydrocarbons (PAH) and alkylated polycyclic aromatic hydrocarbons was identified and determined quantitatively in discharge water from hydrostatic testing of natural gas pipelines (DWHT). Over 150 PAH or alkylated PAH were detected in portions of DWHT using solvent extraction for prefractionation and concentration. Concentrations of total PAH content showed a clear decreasing trend throughout dewatering from high value of 32,000 g/L at start to less that 8,000 micrograms/L toward the end of the discharge. This trend was parallel with bulk hydrocarbon concentrations or COD values in the aqueous samples. Consequences for environmental release and disposal practices are discussed based on these results. Natural gas was found to contain organic compounds with carbon numbers between 10 to 28 in addition to methane and heptane. These compounds were present at total concentrations of about 100 mg/cu m and were easily detected by passing natural gas directly through glass cold traps. Components were resolved using gas chromatography and identified using gas chromatography/mass spectrometry. Major components included n-alkanes, branched alkanes, alkylated benzenes, and several aromatic hydrocarbons such as subatituted naphthalenes and biphenyls.
W86-02602

NEW APPROACHES FOR ON-LINE STRIPPING ANALYSIS OF TRACE METALS IN NATURAL WATERS,

New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 2K.
W86-02608

DEVELOPMENT OF A PRIMER ON WELL WATER SAMPLING FOR VOLATILE ORGANIC SUBSTANCES,

Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 7B.
W86-02612

VERIFICATION OF SHORELINE SEWAGE LEACHATES IN FLATHEAD LAKE, MONTANA,

Montana Univ., Bigfork. Biological Station.
For primary bibliographic entry see Field 5B.
W86-02619

SUITABILITY OF SELECTED ORGANISMS FOR MONITORING LEACHATE AT A REFUSE DISPOSAL SITE,

South Dakota State Univ., Brookings. Dept. of Civil Engineering.
J. N. Dornbush.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232825/AS, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, South Dakota Water Resources Research Institute, Brookings, December, 1984. 78 p, 9 tab, 6 fig, 22 ref, 4 append. USGS G-869-04. 14-08-0001-G-869.

Descriptors: *South Dakota, *Water pollution monitoring, *Bioindicators, *Landfill, *Leachate, *Bullheads, *Cattails, Groundwater, Surface interaction trench, Heavy metals.

The Brookings, SD landfill is located over a sand and gravel aquifer with a water table only a few feet below ground. A trench and ponds have been excavated to intercept and treat leachate-contaminated plumes from the landfill. Monitoring wells downstream from the trench have not violated drinking water standards. The objective of this study was to evaluate the potential of biological monitoring of leachate contaminants in the trench. Black bullheads (Ictalurus melas) and narrow-leaf cattails (Typha angustiforlia) were evaluated as potential biological accumulators or concentrators of low-level leachate contaminants. Neutron activation analysis (NAA) and gas-liquid chromatography revealed detectable levels of mercury, vanadium and polychlorinated biphenyls in the bullheads to demonstrate their potential of biomonitoring these toxics. Mercury levels of landfill fish were below 0.5 ppm although concentrations were higher than in control bullheads from a nearby borrow-pit lake. PCB's were detected in all bullhead liver samples but below the 2 ppm MCL established by FDA. Bromine, chlorine, cobalt and potassium were revealed by NAA in narrow-leaf cattails at higher concentrations at the landfill and considered to have the potential for monitoring. Sodium was lower than in the control. Chlorine concentrations increased 250% in cattails suggesting their monitoring use for defining plume direction and locating monitoring wells.
W86-02627

REPLICATION OF HUMAN ROTAVIRUS IN TISSUE CULTURE: RECOVERY AND DETECTION IN FECAL, SEWAGE, AND NATURAL WATER SAMPLES,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, E. B. Siwak, and P. C. Loh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232858/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 161, June, 1984. 24 p, 19 tab. USGS G838-02. 14-08-0001-G838.

Descriptors: *Viruses, *Enterovirus, *Pathogens, Sewage, Water pollution, *Hawaii, *Rotavirus, *Tissue culture, ELISA.

Human rotavirus is the major cause of gastroenteritis among young children. To replicate this virus, sensitive methods using standard tissue culture systems are required. The project goal was to develop laboratory capability to recover and detect this infectious rotavirus in fecal, sewage, and natural water samples. Using simian rotavirus (SA-11) as a model system and an enzyme-linked immunosorption (ELISA) test capable of detecting high concentrations of rotavirus, the protamine sulfate method was determined as superior to the aluminum chloride precipitation and polymer two-phase methods for recovering rotavirus from sewage. The ELISA method was very effective in detecting rotavirus in stool samples of children. Stools from children not displaying clinical symptoms of rotavirus infection were negative for rotavirus, whereas 43 to 58% of stools from children displaying clinical symptoms of rotavirus infection was positive for rotavirus. The results suggested an association of increased rotavirus infections during the winter months in the state of Hawaii. Stools positive for rotavirus by the ELISA test were used as inoculum to develop methods to replicate human rotavirus in the cell culture system. After many unsuccessful attempts, human rotavirus was cultured after two passages in primary cynomolgus monkey kidney cells. Human rotavirus which replicated in the primary monkey kidney cells was shown to be capable of replicating in continuous monkey kidney cells lines such as the MA-104.
W86-02630

BUFFER CAPACITIES OF FRESHWATER LAKES SENSITIVE TO ACIDIC RAIN AND THE LEACHING OF TOXIC METALS FROM THEIR SEDIMENTS,

Rutgers - The State Univ., New Brunswick, NJ. Div. of Water Resources.
R. Schmidt, and S. D. Faust.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232908/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, New Jersey Water Resources Research Institute, New Brunswick, April, 1985. 32 p, 12 ref, 10 fig. USGS G857-04. 14-08-0001-G-857.

Descriptors: *Acid rain, Acid precipitation, Leaching, Heavy metals, Prediction, Lake sediments, Alkalinity, *New Jersey.

The primary goals of this project were to define the buffer capacity of seven fresh water lakes in two different geologies in New Jersey and to determine if significant amounts of trace metals were leached from lake sediments. Data collected showed pH values and alkalinities in six of the seven lakes have probably not decreased due to acidic deposition. The seventh lake, Catfish Pond, is highly acidic. The two lakes which appeard to be the most buffered, White Meadow Lake and Lake Marcia, seem to derive their buffer capacities from the weathering of the clay mineral illite in their sediments; this finding supports the concept that lake bottom sediments may participate in acid neutralization. In six of the lakes, there was no indication that sediments released increased amounts of aluminum, cadmium, lead and zinc into the water column. Catfish Pond, however, exhibited elevated concentrations of aluminum, lead and zinc in the water column. The concentrations of trace metals in two drinking water reservoirs, Split Rock and Clyde Potts, did not exceed potable water standards for New Jersey.
W86-02635

STUDY OF THE MECHANISMS CONTROLLING GASOLINE HYDROCARBON PARTITIONING AND TRANSPORT IN GROUNDWATER SYSTEMS,

Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5B.
W86-02659

ADSORPTION OF METAL IONS AND MINERAL COMPLEXES ON MINERALS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-02662

DETECTION AND EFFECTS OF APERIODIC LEACHATE DISCHARGES FROM LANDFILLS,

Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5B.
W86-02663

CHANGES IN THE SPECIES AND CONCENTRATION OF CARBON, NITROGEN AND SULFUR COMPOUNDS DURING THE BOD TEST AND THEIR EFFECT ON OXYGEN UPTAKE,

Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
L. Del Valle.
Available from the National Technical Information Services, Springfield, VA 22161 as PB85-246791/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Puerto Rico Water Resources Research Institute, Mayaguez, Sept 1984. 31 p, 17 fig, 1 tab, 10 ref. OWRT A-073-PR(1). 14-34-0001-2141.

Descriptors: *Biological oxygen demand, *Water analysis, Nitrification, Sulfur compounds, Organic compounds, Oxygen balance.

The main objective of this study was to obtain a better view of the BOD test, by observing the effect of nitrification and of the oxidation of other possible oxygen-consuming substances, such as sulfur compounds, and to develop a method by which the results of the standard BOD test could be corrected by stoichiometry, so that the final results of the test would only reflect the actual amount of oxygen used in the oxidation of carbonaceous organic matter. Tests were run on wastewater treatment plant effluents in which the changes in oxygen concentration in the samples were measured on a day by day basis, as well as changes in sulfates, nitrites, nitrates, and alkalinity. Some parallel 'inhibited' BOD tests were also run. It was discovered that under the conditions of the standard BOD test there is no significant interfering effect of sulfur compounds in the test. Nitrification was measured, although the effect was not great in the analyzed samples. Stoichiometric corrections for nitrification were applied to the BOD values obtained in the standard BOD test. These 'corrected' BOD values were smaller than the standard values and about the same as the results of the 'inhibited' BOD test. Excellent correlation was found between the 'corrected' and the 'inhibited' BOD values. It may be concluded that both the 'corrected' and the 'inhibited' BOD tests are better parameters than the standard test, in which to rely on the performance evaluation of wastewater treatment plants.
W86-02673

SELECTIVE ISOLATION OF DISSOLVED ORGANIC MATTER FROM AQUATIC SYSTEMS,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2K.
W86-02700

INVESTIGATION OF POLLUTION IN A KARST AQUIFER UTILIZING OPTICAL BRIGHTENER,

Kentucky Water Resources Research Inst., Lexington.
J. Thrailkill, R. F. Wiseman, and B. R. Scanlon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132404/AS, Price codes: A03 in paper copy, A01 in microfiche. USGS G-908-07. 14-08-0001-G-908 (FY 84).

Descriptors: *Groundwater, *Groundwater pollution, Optical properties, Biological properties, *Kentucky, *Karst hydrology, *Tracers, *Path of pollutants, *Optical brightener, Coliforms.

Optical brightener is an additive to laundry detergents and often contaminated groundwater. Its concentration may rapidly and inexpensively be determined by fluorescence techniques, and because its source is human waste water, its presence in groundwater serves as a direct indication of pollution from septic tanks, sewer leaks, and landfills. A total of 105 wells and springs in an area within the Inner Bluegrass Karst Region near Lexington, Kentucky, were described and sampled. Analyses were made for optical brightener (430 samples), total coliform (91), fecal coliform (93), and fecal streptococci (90). As many as 20 optical brightener and 4 bacterial samples were analyzed from a single site during the period from May 20, 1984 to June 17, 1985. Data were also collected on spring discharges, well water levels, and other site characteristics. Statistical analysis of the relationship between optical brightener and the bacterial indices showed low correlation for both spring and wells, in contrast to an earlier study. Although time constraints have precluded a thorough analysis of the data the difference between the results of the two studies appear to be related to differing site populations and analytic and statistical procedures. The data further suggest that the low correlations between optical brightener and the bacterial indices may be a result of bacterial contamination being largely derived from animal waste and other non-human sources, and that optical brightener may be a more reliable indicator of human contamination.
W86-02740

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTH-CENTRAL MISSISSIPPI, AUGUST 1984,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02761

PESTICIDES IN THE NATION'S RIVERS, 1975-1980, AND IMPLICATIONS FOR FUTURE MONITORING,

Geological Survey, Reston, VA. Water Resources Div.
R. J. Gilliom, R. B. Alexander, and R. A. Smith.
Available from Distribution Br, USGS 604 S. Pickett St. Alexandria, VA 22304. USGS Water-Supply Paper 2271, 1985. 26 p, 6 fig, 15 tab, 20 ref.

Descriptors: *Pesticide residues, *United States, Path of pollutants, *Water pollution sources, Pesticides in rivers, Water-quality trends, *Monitoring, *Insecticides.

The Pesticide Monitoring Network for rivers was implemented during 1975-80. Water samples were taken four times per year and bed-sediment samples two times per year at 160 to 180 stations located on major rivers of the United States. Samples were analyzed for 18 insecticides and five herbicides, which together accounted for about one-third of the total amount of all pesticides applied to major crops during 1975-80. Less than 10 percent of almost 3,000 water samples and less than 20 percent of almost 1,000 bed-sediment samples contained reportable concentrations of any of the compounds. The patterns of detection result from a combination of widely variable detection capabilities, chemical properties, and use. Most detections in water samples were of relatively persistent yet soluble compounds: atrazine (4.8% of samples), simazine (1.8%), diazinon (1.2%), and lindane (1.1%). Most detections in bed-sediment samples were of the hydrophobic and persistent insecticides: DDE (17%), DDD (12%), dieldrin (12%), chlordane (9.9%), and DDT (8.5%). Only for atrazine in water, and DDE, DDD, DDT, and chlordane in bed sediments, were geographic patterns of detection correlated ($p <$ or $= 0.10$) with their use on farms. Detections of organochlorine insecticides in both water and bed sediments appear to have erratically but gradually decreased during 1975-80. For the 1975-79 period, more stations had downtrends than had uptrends in bed-sediment levels of organochlorines. No clear trends were evident in concentrations of organophosphate insecticides or herbicides in either water or bed sediments. Findings suggest that future pesticide monitoring efforts must be responsive to changes in pesticides used and to geographic patterns of use. Different types of monitoring approaches are necessary for chemicals having different chemical and physical properties. However, before an effective dynamic monitoring effort can be designed, selected case studies are needed to characterize and refine sampling and analytical capabilities for different types of chemicals, river environments, and sample types. (USGS)
W86-02764

RECONNAISSANCE OF TOXIC SUBSTANCES IN THE JORDAN RIVER, SALT LAKE COUNTY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4155, 1984. 31 p, 1 fig, 14 tab, 15 ref.

Descriptors: Water quality, *Utah, Great Basin, *Heavy metals, *Pesticide resides, Pollutants, Toxins, Sediments, *Jordan River, Reconnaissance studies, Salt Lake County, Toxic substances.

A reconnaissance of toxic substances in the Jordan River, Salt Lake County, Utah, was made during July, 1980 to October, 1982 as part of a larger study of the river that included studies of sanitary quality, dissolved oxygen, and turbidity. Samples for toxic substances were collected at five sites on the Jordan River, at three major tributaries, and at six storm drains. The toxic substance that most frequently exceeded State standards was total mercury. About 78 percent of the 138 samples for total mercury exceeded the State standard of 0.05 microgram per liter. Other toxic substances that exceeded State standards were: Ammonia-18 percent of the samples analyzed, cadmium--9 percent, copper-9 percent, zinc--6 percent, and lead--2 percent. One sample for cyanide and one for iron also exceeded State standards. The diversity of toxic substances with concentrations large enough to cause them to be problems increased from the upstream sampling site at the Jordan Narrows to the next two downstream sites at 9000 South and 5800 South Streets. Concentrations of trace elements in stream-bottom materials also increased in a downstream direction. Substantial increases first were observed at 5800 South Street, and they were sustained throughout the downstream study area. Iron is transported in the greatest quantity of all the trace elements studied, with a mean load of 110 pounds per day. Notable loads of barium, boron, lead, and zinc also are transported by the river. DDD, DDE, DDT, dieldrin, heptachlor, methoxychlor, PCB, and 2,4-D were detected in bottom materials; and DDE, Silvex, and 2,4-D were detected in water samples. Of 112 organic compounds in the Environmental Protection Agency's priority pollutant list, only chloroform was detected in the storm drains that empty into the Joran River. Several metals and phenol also were detected in the samples for priority pollutants. (USGS)
W86-02766

APPRAISAL OF DATA FOR GROUND-WATER QUALITY IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02810

GROUND-WATER CONTAMINATION IN EAST BAY TOWNSHIP, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
F. R. Twenter, T. R. Cummings, and N. G. Grannemann.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4064, 1985. 63 p, 30 fig, 6 tab, 23 ref.

Descriptors: Hydrogeology, Glacial drift, Groundwater, Aquifers, Water supply, *Groundwater movement, Water pollution, *Path of pollutants, Organic compounds, *Groundwater contamination, Chemical analysis, East Bay Township, Grand Traverse County, *Michigan.

Glacial deposits, as much as 360 feet thick, underlie the study area. The upper 29 to 118 feet, a sand and gravel unit, is the aquifer tapped by all wells in the area. This unit is underlain by impermeable clay that is at least 100 feet thick. Ground-water flow is northeastward at an estimated rate of 2 to 5 feet per day. Hydraulic conductivities in the aquifer range from 85 to 250 feet per day; 120 feet per day provided the best match of field data in a ground-water flow model. The depth to water ranged from 1 to 20 feet. Chemical analyses indicate that ground water is contaminated with organic chemicals from near the Hangar/Administration building at the U.S. Coast Guard Air Station at East Bay, about 4,300 feet northeast. The plume, which follows ground-water flow lines, ranges from 180 to 400 feet wide. In the upper reach of the plume, hydrocarbons less dense than water occur at the surface of the water table; they move downward in the aquifer as they move toward east Bay. Maximum concentrations of the major organic compounds include: benzene, 3,390 ug/L; toluene, 55,500 ug/L; xylene, 3,900 ug/L, tetrachloroethylene, 3,410 ug/L; amd bis (2-ethyl hexyl) phthalate, 2,100 ug/L. Soils are generally free of these hydrocarbons; however, in the vicinity of past drum storage, aircraft maintenance operations, and fuel storage and dispensing, as much as 1,100 ug/kg of tetrachloroethylene and 1,500 ug/kg of bis (-ethyl hexyl) phthalate were detected. At a few locations higher molecular weight hydrocarbons, characteristic of petroleum distillates were found. (USGS)
W86-02814

QUALITY OF WATER FROM BEDROCK AQUIFERS IN THE SOUTH CAROLINA PIEDMONT,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02823

RUNOFF AND WATER QUALITY CHARACTERISTICS OF SURFACE-MINED LANDS IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02826

GAZETTEER OF SURFACE-MINE LAKES, EASTERN INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
D. C. Voelker.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4355, 1985. 93 p, 19 fig, 2 tab, 11 ref.

Descriptors: Water quality, *Strip mine lakes, *Gazetteer, Water analysis, *Illinois, Area 35, *Pollutant identification.

Hundreds of lakes have been formed as a result of surface mining in Area 35 of the Eastern Interior Coal Province in Illinois. This gazetteer contains physical and chemical data from 107 surface-mine lakes sampled from June through August 1983. Information collected includes location, morphology, and vertical profile measurements of water quality of the lakes. Sampled lakes range in size from 8.8 to 210 acres, and are from 4.0 to 92.0 feet deep. Maximum widths range from 0.03 to 0.35 mile, and maximum lengths range from 0.27 to 3.08 miles. Some lake waters were stratified, whereas others were completely mixed. General water quality differed widely among the lakes. Specific conductances ranged from 130 to 7,800 micromhos per centimeter (at 25 degrees Celsius). Specific conductances of 2,000 to 5,000 micromhos per centimeter were most prevalent. The pH values ranged from 1.8 to 9.6 at the surface, whereas bottom measurements ranged from 2.0 to 8.5. Water temperatures near the surface ranged from 22.5 degrees Celsius in June to 34.5 degrees Celsius in August. Dissolved-oxygen concentrations differed greatly among the lakes; concentrations near the surface ranged from 6.0 to 13.2 milligrams per liter. Transparencies ranged from 0.3 to 35.4 feet. (USGS)
W86-02831

QUALITY OF WATER IN THE ALLUVIAL AQUIFER, AMERICAN BOTTOMS, EAST ST. LOUIS, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
D. C. Voelker.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4180, 1984. 51 p, 14 fig, 5 tab, 17 ref.

Descriptors: *Groundwater, Water quality, Alluvial aquifers, Water analysis, *East St. Louis, Groundwater levels, Groundwater quality, *Illinois, *American Bottoms, Pollutant identification.

Ground-water levels in the American Bottoms regions around East St. Louis, Illinois, have risen several feet since the early 1970's. Artificial dewatering of the aquifer by increased pumping is being investigated by the U.S. Army Corps of Engineers to alleviate economic and health concerns resulting from elevated ground-water levels. A ground-water quality evaluation is necessary for selecting a feasible dewatering scheme. Analyses of water samples from 63 wells show that except for iron, manganese, and dissolved solids, constituent concentrations do not exceed Illinois water-quality standards. The waters are primarily of the calcium-magnesium-bicarbonate type with some calcium-sulfate type water. Iron concentrations ranged from less than 3 to 82,000 micrograms per liter, manganese from 5 to 5,300 micrograms per liter, and dissolved solids from 140 to 3,000 milligrams per liter. These constituent concentrations exceed Illinois' public water supply, effluent, and general water-quality standards in most samples and analysis indicates the concentrations are representative of the ambient water quality. Concentrations of nitrite + nitrate nitrogen fluoride, zinc, lead, and sulfate also exceeded Illinois water-quality standards in a few samples. Concentrations of organic pesticides, polychlorinated biphenyls, and polychlorinated naphthalenes were below analytical detection limits. (USGS)
W86-02832

QUALITY-ASSURANCE DATA FOR ROUTINE WATER ANALYSIS IN THE LABORATORIES OF THE U.S. GEOLOGICAL SURVEY FOR WATER-YEAR 1983,
Geological Survey, Lakewood, CO. Water Resources Div.
D. B. Peart, and N. A. Thomas.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4234, 1984. 112 p, 180 fig, 10 tab, 4 ref.

Descriptors: Alkalinity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chemical analysis, Chlorides, Chromium, Cobalt, Copper, Dissolved solids, Fluorides, Heavy metals, Iron, Laboratories, Lead, Lithium, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Nitrates, Nitrites, Nitrogen, Nitrogen compounds, Phosphorus, Potassium, Probability distribution, Quality control, Selenium, Silica, Silver, Sodium, Specific conductivity, Statistics, Strontium, Sulfates, Trace elements, *Water analysis, Zinc, *Data collections, *Water quality, *Quality Assurance data.

The U.S. Geological Survey maintains a quality-assurance program based on the analysis of reference samples for its two water-analysis laboratories located in Atlanta, Georgia, and Denver, Colorado. Reference samples containing selected inorganic constituents are prepared at the U.S. Geological Survey's Ocala, Florida office and disguised as routine samples, and sent daily or weekly, as appropriate, to each laboratory through other U.S. Geological Survey offices. The results are permanently stored in the National Water Data Storage and Retrieval System (WATSTORE), the U.S. Geological Survey's data base for all water data. These data are analyzed statistically for precision, bias, and comparability. The results of these statistical analyses are presented for data collected during the 1983 water year. Nutrient samples, simulated precipitation (low-concentration level) samples and selected pesticide samples were also submitted as samples of unknown concentrations. The results of these determinations were statistically analyzed for comparability and these data are presented. In addition, a summary of recovery and precision data from three different instruments for volatile organics is presented. (USGS)
W86-02834

WATER-QUALITY CHARACTERISTICS FOR SELECTED SITES ON THE CAPE FEAR RIVER, NORTH CAROLINA, 1955-80--VARIABILITY, LOADS, AND TRENDS OF SELECTED CONSTITUENTS,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02848

STATISTICAL SUMMARY OF DAILY VALUES DATA AND TREND ANALYSIS OF DISSOLVED-OXYGEN DATA AT NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN) STATIONS,
Geological Survey, Austin, TX. Water Resources Div.
F. C. Wells, and T. L. Schertz.
Available from OFSS, USGS BOX 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4172, 1983. 526 p, 1 fig, 52 tab, 7 ref.

Descriptors: *Water quality, *Data collections, *Texas, Streamflow, Conductance, Dissolved oxygen, Water temperature, Hydrogen ion concentration.

A statistical summary is provided of the available continuous and once-daily discharge, specific-conductance, dissolved oxygen, water temperature, and pH data collected at NASQAN stations during the 1973-81 water years and documents the period of record on which the statistical calculations were based. In addition, dissolved-solids data are examined by regression analyses to determine the relation between dissolved solids and specific conductance and to determine if long-term trends can be detected in dissolved-solids concentrations. Statistical summaries, regression equations expressing the relation between dissolved solids and specific conductance, and graphical presentations of trend analyses of dissolved solids are presented for 515 NASQAN stations in the United States, Canada, Guam, and Puerto Rico. (USGS)
W86-02873

DESIGN OF A GROUND-WATER QUALITY MONITORING NETWORK FOR THE SALINAS RIVER DRAINAGE BASIN, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02909

5B. Sources Of Pollution

TEMPORAL AND SPATIAL VARIABILITY OF STREAMFLOW ACIDIFICATION IN VERMONT,
Vermont Univ., Burlington. School of Natural Resources.
J. C. Clausen, A. J. Pisanelli, and K. M. Roy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214518/AS, Price codes: A04 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Burlington, August, 1984. 51 p, 7 fig, 5 tab, 50 ref, append. USGS G873-02.

Descriptors: *Water pollution sources, Acidic deposition, *Acid rain, Acid precipitation, Streamflow, Sensitivity criteria, Precipitation monitoring, *Vermont, Forested watersheds.

Twelve streams draining the Green Mountains in Vermont were sampled five times along elevation gradients for pH, alkalinity, and conductance to assess their acidification status. Streamflow and precipitation pH were continuously monitored at one site to characterize rainfall/runoff pH depressions. Streamflow pH, alkalinity, and conductance varied both temporally and spatially. Lower streamflow pH, alkalinity and conductance values occurred during spring runoff and at higher elevations. Streamflow chemistry was related to certain acidic deposition sensitivity criteria, including: elevation, watershed area, surficial geology, and bedrock geology. Weekly precipitation composite pH was not different from mean precipitation pH obtained by continuous monitoring. Episodic drops in streamflow pH were primarily described by peak discharge.
W86-02455

ACID PRECIPITATION: COMPOSITIONAL CHANGES DURING THROUGHFALL; SOIL WATER,

Vermont Univ., Burlington. Dept. of Botany.
R. Klein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214534/AS, Price codes: A02 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Burlington, December, 1984. 9 p, 38 ref, 2 tab. USGS G873-04.

Descriptors: *Acid rain, *Acidic deposition, Soil water chemistry, Forested watersheds, *Vermont, Metals.

Lysimeters were installed at two soil depths within each of the three major ecosystems on Camels Hump Mountain. Collections were made weekly during the frost free season of 1982 and 1983. Samples were analyzed for pH, conductivity and a broad range of metals, anionic and cationic constituents and for other physical properties. The findings included: (1) Soil solutions obtained from the upper elevations in a northern coniferous forest zone are significantly more acidic than those from the lower elevation hardwood forest zone; (2) Soil solutions for all ecological zones are more acidic in the spring during and shortly after snowmelt than they are later in the frost free season; (3) Aluminum, particularly in soil solutions from the upper elevations, is present in concentrations known to be phytotoxic to seedlings of forest trees and to groundcover plants; (4) Cadmium, Pb and Zn are, in the spring, present in concentrations that are close to being phytotoxic; (5) There are changes in the ratios of divalent cations to specific metals (e.g., Ca + Mg/Al) during the season and as functions of altitude and forest zones; (6) Nitrate concentration in soil water are also elevation and time dependent.
W86-02457

MOBILITY OF SLUDGE-BORNE DICHLOROBENZIDINE IN LAND APPLICATION SYSTEMS,

Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
S. A. Boyd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214625/AS, Price codes: A03 in paper copy, A01 in microfiche. Michigan Institute of Water Research, E. Lansing, Completion Report, (1984). 24 p, 3 fig, 4 tab, 9 ref. USGS G849-02.

Descriptors: *Hazardous wastes, *Carcinogens, *Dichlorobenzidene, Michigan, *Fate of pollutants, Tracers, Sludge.

Fate of the carcinogens 3,3'-dichlorobenzidine (DCB) in sludge-amended soil was evaluated. C-14 labelled DCB was used as a tracer to examine mineralization, binding, and mobility of DCB present in sludge. DCB was shown to be very persistent in soil and sludge amended soil with < 2% of the added (C-14)DCB evolved as C-14 CO2 during a 26 week incubation. The major fate of DCB appeared to be the formation of bound (nonextractable) residues with soil and sludge organic matter. Mobility of DCB was evaluated using soil columns which were irrigated with 2.54 cm of water per day for 16 weeks. The strong binding of DCB rendered it highly immobile despite being placed in a sandy soil which was irrigated with large amounts of water. However, some finite, albeit small, quantity was leached through the soil profile in what could be described as a 'slow bleed' of DCB and/or a DCB-conjugate.
W86-02466

UNIFIED MASS TRANSPORT MODEL FOR HIGH AND LOW GROUNDWATER DISPERSIVITIES,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
N. D. Katopodes, C-T. Wu, and D. Karamouzis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214633/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Michigan Institute of Water Research, East Lansing, August 1984. 62 p, 44 fig, 10 ref. USGS G849-03.

Descriptors: *Mathematical models, *Groundwater movement, Contaminants, *Dispersion, Finite elements, Groundwater, *Mass transport, Numerical methods, Seepage, Michigan.

Mass transport in groundwater is a phenomenon whose physics vary dramatically depending on the magnitude of the dispersion coefficients. At high dispersivities, the dominant transport mechanism is dispersion, which is effectively simulated by means of classical finite element techniques, which have also become the most popular means for computing the flow of groundwater. Therefore the same discretization and field parameters can be used for the simulation of contaminant transport, and the local seepage velocity and saturated thickness can be directly used as input to the transport phase of the modeling process. On the other hand, when the dispersion coefficients are small, convection becomes the dominant factor in the transport of contaminants and the finite element solution becomes unstable. Several remedies have been proposed for the resolution of this difficulty, but most of them require special algorithms for convection-dominated flows, which is almost equivalent to a priori knowledge of the flow conditions and thus limits the predictive ability of the model. In this report certain variances of the classical finite element method are presented, which permit optimum simulation of contaminant transport for both dispersion and convection-dominated flow conditions. These are based on so-called Petrov-Galerkin and Taylor-Galerkin schemes that automatically adjust to the flow conditions and thus unify the simulation of extreme physical conditions in a single computer model. Several tests for verification of the proposed model's validity are presented, followed by description of some novel features of the computer code for accurate and efficient application to practical problems.
W86-02467

EFFECTS OF GRAVEL EXTRACTION ON THE MEADE RIVER AT ATQASUK, ALASKA,

Alaska Univ., Fairbanks. Inst. of Water Resources.
D. M. Schell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214724/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report I84-14, March, 1984. 26 p, 3 fig, 7 ref. USGS G827-02.

Descriptors: *Water quality, *Turbidity, Water chemistry, *Oxygen content, *Dredging, *Fisheries, Carbon: Nitrogen ratios, *Alaska, Suspended sediments.

The water quality impacts resulting from dredging gravel in the Meade River at Atqasuk, Alaska, (170 degrees W, 70 degrees 28'N) have been studied in the context of fishery resources, principally least cisco, broad whitefish and chum salmon used by local Inupiat residents. Gravel was removed during the summer ice-free months and conveyed via pipeline to an on-land storage site. Runoff from the storage pile was returned to the Meade River with the accompanying fine inorganic particulate matter and organic detritus at loadings up to 10,000 mg/l. The major immediate effects on the receiving waters were to increase turbidity and suspended sediment loads near Atqasuk and downstream as far as 60 km. Inorganic sediments settled out faster than the organic peat detritus and the ratio of organic/inorganic matter increased with distance downstream. Carbon/nitrogen ratios in the organic fraction were constant with time and distance indicating low biological activity in the peat particles. Fisheries impacts are being described separately by the biological investigators. Oxygen demand by microbial consumption of organic matter during winter months was assessed through measurement of concentrations of dissolved oxygen in underice waters in the river channels in spring 1984. Oxygen concentrations were similar to samples taken in the previous winter indicating that respiration rates were very low. Biological studies on fish populations and migrations are continuing.
W86-02475

ACID PRECIPITATION: SOURCE IDENTIFICATION AND ITS EFFECTS ON WATER QUALITY,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
C. P. C. Poon, T. Wright, and M. North.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214880/AS, Price codes: A05 in paper copy, A01 in microfiche. Rhode Island Water Resources Research Center, Kingston, Completion Report No 3 Sept 1984, 86 p, 17 fig, 13 tab, 24 ref. USGS G867-04.

Descriptors: *Rhode Island, *Acid rain, Meteorological data collection, Tracking techniques, Watersheds, Acidity, Alkalinity, Flow, Deposition, Land use, Hydrogen ion concentration.

Three small watersheds in the rural area of R.I. were studied for the effects of acid precipitation on the water quality. All three rivers namely, Wood, Beaver, and Usquepaug, have Class A high water quality with very low alkalinity. Storm tracks were identified by using sequential meteorological maps including satellite photos, radar precipitation scans, and pressure maps. Precipitation samples were titrated and their acid components were quantified by the Gran Plot technique. Storms from the west and southwest direction usually carry more acids than those from west-northwest and south-southwest. All storms have similar effects on the three rivers with the chemistry change more pronounced for the Beaver river because of its smallest size. A large storm or a small storm but with high acid concentrations often reduced the alkalinity of the river water to less than 1.0 mg/l. On extreme cases the alkalinity was reduced to zero and the acidity was increased by 11 folds. As much as 1/2 pH unit drop in the river water could occur in 1/2-day but it would take as long as 5 days to achieve complete recovery. Other than storm direction and storm size, other factors that changed river water chemistry included dry deposition between storms, river flow prior to storm and land use pattern.
W86-02491

NUMERICAL SOLUTION OF TWO-DIMENSIONAL TRANSVERSE DIFFISION EQUATION,

Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
P. Srinivasan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215002/AS, Price codes: A08 in paper copy, A01 in microfiche. December 1981. Thesis Submitted as Requirement for Degree of Master of Science. 147 p, 19 fig, 32 tab, 5 app, 27 ref. B-069-IA.

Descriptors: *Fate of pollutant, *Diffusion coefficient, *Model studies, Iowa, Mathematical models, Finite difference methods, Mixing, Dye concentrations, *Missouri River, Streams.

A solution of the equations governing the mixing of toxic substances in natural streams is presented. The two-dimensional convection-diffusion equa-

tion in a curvilinear coordinate system uses normalized cumulative discharge as an independent variable. The two-dimensional transverse diffusion equation used in the model, and the method of estimation of transverse diffusion are described and discussed. A finite-difference scheme was formulated to solve the convection-diffusion equation using the alternating-direct implicit method. Model tests using an analytical solution developed for a steady state condition are presented. The model was verified with data from a field test conducted in a 27-mile reach of the Missouri River, using dye injected into the circulating system of a powerplant. Predicted values and observed values were in good agreement.
W86-02503

ROLE OF NITRIFICATION IN CONTRIBUTING TO LOW OXYGEN CONDITIONS IN AN URBAN WATERWAY,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. W. Nixon, and V. M. Berounsky.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215051/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, Rhode Island Water Resources Center, Kingston, 1984. 49 p, 12 fig, 6 tab, 50 ref. USGS G867-06.

Descriptors: *Nitrification, *Providence River, *Rhode Island, Oxygen demand, Nitrogen compounds, Ammonia, Nitrate, Nitrite, Isotope studies, Water quality waterways.

Rates of nitrification were measured with 15 N tracer methods in the Providence River (R.I.) an urban river with high (over 1200 mmol + 3 ammonium ion/cubic m/3 r ammonia inputs. The rates found for fall and winter were lower than expected, 0.0099 - 0.0404 micromol liter d. Rates of nitrification calculated for ammonia-enriched Narragansett Bay mesocosms were an order of magnitude higher at the same concentrations of ammonium ion as the river samples. Possible reasons for the low rates are: a lag period of little or low nitrification activity, delayed recovery of upper water nitrifiers from light inhibition, low concentrations of nitrifying bacteria or, most likely, a substance within the river is inhibiting nitrification. Phytoplankton uptake rates of both ammonium nitrate were measured by 15N, and rates were similar to those found in other studies. Spring rates were higher than fall, winter were lowest. There was little uptake of nitrate. The measured nitrification rates indicate an annual nitrogenous oxygen demand to the river comparable to only about 1% of the annual carbonaceous oxygen demand of the river, suggesting that nitrification is not consuming a significant amount of oxygen in the Providence River.
W86-02508

ACID PRECIPITATION IN THE WASHINGTON CASCADES, PHASE II,

Central Washington Univ., Ellensburg. Dept. of Chemistry.
C. Duncan, and W. Ausserer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215101/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Washington Water Resources Research Institute, Pullman, Sept 1984. 37 p, 9 fig, 12 tab, 19 ref. USGS G876-03.

Descriptors: *Acid rain, *Lake acidification, Lake susceptibility, Rain composition, Water chemistry, *Acid precipitation, Water pollution sources, *Washington, Cascade Range.

Bulk precipitation was monitored at three sampling stations spanning the Washington Cascades over the Stevens Pass highway route and at one location in the Snoqualmie Pass area over the period November, 1983, to May 1984. The volume weighted average pH over the collection period at Stevens Pass was 5.19. During the periods of simultaneous collection, the pH levels of the Stevens Pass site were higher than those of the Snoqualmie Pass samples. The nitrate to sulfate equivalent ratio at the Stevens Pass site was .61. Based on winter collection, a minimum sulfate deposition is estimated to be 5.8 kg Ha/sq m at Stevens vs. 9.2 kg Ha/sq m at Snoqualmie Pass for 1984. The strong acid content of the samples was observed to increase with the onset of spring. During the summer of 1983, 30 watershed source lakes lying in the Cascades at locations north of Stevens Pass were sampled. All lakes were found to be susceptible, but not acid, with alkalinatives ranging from 39 to 220 uN. Two lakes in the southern portion of the Alpine Lakes Wilderness Area were found to be almost devoid of alkalinity (ANC Av = 3.1 uN) with corresponding low pH levels (Av = 5.8). Overall, the composition of the lake waters (in terms of acid neutralizing capacity relative to calcium, magnesium, sodium, and potassium concentrations) indicated that no significant acidification of the waters has taken place.
W86-02513

KINETIC STUDY OF THE EFFECTS OF ACID RAIN ON TRACE METAL UPTAKE,

Maine Univ. at Orono. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-02517

HYDROGEOLOGY AND PROCESSES OF ACID NEUTRALIZATION IN CADWELL CREEK WATERSHED, QUABBIN RESERVATION, MASSACHUSETTS,

Massachusetts Univ., Amherst. Dept. of Geology and Geography.
W. C. Leonard, R. F. Yuretich, and S. J. Pohanka.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216893/AS, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report, Massachusetts Water Resources Research Center, Publication N. 148, Amherst, December 1984. 131 p, 46 fig, 10 tab, 39 ref. USGS G-848/02.

Descriptors: *Acid rain, *Acid streams, *Acidic soils, *Acidic water, *Acidity, *Alkalinity, *Massachusetts, Quabbin Reservior, Groundwater storage, Groundwater runoff, Hydraulic gradient, Hydrology, Geohydrology, Geochemistry, Geology, Streamflow, Evapotranspiration, Drinking water, Reservoir operation, Massachusetts.

A detailed hydrogeological and geochemical study was undertaken of Cadwell Creek, a small (7.28km2) forested watershed on the west side of Quabbin Reservoir in central Massachusetts. Paleozoic crystalling metamorphic rocks comprise the bedrock in the watershed and are the source material for the glacial till, the main aquifer. During 1983 41% of incoming precipitation was returned to the atmosphere as evapotranspiration and 55% left the watershed as stream runoff. Furthermore, 45% of this stream runoff was groundwater discharge or base flow. Specific conductivity and pH, both field and aerated, showed strong correlations with the groundwater velocity and hydraulic gradient, showed strong correlations with the groundwater velocity and hydraulic gradient. The pH ranged from 4.7 to 7.0 and the specific conductivity from 25 to 70 micromhos/cm. Significant correlations of silica with alkalinity and cations, coupled with a dearth of exchangeable base cations in the watershed soild, indicate that silica weathering is the major control on groundwater composition. Two-thirds of the total base flow comes from areas with low pH and low specific conductivity, i.e. is incompletely neutralized. Also, since baseflow contributes only 45% of the stream runoff, the water leaving the watershed is incompletely neutralized and sensitive to further acidification. However, because of unusual hydrologic and topographic relationships, Cadwell Creek alone should not be used as a standard for all streams draining into Quabbin Reservoir.
W86-02520

EFFECTS OF LAND USE PRACTICES ON WATER RESOURCES IN VIRGINIA,

George Mason Univ., Fairfax, VA. Dept. of Biology.
For primary bibliographic entry see Field 5G.
W86-02523

CHARACTERIZATION OF ACID RAIN PHENOMENA, ATLANTA, GEORGIA,

Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
C. Beck, and J. Demere.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216943/AS, Price codes: A04 in paper copy, A01 in microfiche. Environmental Resources Center Report No. ERC 04-84, Georgia Institute of Technology, Atlanta, July, 1984, 46 p, 1 tab, 32 ref. G-836(03).

Descriptors: *Acid rain, *Georgia, Water pollution sources, Rain monitoring, Urban site, Subevent sampling, Seasonal variations, Regolith effects, Path of pollutants, Atlanta.

Rain collection and chemical analysis for pH, Na, K, Mg, Ca, NH4, Cl, NO3 and SO4 was initiated at an urban Atlanta site in August 1983 and is continuing on an event and subevent basis. Additional collecting began at Suburban Stone Mountain in June 1984. Current data do not indicate significant urban-suburban-rural differences in composition for the species studied. Subepisode sampling indicates minor and irregular changes in composition during frontal system rains, but during local rains, particularly intense events following extended dry periods during late spring and summer, there are marked decreases with time in the concentrations of all species except H+. Yearly cycles involving summer concentration maxima, in part correlated with summer thunderstorms, are noted for H+, NH4, NO3 and SO4 and possible K and Ca. Stream observations at Stone Mountain provide no evidence for major early regolith modification of rain, other than SO4 removal, but evaporation in a complex path from rock outcrop to stream and possible stream pollution complicate interpretation.
W86-02525

FACTORS INFLUENCING, INFILTRATION, FLOW, INSTABILITY, AND MOVEMENT OF TOXICS IN LAYERED FIELD SOILS,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
T. S. Steenhuis, and R. J. Glass.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216968/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, August 1984. 45 p, 5 fig, 4 tab, 31 ref. USGS G859-03.

Descriptors: *Infiltration, *Soil water movement, *Path of pollutants, *New York, Wetting front instability, Solute movement.

Application of solute transport theory based on homogeneous laboratory soil column experiments to field situations has been less than successful. Two mechanisms responsible for the discrepancy involve movement through macropores and flow instability or fingering. The latter is observed in soils where the top layer has a lower conductivity than the subsoil. The research presented in the report focuses on a description of unstable wetting fronts in the laboratory and for field soils. The main findings were that high initial moisture contents, while having a stabilizing effect when uniformly distributed, allow instability to occur when distributed heterogeneously by an earlier unstable infiltration flow; that unstable flow fields, once established, change very little in time even over relatively long lengths of time; and that unstable flow fields and properties may be systematically and quantitatively explored through controlled laboratory experimentations. The results of the study have implications for monitoring systems and groundwater pollution prediction models applied to field soils where instability occurs.
W86-02527

DIAGNOSING THE CAUSES OF GROUNDWATER CONTAMINATION USING A MATHEMATICAL MODEL,

Cornell Univ., Ithaca, NY. Center for Environmental Research.
S. Pacenka.

Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217008/AS, Price codes: A03 in paper copy, A01 in microfiche. Technology Transfer Project Completion Report, Sept 1984. 12 p, 2 tab, 3 fig, 6 ref, 2 append. USGS G859-23.

Descriptors: *Technology transfer, *Training, *Groundwater pollution, *New York, Mathematical models, Water pollution sources, Path of pollutants.

Ground-water contamination cases are now being detected at a rate faster than the capability of regulatory agencies to diagnose and solve them. Automation, in the form of low-cost microcomputers and simple mathematical models of contaminant behavior, can help to gain control of the growing backlog of cases. These tools can amplify the skills of the limited number of specialists in this area now employed by the key agencies such as state-level environmental and health departments. Since the same tools can also be used in advance planning for the prevention of ground-water contamination, they could also help to foster the transition from the current, crisis-driven system to one which detects potential problems early and eventually prevents them before they start. The report describes a technology transfer workshop which employed microcomputers and associated software in training agency specialists about the movement and fate of groundwater contaminants.
W86-02531

STUDY AND PREDICTION OF BACTERIAL AND VIRAL CONTAMINATION OF GROUNDWATER FROM LANDFILLS AND SEPTIC TANK SYSTEMS,

Delaware Univ., Newark. Dept. of Civil Engineering.
M. Y. Corapcioglu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217701/AS, Price codes: A04 in paper copy, A01 in microfiche. Delaware Water Resources Research Center, Newark, Project Completion Report, 1984. 55 p, 18 fig, 3 tab, 44 ref. USGS G833/02.

Descriptors: *Groundwater pollution, Sanitary landfills, Septic wastewater, Path of pollutants, *Soil disposal fields.

To serve as a tool in the long term evaluation of the risk of accumulation of microbial contaminants (bacteria and viruses) entering soil and groundwater, a mathematical model is developed to predict the spatial and temporal distribution of pollutant concentration. The governing equation for bacterial transport is coupled with another transport equation for the bacterial nutrient present in the seeping wastewater. The deposition and declogging mechanisms are incorporated into the model as a rate process for bacteria and as an equilibrium partitioning for viruses. While the decay is assumed to be a first order reaction and the growth of bacteria is assumed to follow the Monod equation, the model equations exhibit nonlinearity and coupling. A simplified set of equations is solved analytically to test the numerical results. Coupled numerical solutions in one and two dimensions are obtained by the Galerkin method at spatial and temporal locations of interest. Cases studied include a soil column and a horizontal two-dimensional field coupled with the one dimensional solution. It has been found that the bacteria is removed almost totally within the top 7 cm of soil with minimal risk of clogging.
W86-02535

SINGLE-WELL, MULTIPLE-PULSE TRACER TECHNIQUE FOR ESTIMATING GROUND WATER VELOCITIES AND POLLUANT TRANSPORT RATES: THEORETICAL DEVELOPMENT,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
P. G. Kaplan, and D. I. Leap.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225845/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 167, August, 1984. 27 p, 8 fig, 14 ref. USGS G841-02.

Descriptors: *Groundwater movement, *Groundwater pollution, *Tracers, wells, Path of pollutants, Pulse testing(wells), Test wells, *Indiana.

Two new methods have been developed to provide velocity estimations that should be superior to standard single-well, point dilution drift tests or to single-well injection tests because the new methods determine velocity over a larger distance from the well than is possible with the standard methods, and the tracer pulses utilized in the new methods are narrow enough that their behavior approaches that of a point in a flow field. Both methods utilize the superposition of radial, well-flow velocity and linear, regional ground-water velocity. Neither of the theories has been tested experimentally or in a field setting. Plans exist for laboratory testing of both using scale models of aquifers. The first method requires prior knowledge of the product of effective porosity and aquifer thickness. Three pulses are allowed to drift into the aquifer and are then pumped back. Variations in retrieved pulse spacing are used to estimate drift distance and regional velocity. The second method does not require prior knowledge of the porosity-thickness product and utilizes only two pulses. The two identical, square-wave pulses are injected into the aquifer in very thin streams and flushes in with water. The pulses are then immediately pumped back. Variations in time spacings between the injected and retrieved pulses can then be used to estimate pulse travel distance and regional velocity.
W86-02560

INFLUENCE OF NITROGEN APPLICATION AND IRRIGATION ON GROUND-WATER QUALITY IN THE COASTAL PLAIN,

Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225852/AS, Price codes: A03 in paper copy, A01 in microfiche. Delaware Water Resources Research Center, Newark, Project Completion Report, 1984. 22 p, 7 tab, 20 ref. USGS G833/06.

Descriptors: Groundwater, *Nitrates, Irrigation, New Jersey, Leaching, *Return flow, *Groundwater pollution.

Soil samples were taken on 16 irrigated fields and one forested site to evaluate nitrogen leaching. Corn was grown on all but one of the fields for at least 3 out of the last 4 years. Soil samples were also taken from irrigated corn plots where poultry manure and ammonium nitrate fertilizer were applied at a rate of 202 kg/ha. Nitrate concentrations were lower on the forested site and a field where soybeans were grown for 4 years than on the other sites. Nitrate leaching was occurring on some of the fields in both irrigated and non-irrigated areas. Nitrate concentrations at different depths were not related to soil type.
W86-02561

LATERAL MOISTURE MOVEMENTS IN UNSATURATED ANISOTROPIC MEDIA,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 2G.
W86-02562

GROUNDWATER PROBLEMS IN THE MID-ATLANTIC FALL-LINE CITIES,

District of Columbia Univ., Washington. Water Resources Research Center.
For primary bibliographic entry see Field 2F.
W86-02574

DEVELOPMENT OF FREQUENCY FUNCTIONS FOR URBAN NON-POINT SOURCE RISK EVALUATION,

Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
G. K. Young, and E. Neal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225993/AS, Price codes: A06 in paper copy, A01 in microfiche. D.C. Water Resources Research Center, Washington, District of Columbia, Report No. 59, September 1984. 88 p, 9 fig, 8 tab, 16 ref, 10 append. USGS G834-04.

Descriptors: *Urban hydrology, *Washington(DC), *Water pollution sources, Calibration, Microcomputers, Runoff, Verification, Watershed Data, Water quality, *Mathematical models, Rainfall-runoff relationships, Computer programs.

A microcomputer-based daily accounting model of runoff and pollutant emission from an urban catchment has been developed. The model has been calibrated and verified by application to D.C. area watershed data. The results from the investigation indicate that the model is accurate and reliable. The model is easily implemented on a microcomputer and thus avoids the extensive time and costs associated with modeling urban water quality on mainframe computers, using existing complex simulation models.
W86-02575

ORGANIC CONTAMINANT TRANSPORT IN GROUNDWATER, SURFACE WATER, AND SURFACE WATER SEDIMENTS. YEAR 1 PROGRESS REPORT,

Wyoming Univ., Laramie. Coll. of Arts and Sciences.
M. J. Crossey, and H. L. Bergman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-226322/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Wyoming,Water Research Center, Laramie, September 1984. 33 p, 4 fig, 1 tab, 19 ref. USGS G879-03.

Descriptors: *Wyoming, *Path of pollutants, *Surface waters, *Groundwater, Water quality, Surface-groundwater relations, Organic compounds, Contamination, Oil wastes, Water pollution sources, *Groundwater pollution, *Laramie River.

Questions concerning the transport and fate of contaminants in the environment have typically been limited to single compounds. Hazardous waste disposal facilities, chemical plants, oil refineries, etc., however, typically produce complex waste streams which may contact groundwater or surface waters. This study gives results on movement through ground and surface water of a complex mixture of organic compounds emanating from a wood-treatment facility located adjacent to the Laramie River in Laramie, Wyoming. A conceptual model summarizing laboratory and site observations shows: (1) subsurface transport of contaminants in oil, oil/water emulsions, and groundwater; and (2) riverine transport of contaminants in water, sorbed to sediments, and as oil globules. Experiments with glass column packed with a uniform material (1 mm glass beads, sand or gravel) indicates that in even the most homogenous, isotropic matrix, oil/water mixtures cannot be expected to flow in a uniform manner. Creosote sludges and oils break up into globules and stringers with no uniform front of contamination. Data from a field study using mini-piezometers in the Laramie River adjacent to the site confirm this observation. Chemical analysis of sediments and fish, as well as field observations indicating oily droplets moving along the river bed, clearly establish contamination of the Laramie River resulting from offsite migration of creosote from the wood treating facility.
W86-02579

EVALUATION OF SURFACE WATER RUNOFF FROM SWINE FACILITIES FOR CONTAMINATION WITH VIRUSES,

Nebraska Univ.-Lincoln. Dept. of Veterinary Science.
C. Kelling, and M. L. Frey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227197/AS, Price codes: A02 in paper copy, A01 in micro-

fiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, August 1984. 9 p, 1 fig, 2 tab. G854-04. 14-08-0001-G854.

Descriptors: *Water pollution sources, *Nebraska, Water quality, Surface water, Runoff, *Viruses, Water pollution, Contamination, *Farm wastes, Pseudorabies virus.

Molecular filtration was used to concentrate pseudorabies virus (PRV; Herpesvirus suis) from 6 liters of non-sterile water containing particulate matter from a natural source (creek or lake water) in which a known quantity of PRV was added. The molecular filtration technique used proved to have an average 63% recovery rate. Two surface water runoff samples were collected from each of 10 Nebraska swine farms where pseudorabies (PRV) virus infection and clinical disease had been diagnosed, and later confirmed by virus isolation or immunofluorescence. Each of the 20 samples were sonicated, clarified by low speed centrifugation and concentrated using the molecular filtration system. Aliquots of the concentrates were used to inoculate cell cultures for virus isolation. Other aliquots were further concentrated by high speed centrifugation and used to prepare grids for electron microscopic visualization. Pseudorabies virus and other viruses were not isolated from the runoff samples using cell cultures or observed by electronmicroscopy. Occasional unidentified single virions were seen by the latter procedure.
W86-02584

ALDICARB STUDIES IN GROUNDWATERS FROM CITRUS GROVES IN INDIAN RIVER COUNTY, FLORIDA,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
F. E. Dierberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227239/AS, Price codes: A05 in paper copy, A01 in microfiche. Florida Water Resources Research Center, Gainesville, Publication No. 76, June 1984. 77 p, 5 fig, 9 tab, 37 ref, 3 append. USGS G835-03.

Descriptors: *Pesticide kinetics, Degradation, Persistence, Soil profile, *Groundwater, Citrus, *Florida, *Fate of pollutants, Groundwater pollution.

The disappearance of aldicarb (2-methyl-2(methylthio) propionaldehyde 0-(methylcarbamoyl) oxime) and its two toxic degradation products, aldicarb sulfoxide and aldicarb sulfone, were measured in laboratory studies using groundwaters and subsoils collected from citrus groves in Indian River County, Florida, and incubated under controlled conditions which best represented the in situ environment. The half-life times for total residue disappearance in groundwater-saturated subsoils ranged from 10-26 days, suggesting a resumption to the reported faster aerobic degradation rates in the upper soil layers after having undergone slow degradation in unsaturated subsoils. Based on the degradation rates found in this study, hydrologic parameters obtained for Indian River County subsoils, and amounts of total toxic residue reported entering Florida groundwaters, it was estimated that toxic residues in aldicarb-contaminated groundwaters in Indian River County would migrate only short distances (1-17 ft) before conversion of toxic residues to non-toxic residues was completed. Based on hydrolysis experiments in sterile pH-buffered distilled water for aldicarb, hydrolysis rate constants became second-order (kOH = 1.94 x 10 to the third L mole minus 1 day minus 1 at 20 degrees C) at pH 8 and above; acid-catalyzed hydrolysis occurred at pH 4, but not to the same extent as base-catalyzed hydrolysis.
W86-02588

ANALYSIS OF INJECTION IN STRATIFIED AQUIFERS,

Florida Univ., Gainesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-02589

CHANGES IN DISTRIBUTION OF MINERAL NITROGEN UNDER NATIVE RANGE AND CULTIVATED FIELDS AT THE NEBRASKA SANDHILLS AG. LABORATORY,

Nebraska Univ., North Platte. Dept. of Agronomy.
G. L. Hergert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227254/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, September 1984. 29 p, 11 fig, 5 tab, 8 ref. USGS G854-05. 14-08-0001-G854.

Descriptors: *Nitrate, *Leaching, Movement, *Nebraska, Water management, Irrigation practices, Unsaturated zone, Nitrogen fertilizer management.

The objectives of this project were to: (1) determine the distribution of nitrate-N, ammonium-N and Cl from the soil surface to the water table under cultivated irrigated fields and adjacent native range sites at the UNL Sandhills Ag. Laboratory; and (2) compare this information with nutrient profiles taken during 1980 and 1981 to determine downward movement of the nitrate to the water table. Substantial textural differences occurred with small depth increments at these sites. Textural changes caused increased water content at coarse/fine boundaries and produced higher nitrate content showing an ion sieving effect. The data shows significant enrichment of nitrate-N to a depth of 70 feet under irrigated corn as compared with adjacent native range. Analysis of past data and this sampling indicate an average downward movement of nitrate lost by leaching of 7 feet/year under the cultivated area. Ammonium enrichment of the soil under the irrigated corn compared to the native range was also discerned to a 50-foot depth. Previous samplings indicated little difference in ammonium distributions between sites. A simplistic vadose zone nitrogen budget indicated average annual nitrate-N losses of 50 to 70 lbs/N/A/year. The data do not unequivocally answer the questions of whether some nitrate has been dentrified or has already reached the water table at 100 feet.
W86-02590

IMPLICATION OF TEMPORAL VARIATIONS AND VERTICAL STRATIFICATION OF GROUNDWATER NITRATE-NITROGEN IN THE HALL COUNTY SPECIAL USE AREA,

Nebraska Univ.-Lincoln. Conservation and Survey Div.
M. E. Spalding.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227262/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, Nebraska Water Resources Center, Lincoln, September 1984. 44 p, 9 fig, 3 tab, 13 ref. USGS G854-06. 14-08-0001-G854.

Descriptors: *Nebraska, Groundwater, Water quality, *Stratification, *Temporal distribution, Spatial distribution, *Nitrates, *Nitrogen.

Vertical distribution and temporal variations in NO3-N concentrations and water level measurements during 1980 and 1981 were interpreted to ascertain the feasibility of developing a solute transport model between the study area, which is underlain by a large zone of NO3-N contaminated groundwater, and Grand Island, NE. NO3-N concentrations in shallow groundwater downgradient from irrigated fields were high and reflect site specific anthropogenic inputs. The large temporal variations and their unpredictability are caused by fluxes of NO3-N carried by infiltrating precipitation and irrigation return flows. There is a decrease in NO3-N levels with depth in the aquifer with the sharpest decrease occurring in the upper half. Concentrations at mid-depth and near the bottom of the aquifer are much lower and less variable than in the shallow groundwater. This homogeneity results from slow vertical movement. Near the eastern edge of the study area, there is a sharp decline in the areal concentrations of NO3-N and a markedly different vertical profile. These changes coincide with the location of a recently delineated NO3-N redox front where NO3 is being actively removed from the groundwater. Thus, the discovery of the non-conservative nature of NO3 within the study area invalidates the predictive usage of classical solute transport models.
W86-02591

ORGANIC GROUNDWATER CONTAMINATION EVALUATION AND PREDICTION,

Missouri Univ.-Columbia. Dept. of Civil Engineering.
J. T. O'Connor, M. M. Ghosh, and S. K. Banerji.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230068/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September 1984. 69 p, 15 tab, 59 ref. USGS G-852-05. 14-08-0001-G-852.

Descriptors: *Path of pollutants, *Soil water, Organic compounds, Groundwater pollution, Soil adsorption capacity, Groundwater movement.

Adsorption of two organic compounds, Trichloroethylene (TCE) and Pentachlorophenol (PCP), on several Missouri soils were determined. The soils used were: Coppock, Parsons, Putnam, Grundy and Lebanon Series. TCE concentrations were determined by gas chromatography, while PCP determinations were made by radio-assay technique. Batch adsorption experiments were conducted using a soil and different concentrations of the organic compound. It was found that the adsorption data for both TECE and PCP followed Freundlich relationship. TCE and PCP adsorption on Missouri soils decreased with increasing pH. Organic matter in soil was an important parameter in determining the PCP adsorption was somewhat high. This would indicate that TCE would migrate readily with groundwater while PCP migration would be somewhat retarded.
W86-02614

EFFECTS OF U.S. ANTIMONY'S DISPOSAL PONDS ON ALLUVIAL AQUIFER AND PROSPECT CREEK, WESTERN MONTANA,

Montana Univ., Missoula. Dept. of Geology.
W. W. Woessner, and M. Shapely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230100/AS, Price codes: A05 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Bozeman Completion Report No. 145, 1985. 81 p, 27 fig, 5 tab, 25 ref. USGS G853-03. 14-08-0001-G853.

Descriptors: Mining, *Heavy metals, Groundwater, Surface water, *Water pollution sources, Groundwater movement, Arsenic waste, Lysimeters, Leachate, Alluvial aquifers, *Tailings ponds, U.S. Antimony, *Montana, Prospect Creek.

The study investigated the effects of a 10 acre impoundment, storing antimony milling and processing waste, on the alluvial groundwater and stream system of a mountain drainage in western Montana. The ponds were instrumented with nine suction lysimeters and the adjacent groundwater system with seven shallow monitoring wells. The associated valley surface water systems were also gaged and sampled for water chemistry. Water quality samples, head measurements and stream discharge gaging were scheduled to record data from the widest possible range of hydrologic conditions. Concentrations of dissolved AS and Sb were found to range from 6.3 to 410.0 mg/l and 4.7 to 100.0 mg/l, respectively, in the sodium sulfate dominated pond fluids. Recharge of the underlying groundwater system occurs principally by seepage from the pond bottom and unsaturated flow in the vadose zone beneath the ponds. Rapid rises of up to 1.7 feet per day of the underlying groundwater system occur in response to large quantities of recharge from adjacent losing reaches of Prospect Creek and Cox Gulch. Pond fluids in the vadose zone are entrained in groundwater during periods of water table rise and carried down gradient east of the ponds. Antimony concentrations in the groundwater down gradient from the pond range up to 1.9 mg/l. Arsenic concentrations never exceed 0.033 mg/l. Sulfate, sodium and antimony from the waste disposal ponds measurably degrade surface water and groundwater for at least three and one half miles downstream from the site.

W86-02618

VERIFICATION OF SHORELINE SEWAGE LEACHATES IN FLATHEAD LAKE, MONTANA,

Montana Univ., Bigfork. Biological Station.
J. A. Stanford, and J. H. Jourdonnais.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230118/AS, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Center Bozeman completion report no. 148, Bozeman, February, 1985. 38 p, 7 fig, 13 tab, 11 ref. USGS G853-04. 14-08-0001-G853.

Descriptors: Fluorometry, Florescence, *Sewage leachates, Lake shores, Detergents, Algae, Groundwater, Septic tanks, Soil disposal fields, Organic compounds, Conductivity, *Montana, *Flathead Lake, *Water pollution sources, *Nutrients.

Field measurements of fluorescence and conductivity were used to locate seeps entering littoral areas of Flathead Lake. Seeps contaminated by sewage leachates generally produced significantly greater fluorescence than would be expected from the presence of naturally occurring humic substances. High fluorescence result from whiteners, which are detergent additives, apparently leached from faulty drainfields near the lakeshore. Seeps were designated as contaminated by sewage leachates if the ratio of fluorescence; dissolved organic carbon exceeded 380. Accuracy of this index was established by fluorescence patterns from emmission scans specific to whiteners in seep water. Although mats of algae characterized littoral areas receiving nutrient laden groundwater, no relationship was found between the degree of contamination of algae species composition or biomass. Natural, unpolluted groundwaters contained sufficient nutrients to promote algae mats. Based on these, stepwise procedures for in situ surveys were developed to quantify sewage contamination from shoreline septic systems in lakes.
W86-02619

UNCERTAINTY IN MODERN IMPOUNDMENT MODELS: EFFECTS AND METHODS OF ANALYSIS,

Nevada Univ. System, Las Vegas. Water Resources Center.
R. H. French, and F. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232783/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, Publication 41097, 1984. 33 p, 2 tab, 7 ref, 4 append. USGS G855-04. 14-08-0001-G-855.

Descriptors: Modeling, *Reservoir models, Water quality models, Dynamic models, *Coefficient variability.

Behavior of a system in a dynamic impoundment model is described by a set of simultaneous partial differential equations. Accuracy and validity of the model is dependent upon coefficients utilized in the model. It has been noted that a clever modeler can achieve any desired results by careful adjustment of the coefficients. Further, there is no guarantee that the coefficients chosen are unique to a given solution. A more rational approach is to include, explicitly in the model, the variability of the coefficient values. Review of the literature indicates that previous investigators have addressed the problems of coefficient variability and uncertainty in a number of ways. In semi-empirical models standard and rather simple statistical concepts are used. A second and probably the most popular method is use of Monte Carlo simulation. Other methods include propagation of variance and treatment of the equations in the model as random differential equations. At the present time only one commonly available dynamic impoundment water quality model, CE-QUAL-RI, has the capability of taking coefficient uncertainty into account. Other techniques may yield more cost-effective results in terms of modeling simplicity and computer utilization.
W86-02623

CHEMICAL CONSTITUTENTS OF RAINFALL AT DIFFERENT LOCATIONS ON OAHU, HAWAII,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
G. L. Dugan, and P. C. Ekern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232866/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Report 160, Honolulu, May, 1984. 25 p, 7 tab, 4 fig. USGS G838-03. 14-08-0001-G838.

Descriptors: *Acid rain, *Chemistry of precipitation, *Nitrogen compounds, Organic nitrogen, Sulfur cycle, Tropic Zone, *Hawaii, *El Chichon, *Kilauea Volcano, Oahu, Hawaii Island.

Rainfall sampling, which began in 1981 before the 1982 to 1983 El Nino and continued into 1984 on Oahu in Hawaii, represented sites with widely different rainfall amounts. Samples stored under refrigeration prior to analysis were analyzed for pH and for the major cations, chloride and sulfate, and the nitrogen series. For the stored samples, the rainiest site was acidic with median pH 4.9, and rainfall weighted pH 4.77. Samples analyzed immediately on receipt at the laboratory had median acidity of pH 4.2 and rain-weighted pH 4.22. Samples that included some cloud water had acidity with a median pH 5.1 and rainfall weighted pH 5.17. Samples taken before and after the eruption of El Chichon in April 1982 showed no apparent effect of the stratospheric sulfur on rainfall acidity. Electrical conductivity of the rainfall was equivalent to cation concentrations of 1 to 10 milliequivalents per liter. Chloride, a major cation, decreased with distance from the ocean sources. Sulfates values in the rainwater increased during southerly flow when Kilauea volcano was erupting, so that the sulfate to chloride ratio increased to tenfold that for seawater. Organic nitrogen forms made up about 40% of the total nitrogen content of the rainfall, and calculated organic-N loadings from the annual rainfall had values from 4.39 to 1.62 kg/ha/yr. The pH values of 4.2 to about 5.0 support the contention that the acidity in naturally occurring rainfall in remote areas has a pH slightly below 5.0.
W86-02631

TOXIC ORGANIC CHEMICAL TRANSPORT AND FATE IN GROUNDWATER SYSTEMS,

Princeton Univ., NJ.
R. A. Ferrara, and W. G. Gray.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232890/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, New Jersey Water Resources Research Institute, New Brunswick, April, 1985. 13 p, 8 fig 2 ref. USGS G857-05. 14-08-0001-G-857.

Descriptors: *Groundwater pollution, Mathematical modeling, *New Jersey, Path of pollutants, Landfills, Industrial wastes.

This project involved the development and application of a mathematical model of groundwater contaminant transport and fate. An existing two-dimensional groundwater flow and contaminant transport model was modified to include contaminant transformation processes including nonlinear adsorption and description, biodegradation, hydrolysis and volatilization. The model was applied to Price's Landfill in Pleasantville, New Jersey. Comparisons were made between predictions of contaminant migration with and without transformation processes. The simulations presented provide some guidance as to the range of values within which it is clearly necessary or clearly unnecessary to model transformation processes in addition to transport processes. The impact on a model's prediction of the migration of a contaminant plume can be substantial. Similarly, when such models are used to evaluate aquifer restoration techniques, the consideration of transformation terms can also be important. Assuming a conservative substance can lead to erroneous predictions regarding the extent and duration of aquifer restoration necessary to obtain a given level of decontamination.

W86-02634

SEDIMENT AND PESTICIDE/HERBICIDE TRANSPORT RELATIONSHIPS,

Kansas Water Resources Research Inst., Manhattan.
A. D. Parr, D. D. Lane, and C. Richardson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232973/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, January, 1985. 28 p, 16 fig, 2 tab, 8 ref. USGS G843-04. 14-08-0001-G-843.

Descriptors: *Kansas, *Sediment transport, *Path of pollutants, *Non-point pollution, Agriculture, Diffusion, Runoff, Laboratory simulation.

This study examined the entrainment of interstitial soil pore water by overland sheet flow. A series of laboratory experiments were performed in which water was passed at various velocities and depths over a soil bed. The soil was saturated with a sodium bromide solution prior to each experiment and the runoff water was sampled at the end of the flume. The samples were anlyzed for bromide concentration then concentration and mass loss rate curves were developed. A diffusion model was formulated and used to describe mass transfer across the soil surface. The experimental data was fitted to the diffusion model with a procedure developed to determine diffusion parameters from empirical data. In general, the experimental data conformed quite well to the diffusion model, with the diffusion coefficient depending on velocity and soil surface roughness.
W86-02642

STUDY OF THE MECHANISMS CONTROLLING GASOLINE HYDROCARBON PARTITIONING AND TRANSPORT IN GROUNDWATER SYSTEMS,

Connecticut Univ., Storrs. Inst. of Water Resources.
G. E. Hoag, C. J. Bruell, and M. C. Marley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242907/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, October 1984. 51 p, 13 fig, 7 tab, 30 ref, append. USGS G832-06. 14-08-0001-G-832.

Descriptors: *Groundwater pollution, *Hydrocarbons, Solvents, Interfaces, *Path of pollutants, Gasoline fuel, Organic compounds, Pollutant identification, Soil venting processes.

The environmental impacts of spilled gasline on ground water resources are severe and long-term. Environmental regulation of underground fuel storage is limited in the U.S. Transport phenomena controlling the fate of gasoline hydrocarbons in soil and groundwater systems are poorly understood. Methods to restore contaminated gasoline spill sites are limited and usually only address recoverable gasoline product. A gasoline hydrocarbon fingerprinting method was developed for aliphatic, aromatic, and halogenated compounds as a qualitative and quantitative research tool. A 1/8 ins. x 10 ft. stainless steel column packed with 5% AT-1200 + 1.75% Bentone 34 on Chrom-W-AW 100/120 mesh was used with a 15 cm3/min Helium carrier gas flow rate. Flame ionization and Mass Spectroscopy were used as methods for quantitative and qualitative analysis, respectively. Electron capture detection was used for quantitative halocarbon analysis. More than 50 hydrocarbons were identified and quantified in several gasoline grades by various manufacturers. Soil venting experiments indicate that gasoline can be readily volatilized from the vadoze zone using induced vaccuum or pressure. Experiments were run on several soils and various air flow rates. It was found that Dalton's and Raoult's Laws were followed in the venting process. Therefore, equilibrium chemistry can be used to model the venting of gasoline from soils.
W86-02659

SEDIMENT-WATER COLUMN EXCHANGES OF NUTRIENTS AND OXYGEN IN THE TIDAL JAMES AND APPOMATTOX RIVERS,

Virginia Inst. of Marine Science, Gloucester Point.
C. F. Cerco.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242915/AS, Price codes: A06 in paper copy, A01 in microfiche. March 1985. 110 p, 43 fig, 10 tab, 11 ref, 3 append.

Descriptors: *Sediments, Sediment-water interface, Oxygen demand, Nutrients, *Nitrogen, *Phosphorus, Tidal rivers, Estuaries, *James River, *Appomattox River, *Chesapeake Bay, Virginia, Dissolved oxygen, Ammonium, Orthophosporus, Path of pollutants.

Fluxes between the sediments and overlying water of ammonium, nitrate, total phosphorus, ortho phosphorus, and dissolved oxygen have been measured in the tidal James and Appomattox Rivers, Va. A total of 68 nutrient flux measures, 203 oxygen flux measures, and 18 control measures were collected in the summer months, 1983 and 1984. Ammonium is predominantly released from the sediments at a mean rate of 9.82 mg/sq m/hr. Nitrate is predominantly taken up by the sediments at a mean rate of 1.53 mg/sq m/hr. Total phosphorus is taken up by the sediments at a mean rate of 1.67 mg/sq m/hr. Ortho phosphorus may be taken up or released. Mean flux is an uptake of 0.75 mg/sq m/hr. Dissolved oxygen is taken up at a mean rate of 44 mg/sq m/hr.
W86-02660

DETECTION AND EFFECTS OF APERIODIC LEACHATE DISCHARGES FROM LANDFILLS,

Connecticut Univ., Storrs. Inst. of Water Resources.
J. Stuart, H. Luce, S. Smith, and R. Black.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242949/AS, Price codes: A10 in paper copy, A01 in microfiche. Completion Report, September 1984. 184 p, 50 fig, 28 tab, 69 ref, 2 append. USGS G832-04. 14-08-0001-G-832.

Descriptors: *Landfills, *Leachates, Waste dumps, *Groundwater pollution, Path of pollutants, Pollutant identification, Aperiodic leachate pulses, Water analysis, Soil analysis.

Pilot studies showed that aperiodic pulses of leachate were emanating from a nearby landfill. To evaluate methods of monitoring aperiodic leachate pulses and to characterize their composition, this study was initiated. Monthly variations in pH, specific conductivity, Ca, Cl, Fe, Mg, NH-4, NO3, K and Zn were monitored in water taken at well point depths of about 10, 20, and 40 feet from six wells and from nearby surface streams. By ground electromagnetic conductivity, a leachate plume was located emanating in a southerly direction from the landfill. A limited organic dye test showed groundwater movement to the south-southwest from the landfill to be rapid and descending. Purgeable hydrocarbons and halocarbons, compounds including methylene chloride, chloroform, toluene, and benzene were found in the leachate and in some residential wells adjacent to the landfill. By high resolution, capillary column gas chromatography (HRCCGC) and HRCCGC mass spectroscopy, base/neutral extractable organic compounds were obtained from well and surface stream water extracts. General compound classes identified by HRCCGC included a group of organic iodo compounds, alkylated phenols, phthlates, aromatics and some N containing heterocyclics. Analyses of soils from landfill drainages, using 6 profiles from two transects, yielded levels of Ca, Mg, Fe, Mn, Cu, Cr, Pb not found in control soils, and showed contamination of groundwater in the intermittent drainageway to the south. The flush of leachates was found to be affected by precipitation levels proving the aperiodic nature of the leachate movement from the landfill.
W86-02663

ACID RAIN BUFFERING POTENTIAL IN OREGON CASCADE LAKES: SECONDARY MINERAL SOLUBILITY CONTROL OF SOLUTION IONIC COMPOSITION,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
P. O. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246734/AS, Price codes: A02 in paper copy, A01 in microfiche. Oregon Water Resources Research Institute Publication WRRI-100, Corvallis, March, 1985. 16 p, 2 fig, 7 tab, 18 ref. USGS G864-02. 14-08-0001-G-864.

Descriptors: Lakes, *Acid rain, *Geochemistry, Speciation, *Buffering, *Aluminum, Water properties, Water chemistry, Chemical properties, *Oregon.

Results from Nelson and Delwiche (1983) were extended to determine possible geochemical controls on the chemical composition of Oregon's Cascade lakes. Two types of chemical equilibrium relationships were developed: (1) predominance-area diagrams relating primary and secondary minerals to determine the phase most likely to be in thermodynamic equilibrium with lake water solutions and (2) chemical speciation calculations, emphasizing aluminum, for the controlling geochemical phase and lake susceptibility to acidification. Comparison of chemical compositions of eight lakes to the phase regions of predominance diagrams indicated that kaolinite was the secondary mineral phase controlling solution chemistry. Gibbsite controlled solution chemistry in one lake. Speciation calculations showed aluminum to be predominantly in hydroxide complexes with free aluminum ion concentration never exceeding 2% of monomeric aluminum. Fluoride and sulfate complexes were generally negligible. Stability indices from solution compositions gave agreement with predicted controlling secondary mineral phases from predominance-area diagrams. The Oregon Cascade lakes studied appear to be in equilibrium or derived from secondary mineral phases formed during the incongruent dissolution of parent feldspar minerals. These geochemical forms, known for their low dissolution kinetics and resistance to chemical weathering, explain the dilute solution chemistry and weak buffering capacity of the lakes and their susceptibility to acidification.
W86-02667

AQUATIC BACTERIA AND PESTICIDE DEGRADATION,

Oregon State Univ., Corvallis. Dept. of Microbiology.
R. J. Seidler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246775/AS, Price codes: A03 in paper copy, A01 in microfiche. Oregon Water Resources Research Institute Publication WRRI-93, Corvallis, August 1984. 30 p, 6 fig, 5 tab, 23 ref. USGS G864-03. 14-08-001-G-864.

Descriptors: *Aquatic bacteria, *Pesticides, *2-4-D, Chlorinated aromatics, Biodegradation, Alcaligenes, Pseudomonas, Bacteria, DNA plasmids.

Thirty bacteria exhibiting the ability to utilize the herbicide 2,4-dichlorophendoxy acetate (2,4-DD) have been isolated from aquatic habitats in western Oregon. Bacteria utilizing 2,4-D were obtained from two-thirds of attempted enrichment trials. All but one of the isolates are gram-negative rods, oxidase positive, and aerobic. Those examined have lateral or subpolar flagella and have 61-67% guanine plus cytosine content in the chromosomal DNA. The cultures conform to bacteria of the genus Alcaligenes or Pseudomonas. Enrichment experiments revealed that approximately 10-20 indigenous bacteria per 100 ml of water were capable of using 2,4-D supplied at high concentrations of 150 micrograms of 2,4-D per ml water. About 800 or more bacteria 100 ml of water can use 1-5 micrograms/ml. Over 60% of the isolates contained detectable DNA plasmids with molecular weights in the range of 10-53 megadaltons. One large plasmid, designated pEML 159, had many similarities with a plasmid obtained from an Alcaligenes species isolated in Australia. Attempts to transfer between bacteria the genetic ability for utilizing 2,4-D met with limited success. Only pEML 159 was transmissable, and only to species closely related to the donor strain. No genetic transfer of 2,4-D utilization ability into bacteria numerically common in aquatic habitats was detected. It is concluded that aquatic bacteria which utilize 2,4-D are widespread but are present in relatively low numbers. Some of these organisms are able to use well over 150 micrograms/ml of 2,4-D and can rapidly cleanse aquatic environments containing much smaller levels of the pesticide. These bacteria are usually able to metabolize other chlorinated aromatics of the 2,4-D structural family.
W86-02671

FATE OF SELECTED PRIORITY POLLUTANTS IN REGIONAL WASTEWATER TREATMENT PLANTS IN PUERTO RICO AND THEIR IMPACT OF THE QUALITY OF COASTAL RECEIVING WATERS,

Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02674

IMPACTS OF INDIVIDUAL ON-SITE SEWAGE DISPOSAL FACILITIES ON MOUNTAIN VALLEYS - PHASE II - WATER-QUALITY CONSIDERATIONS,

Idaho Univ., Moscow. Dept. of Agricultural Engineering.
S. P. Luttrell, and C. E. Brockway.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249159/AS, Price codes: A05 in paper copy, A01 in microfiche. Idaho Water and Energy Recources Research Institute, Moscow, Completion Report, May, 1984. 74 p, 30 fig, 6 tab, 29 ref. USGS G839-03. 14-08-0001-G839.

Descriptors: *Water pollution sources, *Idaho, *Groundwater quality, *Septic tanks, Septic wastewater, Water quality, Aquifers.

A rapid increase in residential development utilizing primarily on-site sewage disposal systems is occurring in the Big Wood River valley in Idaho. Hydrologic characteristics of the Big Wood River and aquifer systems were evaluated addressing ground-water characteristics, groundwater/surface-water relationships, and water quality in relation to on-site sewage disposal systems. Ground water is unconfined and often occurs close to land surface in unconsolidated valley-fill deposits, which range from less then 40 feet to more than 180 feet in thickness. Ground-water underflow at Halley was calculated to be approximately 40,000 acre feet per year. A ground-water quality network of approximately 50 wells was established from which samples were collected in July-August, 1983. Approximately 20 wells were then selected from which samples were collected through March, 1984. The mean concentrations of nitrate-n, chloride, and orthoshosphate were 0.53, 2.4, and .013 mg/L, respectively. Nitrate-n concentrations ranged from 0.1 to 2.2 mg/L, well below the USEPA recommended limit of 10 mg/L. The mean specific conductance was 371 micromhos/cm at 25 deg C. Mean concentrations on nitrate-n, chloride, and orthophosphate from surface-water samples were 0.44, 1.8, and .015 mg/L, respectively. Ground-water levels were measured in approximately 60 wells from which a water-table contour map and a ground-water/surface-water profile were constructed for July-August, 1983. The profile indicates hydraulic connection between ground water and surface water in much of the study area.
W86-02694

HYDROLOGIC AND WATER QUALITY IMPACTS OF PEAT MINING IN NORTH CAROLINA,

North Carolina State Univ. at Raleigh. Dept. of Forestry.
J. D. Gregory, R. W. Skaggs, R. G. Groadhead,
R. H. Culbreath, and J. R. Bailey.
Available from the National Technical Information

Service, Springfield, VA 22161 as PB85-249175/AS, Price codes: A11 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No 214, August, 1984. 215 p, 93 fig, 31 tab, 16 ref.

Descriptors: *Surface drainage, *Subsurface drainage, *Water quality, *Peat, Peat soils, Mine drainage, Peat mining, Coastal Plains, North Carolina.

The surface and subsurface hydrologic impacts of peat mining were studied at a pocosin site in the lower Coastal Plain of Northeastern North Carolina. Runoff and water quality data were collected for discharge from field ditches draining sites being actively mined and sites with natural vegetation. A water management model (DRAINMOD) was adapted to simulate surface hydrology. The finite element method was used to evaluate the effects of peat mining on vertical seepage to a deep aquifer and lateral seepage from a nearby lake. Volume, duration, and peak flow of storm discharge from field ditches was greater from the mining sites than from those having natural vegetation. Baseflow between storm events was greater from vegetated sites than from the mined sites. Reduced evapotranspiration, reduced infiltration capacity aand grading and sloping of the surface are most likely responsible for those differences. Relatively high concentrations of organic sediment in field ditch outflows resulted from the highly erodible state of the mined surface and the field ditch channels. However, much of the sediment load settled in the weir stilling ponds and concentrations decreased downstream in collector and main anels due to settling and dilution. Concentrations of nitrogen and phosphorus varied little among sampling sites but were considerably higher than those reported in outflow from similar sites with natural vegetation in several other studies. Mining appeared to have no significant impact on concentrations of K, Ca, Mg, and Cl in outflows.
W86-02696

SOME HYDROLOGIC ASPECTS OF PROPOSED COAL MINING IN THE NORTH FORK OF THE FLATHEAD RIVER HEADWATERS AREA, NORTHWEST MONTANA AND SOUTH EAST BRITISH COLUMBIA,

Montana Bureau of Mines and Geology, Butte.
For primary bibliographic entry see Field 4C.
W86-02707

TRANSFER OF INFORMATION AND TECHNOLOGY ON ACID MINE DRAINAGE FROM RESEARCH TO THE USER,

West Virginia Univ., Morgantown. Water Research Inst.
C. L. Dodson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101300/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, 1984. 9 p. USGS G877-222. 14-08-0001-G877.

Descriptors: *West Virginia, *Acid mine drainage, Education, Technology transfer, Water quality standards, Iron, Heavy metals, Reviews, Information exchange, Communication, Sediment, Stream pollution, Fish, Aquatic life, Water pollution effects, Ecology, Chemical properties.

The project was designed to inform the user of results of the acid-mine-drainage research of the state water-research-institute program. A chief objective was to supply the Division of Water Resources, West Virginia Department of Natural Resources, and others having a like concern, technology or information that can be used to aid in establishing rational water-quality standards for iron in streams of the state and region. Information-transfer methods included meetings with principal users to determine needs, close personal contacts for individual and small-group discussions, written communications that included reports, a radio program, and a seminar held by principal investigators and others and users and others concerned with use. The most practical method of transferring information during the period of the project was by direct personal contact, and the method having the greatest impact was the seminar. The project made a valuable contribution to the water-resources needs of the state, and the effectiveness of this project indicates that such a technology/information-transfer project should be included in the annual programs of each state water research institute.
W86-02711

ADSORPTION OF HEAVY METALS ON SEDIMENTS IN STREAMS RECEIVING ACID MINE DRAINAGE,

West Virginia Univ., Morgantown. Water Research Inst.
B. I. Haddad, and C. R. Jenkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101334/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report 1984. 48 p, 2 fig, 9 tab, 33 ref, append. USGS G 877-203. 14-08-0001-G877.

Descriptors: *West Virginia, *Acid mine drainage, Heavy metals, Aluminum, Iron, Manganese, Zinc, Sediments, Water quality standards, Bottom sediments, Suspended sediments, Adsorption, Oxides, Stream pollution, Sediment distribution, Chemical composition.

Sediment samples were collected, from the Monongahela River, between Morgantown, West Virginia and Point Marion, Pennsylvania, and from two tributaries, Robinson Run and West Run. Distribution of bottom sediment in the navigation channel of the Monongahela River was found to be uneven. Sediment resuspension caused by towboats traffic was significant. A sequential extraction procedure conducted on river sediment showed that the Fe-Mn oxide phase of the sediment held the largest share of heavy metals. Heavy metals monitored were Al, As, Cd, Cr, Fe, Mn, Se, and Zn. As and Se concentration were not reliable because the equipment and procedure used were inadequate to detect concentration that were present. The organic carbon content of the sediment was found to be higher than comparable streams. The effect of pH 5.0 on heavy metal release from sediment was investigated. Mn and Zn were the only heavy metals that exhibited potential for release from sediment. The heavy metals content of the Monongahela River sediment was higher than comparable rivers. A comparison of heavy metals content in sediment from Monongahela River and tributaries showed a higher content in the river sediment.
W86-02714

RELATIONSHIP BETWEEN CHEMICALLY DETERMINED AND BIOLOGICALLY AVAILABLE FORMS OF PHOSPHORUS IN LAKES AND STREAMS,

Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
F. B. Trama, and A. W. McIntosh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126117/AS, Price codes: A05 in paper copy, A01 in microfiche. Final Technical Completion Report, September 1985. 73 p, 23 fig, 42 tab, 50 ref. B-076-NJ. 14-34-0001-9152.

Descriptors: *Reservoirs, Tributaries, Storm water, Water quality, *New Jersey, Phosphorus, *Eutrophication, Bioassay, Limnology, Water pollution.

Concentrations of total, total dissolved, soluble reactive and bioavailable phosphorus were determined monthly for three years in two proximal reservoirs and their major tributaries. Spruce Run reservoir was a eutrophic on-stream impoundment, and Round Valley reservoir was a mesotrophic pumped storage body of water. Baseflow and stormflow conditions were monitored for the main tributaries of Spruce Run reservoir. Temperature, light transmission, dissolved oxygen concentration and chlorophyll a levels were measured monthly in both reservoirs. Stormflows contributed about 33% of the annual TP load from Spruce Run Creek and 53% from Mulhockaway Creek to Spruce Run reservoir. Mean baseflow BAP/TP ratios were 0.43 and 0.35 for Spruce Run and Mulhockaway Creeks, respectively, but the stormflow BAP/TP ratio of 0.17 was the same for both streams. Mean TP concentrations were 15 and 29 microgram/liter in Round Valley and Spruce Run reservoirs, respectively, but the three-year average BAP/TP ratio of 0.21 was the same for both reservoirs. Both reservoirs were efficient phosphorus traps, especially with respect to BAP concentrations, which were reduced by 72% in Spruce Run reservoir. Secchi disc depth, chlorophyll a and dissolved oxygen concentrations in Round Valley reservoir responded quickly to an episodic enrichment of phosphorus but only the chlorophyll a showed a rapid recovery. The rate of hypolimnetic oxygen consumption (AHOD) of 0.06 microgram O2/cm2/day in Round Valley failed to improve during the three years of investigation. Phosphorus budgets were assembled for both reservoirs and used to compare predicted TP concentrations to those observed. An equilibrium-based model proposed by Lee et al. gave poor agreement. The Dillon-Rigler model accurately predicted the observed annual mean TP concentrations and not the springtime TP concentration it was supposed to predict.
W86-02721

EVALUATION OF DATA REQUIREMENTS FOR GROUNDWATER CONTAMINANT TRANSPORT MODELING,

Washington Univ., Seattle. Dept. of Civil Engineering.
E. W. Strecker, W. Wen-Sen Chu, and D. P. Lettenmaier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126133/AS, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Series Technical Report No 94, May 1985. 92 p, 30 fig, 13 tab, 45 ref. USGS C-3173-G. 14-08-0001-G1059.

Descriptors: *Groundwater, *Contaminant transport, *Data requirements, *Path of pollutants, *Parameter identification, *Method of characteristics, *Computer models, Prediction, Mathematical models, Risks.

Groundwater flow and contaminant transport models have been widely used for planning and design purposes in the past decade. The predictive ability of these models is limited by the assumptions and approximations introduced in the model governing equations and their solutions, the model parameters used, and the availability and quality of the model calibration data. By combining a parameter identification algorithm with the united states geological survey's Method of Characteristics (USGS-MOC) Code and using two synthetic aquifers, this study evaluated the effects of data availability and uncertainty on groundwater contaminant transport prediction by a series of numerical experiments. The study results indicate that the predictive ability of USGS-MOC is limited unless relatively extensive and good quality data are available. Extending the time length of observation was generally more effective in improving parameter estimates than adding more observation wells. Finally, provided that all boundary conditions are known, the accurate estimation of transmissivity in an aquifer is by far the most important step toward more reliable prediction of contaminant transport. The experimental results showed that when only limited data were available for model calibration, the predicted contaminant concentrations could be significantly in error in just five years of simulation. Based on the study results, we suggest that with typical data bases, groundwater flow and contaminant transport model results should be accompanied by detailed uncertainty analysis prior to implementation for planning or design purposes.
W86-02723

MODELING OF OVERLAND FLOW BY THE DIFFUSION WAVE APPROACH,

Kentucky Water Resources Research Inst., Lexington.
R. S. Govindaraju, S. E. Jones, and M. L. Kavvas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132388/AS, Price codes: A05 in paper copy, A01 in micro-

fiche. Research Report No. 159, August 1985. 79 p, 13 fig, 1 tab, 18 ref, 1 append. USGS G-908-03. 14-08-0001-G-908(FY 84).

Descriptors: *Kentucky, *Pollutant transport, *Path of pollutants, *Overland flow, Model studies, Oil fields, Oil pollution, Flow characteristics, Flow pattern.

Water quality degradation and a need for precise answers to transport of pollutants by overland flow were studied with special reference to the evaporation pits located adjacent to streams in the oil producing regions of eastern Kentucky. The practical shortcomings of the state-of-the-art kinematic wave are discussed and a new mathematical modeling approach for overland flows using the more comprehensive diffusion wave is attempted as the first stem in solving this problem. A Fourier series representation of the solution to the diffusion wave is adopted and found to perform well. The physically justified boundary conditions for steep slopes is considered and both numerical and analytical schemes are developed. The zero-depth-gradient lower condition is used and found to be adequate. The steady state analysis for mild slopes is found to be informative and both analytical and numerical solutions are found. The effect of imposing transients on the steady state solution are considered. Finally the cases for which these techniques can be used are presented.
W86-02738

IDENTIFICATION OF SOIL-WATER CHEMICAL PARAMETERS FOR THE PREDICTION AND TREATMENT OF SUSPENDED SOLIDS IN SURFACE WATER RESERVOIRS OF COAL MINE LANDS,

Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5D.
W86-02739

INVESTIGATION OF POLLUTION IN A KARST AQUIFER UTILIZING OPTICAL BRIGHTENER,

Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5A.
W86-02740

CONTROLS ON PHOSPHORUS MOBILITY IN THE POTOMAC RIVER, NEAR THE BLUE PLAINS WASTEWATER TREATMENT PLANT,

Geological Survey, Reston, VA. Water Resources Div.
P. P. Hearn.
Available from Dist Branch, USGS 604 S. Pickett St. Alexandria, VA 22034. USGS Professional Paper 2231, 1985. 46 p, 29 fig, 2 tab, 56 ref.

Descriptors: *Potomac River, *Wastewater disposal, *Sewage disposal, *Phosphates, *Path of pollutants, Sediments, Bottom sediments, Sorption, Nutrients.

The removal of phosphorus from wastewater treatment plant effluents is desirable, both in terms of water quality, and also because it can cost less than nitrogen or carbon removal. The biological availability of phosphorus in a sediment-water system is controlled by a number of processes. Effective decision-making requires a data-collection effort tailored to specific locations. The Blue Plains wastewater treatment plant is the largest point source of phosphorus in the entire Potomac River basin, discharging an average of 2000 kilograms of phosphorus into the river each day. The transport of phosphorus near the treatment plant was found to be affected primarily by the circulation regime and chemical reactions with suspended and bottom sediments. The effect of river discharge on the convective transport of phosphorus near the outfall is significantly reduced by a mid-river shoal area that confines the flow path of the effluent to an embayment on the eastern side of the river for a distance of 2 miles below the outfall. This embayment serves as a sediment trap, where protection from bottom scour permits clay-rich sediments to accumulate. Mean residence time is 2-1/2 days for the effluent to leave the embayment area. The amount of dissolved phosphorus available within the water column is regulated primarily by sorption and precipitation reactions with suspended and bottom sediments. Amorphous ferric oxyhydroxides are the primary phase responsible for phosphorus sorption. A substantial amount of phosphorus is associated with residual iron and aluminum from within the treatment plant, especially in sediments close to the outfall. The concentration of amorphous iron in fine-grained sediments is significant with respect to the circulation regime within the embayment. Phosphorus has accumulated in areas of fine-grained sediment deposition. Conversely, the absence of these compounds in sand-rich sediments near the outfall has apparently facilitated the precipitation of the ferrous phosphate mineral vivianite. Approximately 13 percent of the phosphorus discharged between September 1977 and August 1980 has been retained in the embayment. A diurnal cycle corresponds to the metabolic utilization of phosphorus by phytoplankton. This cyclic sorption is superimposed upon a constant and non-cyclic sorption of phosphorus by inorganic phases. (USGS)
W86-02762

PESTICIDES IN THE NATION'S RIVERS, 1975-1980, AND IMPLICATIONS FOR FUTURE MONITORING,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02764

WATER-QUALITY CHARACTERISTICS OF STREAMS IN THE PICEANCE CREEK AND YELLOW CREEK DRAINAGE BASINS, NORTHWESTERN COLORADO,

Geological Survey, Meeker, CO. Water Resources Div.
R. L. Tobin, H. E. Stranathan, and K. J. Covay.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4261, 1985. 80 p, 35 fig, 14 tab, 34 ref.

Descriptors: *Chemical analyses, *Energy, Water resources, *Colorado, Water quality, *Piceance Creek basin, *Yellow Creek basin.

Physical and chemical data for streams in the Piceance Creek and Yellow Creek drainage basins, Colorado collected during the 1977-81 water years are summerized. Stream temperatures ranged from -0.5 to 35.0 degrees Celsius and were warmest near the downstream reaches of Piceance and Yellow Creeks. Minimum concentrations of dissolved oxygen were greater than 3.0 milligrams per liter in Piceance and Yellow Creeks, and concentrations of dissolved oxygen exceeded saturation during periods of active photosynthesis. Values of pH in streams ranged from 6.9 to 9.0 and were least during snowmelt runoff and greatest in low flows in the lower reaches of Piceance and Yellow Creeks. Concentrations of suspended sediment exceeded 100,000 milligrams per liter in localized runoff. Specific conductance varied inversely with discharge. Sodium, magnesium, bicarbonate, and sulfate ions and concentration ranges of dissolved solids between 400 and 1,700 milligrams per liter were characteristic of the water quality of the perennial streams. Calcium and bicarbonate dominated the major ions, and concentrations of dissolved solids normally were less than 600 milligrams per liter in the intermittent streams during storm and snowmelt runoff. Augmentation to Piceance and Yellow Creeks from ground-water sources in the lower reaches of both streams increased concentrations of dissolved solids several thousand milligrams per liter during medium and low flows and caused a change in water-quality type from sodium magnesium bicarbonate to a high-percentage sodium bicarbonate. Increases in dissolved concentrations of arsenic, boron, fluoride, lithium, strontium, and sulfate were related to ground-water sources or discharges from areas of energy resource development. (USGS)
W86-02767

RECONNAISSANCE OF CHEMICAL QUALITY OF SURFACE WATER IN THE UPPER VIRGIN RIVER BASIN, UTAH, ARIZONA, AND NEVADA,

Geological Survey, Salt Lake City, UT. Water Resources Div.
G. W. Sandberg, and L. G. Sultz.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. Utah Department of Natural Resources, Salt Lake City, Technical Publication 83, 1985. 69 p, 7 fig, 9 tab, 27 ref.

Descriptors: Water quality, Salinity, Surface water, Sediment transport, Chemical analyses, Water analysis, *Virgin River basin, Reconnaissance studies, *Utah, *Arizona, *Nevada.

The Virgin River drainage from headwaters in Utah to Littlefield, Arizona has an area of about 5,090 square miles in southwestern Utah, northwestern Arizona, and southeastern Nevada. Water-quality data were obtained from 1 to 5 times at 74 sites in the basin between August, 1981 and September, 1982. Tributary inflow to the Virgin River generally contained smaller dissolved-solids concentrations than did the river during low flow and larger concentrations during high flow. LaVerkin Hot Springs, with a dissolved solids concentration of nearly 10,000 milligrams per liter, contributes a flow of approximately 11 cubic feet per second to the river. Major ions from the springs were sodium and chloride. Dissolved solids in the river system ranged from 56 milligrams per liter at Cascade Spring, Utah, to 2,620 milligrams per liter at Littlefield, Arizona. Calcium and sulfate were predominant ions although other ions were in greater concentration in some reaches. Sediments loads ranged from 0.13 to 3,582 tons per day 39 samples collected in August, 1981 and May, 1982. The maximum recorded sediment load was 1,930,000 tons per day prior to this investigation (1980). Dissolved-oxygen concentrations did not indicate dissolved-oxygen depletion. Sanitary conditions may be degraded downstream from livestock areas. Pesticide concentrations were minimal where sampled. (USGS)
W86-02768

SIMULATING UNSTEADY TRANSPORT OF NITROGEN, BIOLOGICAL OXYGEN DEMAND AND DISSOLVED OXYGEN IN THE CHATTAHOOCHEE RIVER DOWNSTREAM FROM ATLANTA, GEORGIA,

Geological Survey, NSTL Station, MS. Water Resources Div.
H. E. Jobson.
Available from Dist Branch, USGS 604 S. Pickett St. Alexandria, VA 22034. USGS Water-Supply Paper 2264, 1985. 36 p, 17 fig, 3 tab, 25 ref.

Descriptors: *Computer models, Water pollution sources, *Biological oxygen demand, Nitrification, Water quality, *Path of pollutants, Temperature models, Water-quality models, *Georgia, *Chattahoochee River, *Dissolved oxygen, *Nitrogen.

As part of an intensive water-quality assessment of the Chattachoochee River, repetitive water-quality data were obtained at 12 sites along a 69 kilometer reach of the river downstream of Atlanta, Georgia. Concentrations of seven constituents (temperature, dissolved oxygen, ultimate carbonaceous biochemical oxygen demand (BOD), organic nitrogen, ammonia, nitrite, and nitrate) were obtained during two periods of 36 hours, one starting on August 30, 1976, and the other starting on May 31, 1977. The study reach contains one large and several small sewage outfalls and receives the cooling water from two large powerplants. An unsteady water-quality model of the Lagrangian type was calibrated using the 1977 data and verified using the 1976 data. The model provided a good means of interpreting these data even though both the flow and the pollution loading rates were highly unsteady. A kinetic model of the cascade type was found to accurately describe the physical and biochemical processes occurring in the river. All rate coefficients, except reaeration and those describing the resuspension of BOD were fitted to the 1977 data and verified by use of the 1976 data. The study showed that at steady low flow about 38 percent of the BOD settled without exerting an oxygen

demand. This settled BOD was resuspended at high flow and exerted an immediate oxygen demand. About 70 percent of the ammonia extracted from the water column was converted to nitrite but the fate of the remaining 30 percent is unknown. Photosynthetic production was not an important factor in the oxygen balance during either run. (USGS)
W86-02769

APPRAISAL OF WATER-QUALITY CONDITIONS, LOWER BLACK RIVER, WINDSOR COUNTY, VERMONT,

Geological Survey, Bow, NH. Water Resources Div.
K. W. Toppin.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 82-4116, 1983. 61 p, 11 fig, 7 tab, 17 ref.

Descriptors: Water quality, *Hydroelectric power, *Nutrients, *Algal growth, *Primary productivity, *Preimpoundment, Aquatic life, Secondary wastewater, Waste treatment, Nuisance algal, Organic loading, Oxygen demand, Trace elements, Conductance, Organic carbon, Town of Springfield, *Vermont, Black River.

Six hydroelectric power dams are planned along a 22-mile reach of the lower Black River in southeastern Windsor County, Vermont. Data were collected at 10 stations, during water years 1977-81, to appraise quality conditions before construction. Average specific conductance of Black River is 101 micromhos indicating low concentrations of dissolved solids. Concentrations of common constituents and minor elements were generally low and within safe levels for aquatic life. Near-saturated dissolved oxygen concentrations and relatively low mean total organic carbon concentrations indicate little oxygen-consuming substances in Black River. Mean total nitrogen concentrations ranged from 0.31 mg/L (milligrams per liter) to 0.61 mg/L. The highest concentrations were most likely due to secondary waste discharges entering the river. Nitrate was the primary form of inorganic nitrogen, mean concentrations ranged from 0.13 to 0.27 mg/L. Concentrations seem high enough to promote excessive algal growth in the proposed Hawks Mountain Reservoir. Mean concentrations of total phosphorus ranged from 0.014 to 0.112 mg/L as P. Maximum concentrations at all stations generally exceeded U.S. Environmental Protection Agency suggested levels for water entering lakes and reservoirs. Mean orthophosphorus concentrations ranged from 0.005 to 0.029 mg/L, suggesting a potential for nuisance algal conditions to develop in the proposed reservoir. Mean algal growth potential concentrations ranged from 1.3 to 8.8 mg/L, falling within the moderately high to high productivity range. No pesticides and polychlorinated biphenyls were detected. (USGS)
W86-02770

STATISTICAL APPROACH TO EVALUATING THE RELATION OF COAL MINING, LAND RECLAMATION, AND SURFACE-WATER QUALITY IN OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02775

INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY, VOLUME 2--HYDROLOGIC ANALYSIS,

Geological Survey, Albany, NY. Water Resources Div.
P. S. Murdoch, N. E. Peters, and R. M. Newton.
Electric Power Research Institute--ILWAS report EPRI EA-3221, Vol 2, 1984. 58 p, 18 fig, 11 tab, 31 ref.

Descriptors: Water budgets, Watershed hydrology, *Acid rain, Base flow, Groundwater runoff, Evapotranspiration, *Water pollution sources, *Adirondack Mountains, *New York, ILWAS.

A hypothesis of the Integrated Lake-Watershed Acidification Study has been that lakes receiving much of their inflow from deep soil horizons will be more alkaline than those receiving mostly surface runoff. Two similar lake basins in the West-Central Adirondack Mountains were studied. Both basins received about 120 centimeters of acid precipitation annually (pH 4.2). One lake is acidic (pH = 4.7), the other is neutral (pH = 7). Hydrologic and geologic data included (1) thickness of till and capacity to transmit water to the lake, (2) 'flashiness' of runoff and degree of flow augmentation by ground water, (3) flow-duration curves, (4) recession curves representing ground-water decline in winter, (5) monthly changes in watershed storage, including surface retention and soil moisture, and (6) magnitude of ground-water decline in summer and subsequent recharge in fall. The neutral lake receives about 10 times more ground water than the acidic lake. Large amounts of water applied over short periods (such as the spring snowmelt) increase the relative amount of shallow flow and thus increase lake-water acidity). (USGS)
W86-02777

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM IN SOUTHWESTERN NEW JERSEY, 1923-83,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02783

CHEMICAL AND BIOLOGICAL QUALITY OF SELECTED LAKES IN OHIO, 1978 AND 1979,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2H.
W86-02786

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE KISHWAUKEE RIVER BASIN, ILLINOIS,

Geological Survey, De Kalb, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02787

HYDROGEOLOGIC RECONNAISSANCE OF THE SAN MIGUEL RIVER BASIN, SOUTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02789

RUNOFF AND CHEMICAL LOADING IN SMALL WATERSHEDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02794

QUALITY OF GROUND WATER IN MONITOR AND WILLIAMS TOWNSHIPS, BAY COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
F. R. Twenter, and T. R. Cummings.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4110, 1985. 41 p, 16 fig, 10 tab, 5 ref.

Descriptors: *Hydrogeology, Groundwater, *Groundwater pollution, *Groundwater movement, Water quality, Saline water, Coal mining, Bay County, *Michigan.

A hydrogeological study of Monitor and Williams Townships in Bay County, Michigan, was conducted during 1983-84. Migration of mineralized ground water from abandoned subsurface coal mines in Monitor and Williams Townships had been thought to effect the quality of domestic ground-water supplies in the area. To investigate the possibility, wells were installed to obtain geologic data and water samples; related data concurrently collected by other agencies also were analyzed. The principal geologic units are glacial deposits and the Saginaw Formation. Glacial deposits, 75 to 175 feet thick, are primarily clay underlain in places by sand and gravel. This sand and gravel is the primary source of potable ground water in the study area. Underlying the glacial deposits is the Saginaw Formation--a unit that is mostly shale and silty shale containing beds of siltstone, sandstone, and coal. Specific conductance of water from wells indicate that dissolved-solids concentration increases with well depth. About 50 percent of specific conductance values of water from wells more than 100 feet deep were equal to or greater than 5,000 microsiemens, whereas only 13 percent of the values of water from wells less than 100 feet deep were equal to or greater than 5,000 microsiemens. Chemical analyses of water from abandoned mines and the Saginaw Formation in areas without coal indicated that the Saginaw Formation is as likely to influence the water-quality characteristics of the glacial deposits as is water from abandoned mines. (USGS)
W86-02798

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
T. H. Thompson, R. Chappell, and D. L. Hart.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water Resources Investigations Report 83-4118-C, 1984. 5 p, 4 fig, 11 ref.

Descriptors: Groundwater, *Water quality data, Hydrogeology, *Groundwater quality, *Basin and Range province, *New Mexico, *Maps, *Dissolved solids.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps at a scale of 1:500,000 describing the ground-water quality of the New Mexico portion of the Basin and Range province. The first map shows the areal distribution of dissolved solids of ground water in the basin-fill deposits. The second map shows the areal distribution of the dominant chemical type of ground water in the basin-fill deposits. (USGS)
W86-02799

DATA COLLECTED BY THE U.S. GEOLOGICAL SURVEY DURING A STUDY OF URBAN RUNOFF IN BELLEVUE, WASHINGTON, 1979-82,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02811

ANALYSIS OF URBAN RUNOFF DATA AND EFFECTS ON THE SOUTH PLATTE RIVER, DENVER METROPOLITAN AREA, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
S. R. Ellis, J. T. Doerfer, M. H. Mustard, S. R. Blakely, and J. W. Gibbs.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4159, 1984. 66 p, 8 fig, 32 tab, 13 ref.

Descriptors: Tributary basins, *Land use, Rainfall, *Storm loads, Nutrients, Trace elements, *Denver, *Colorado, *Water pollution sources, *Urban runoff, Water quality, Load analysis.

Denver was selected for inclusion in the Nationwide Urban Runoff Program, sponsored by the U.S. Environmental Protection Agency and the U.S. Geological Survey. This report, prepared in cooperation with the Denver Regional council of governments, contains a synopsis of previous urban runoff studies in the Denver metropolitan area.

The report includes a description of the monitored basins, a summary of storm runoff-to-rainfall ratios and estimates of impervious retention, and constituent loads and concentrations from seven small basins. The data from six small and five tributary basins to the South Platte River are analyzed using regression analysis, resulting in two sets of regression equations to predict storm runoff volume and selected constituent loads. The regression equations may be used to estimate storm-runoff volume and constituent loads from unmonitored basins from 15 to 16,000 acres with effective impervious areas of 15 to 90 percent. The effects of urban runoff on the South Platte River in the Denver area are described in three ways. The three methods indicated that storm runoff was a significant contributor of total suspended solids, total organic carbon, total lead, and total zinc to the South Platte River. (USGS)
W86-02813

STREAMFLOW AND SPECIFIC-CONDUCTANCE DATA FOR SELECTED SITES, FEBRUARY 15 THROUGH APRIL 9, 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE,

Geological Survey, Knoxville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02817

WATER-QUALITY CHARACTERISTICS OF ABHA RESERVOIR, ABHA, SAUDI ARABIA,

Geological Survey, Atlanta, GA. Water Resources Div.
W. J. Shampine.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4248, 1984. 42 p, 6 fig, 4 tab, 5 ref.

Descriptors: Water quality, *Reservoir storage, *Water supply, *Phytoplankton, Nutrients, *Saudi Arabia, *Abha, Asir Mountains.

A water-supply reservoir for the town of Abha, in the Asir Mountain range in southwestern Saudi Arabia was studied by periodic, year-long sampling in 1980 to measure changes in some of the water-quality characteristics. Measurements included surface to bottom profiles of temperature, dissolved oxygen, pH, and Eh; surface and bottom chemical analyses; and surface phytoplankton analyses. In January 1980 the reservoir was isothermal and had a mean temperature of 13.8C. Thermal stratification had formed by April and was at a maximum in July, when the water temperature was 21.3C at the surface and 17.3C near the bottom of the reservoir. In April chemically reducing conditions developed in the hypolimnion; concentrations of iron, manganese, and hydrogen sulfide increased significantly. Below a depth of about 5 meters the water became anaerobic, the pH was reduced from 8.5 to 7.2, and the Eh became negative. The reservoir became isothermal again in November 1980 and the reducing conditions slowly dissipated. The dominant phytoplankton population in the reservoir varied from Cyanophyta in the winter and spring, to Chlorophyta in the summer, to diatoms in the fall. The concentration of Anacystis, Oscillatoria, and Aphanizomenon measured in the winter and spring indicate the possibility of some pollution to the reservoir. (USGS)
W86-02820

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE WEST OTTER AREA, ASHLAND AND BIRNEY-BROADUS COAL FIELDS, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02827

GEOHYDROLOGY AND GROUND-WATER FLOW AT VERONA WELL FIELD, BATTLE CREEK, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02840

GROUND-WATER RESOURCES AND POTENTIAL HYDROLOGIC EFFECTS OF SURFACE COAL MINING IN THE NORTHERN POWDER RIVER BASIN, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02841

HYDROLOGY OF MAJOR ESTUARIES AND SOUNDS OF NORTH CAROLINA,

Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 2L.
W86-02842

WATER-QUALITY CHARACTERISTICS FOR SELECTED SITES ON THE CAPE FEAR RIVER, NORTH CAROLINA, 1955-80--VARIABILITY, LOADS, AND TRENDS OF SELECTED CONSTITUENTS,

Geological Survey, Raleigh, NC. Water Resources Div.
J. K. Crawford.
Available from Distribution Branch, USGS, Alexandria, VA 22304. USGS Water-Supply Paper 2185-F, 1985. 44 p, 15 fig, 17 tab, 103 ref.

Descriptors: Water quality, Water quality standards, *Ions, *Trace elements, *Nutrients, *North Carolina, Specific conductivity, Hydrogen ion concentration, Sulfates, Nitrates, Mercury, Iron, Manganese, Phosphorus, Nitrogen, Phytoplankton, Eutrophication, *Development impacts, Cape Fear River, Haw River, Deep River, B. Everett Jordan Dam.

Historical water-quality data collected by the U.S. Geological Survey from the Cape Fear River at Lock 1, near Kelly, North Carolina, show increasing concentrations of total-dissolved solids, specific conductance, sulfate, chloride, nitrite plus nitrate nitrogen, magnesium, sodium, and potassium during the past 25 years. Silica and pH show decreasing trends during the same 1957-80 period. These long-term changes in water quality are statistically related to increasing population in the basin and especially to manufacturing employment. Comparisons of water-quality data for present conditions with estimated natural conditions indicate that over 50 percent of the loads of most major dissolved substances in the river at Lock 1 are the result of development impacts in the basin. Over 80 percent of the nutrients plus nitrate nitrogen, ammonia nitrogen, and total phosphorus presently in the streams originate from development. At four sampling stations on the Cape Fear River and its tributaries, recent water-quality data show that most constituents are always within North Carolina water-quality standards and Environmental Protection Agency water-quality criteria. However, iron, manganese and mercury concentrations usually exceed standards. Although no algal problems have been identified in the Cape Fear River, nitrogen and phosphorus are present in concentrations that have produced nuisance algal growths in lakes. (USGS)
W86-02848

WATER QUALITY IN THE NEW RIVER, CALEXICO TO THE SALTON SEA, IMPERIAL COUNTY, CALIFORNIA,

Geological Survey, San Diego, CA. Water Resources Div.
J. G. Setmire.
Available from Distribution Branch, USGS, 604 S. Pickett Street, Alexandria, VA 22304. USGS Water-Supply Paper 2212, 1984. 42 p, 20 fig, 12 tab, 16 ref.

Descriptors: *Water pollution sources, *Organic loading, *Dissolved oxygen, *California, Natural recovery, Benthic invertebrates, New River, Calexico.

The New River, which crosses the international boundary and enters the United States at Calexico, California, often contains material having the appearance of industrial and domestic waste. In May 1977, during a 4-day water-quality reconnaissance, white-to-brown, extremely turbid water crossed the border and was sampled on three occasions. During periods of waste discharge, concentrations of total organic carbon in the river at Calexico ranged from 80 to 161 milligrams per liter and dissolved organic carbon ranged from 34 to 42 milligrams per liter; the maximum chemical oxygen demand was 510 milligrams per liter. To determine the occurrence of the organic material and its effects on downstream water quality, intensive sampling for chemical and biological characteristics was done in the New River from May 1977 to June 1978. Dissolved-oxygen concentration was measured along longitudinal profiles of the River from Calexico to the Salton Sea. A dissolved-oxygen sag which developed downstream from the gage at Calexico varied seasonally. The sag extended farther downstream and had lower concentrations of dissolved oxygen during the summer months than during the winter months. High concentrations of organic material were detected as far as Highway 80, 19.5 miles downstream from the international boundary. The numbers and diversities of benthic invertebrate organisms showed that very few were able to survive the water-quality conditions in the upper reaches of the river. Lower reaches had greater numbers and diversities of organisms. Standard bacterial indicator tests showed fecal contamination a health hazard, exists in the New River. (USGS)
W86-02849

PHOSPHORUS LOADING TO MCGRATH AND ELLIS PONDS, KENNEBECK COUNTY, MAINE,

Geological Survey, Augusta, ME. Water Resources Div.
W. J. Nichols, J. W. Sowles, and J. J. Lobao.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4177, 1984. 20 p, 7 fig, 5 tab, 6 ref.

Descriptors: *Maine, *Lakes, *Limnology, Hydrology, *Phosphorus, Surface water, *Water pollution sources.

McGrath and Ellis Ponds in south-central Maine have been identified as having nuisance algae blooms. In 1978, a cooperative study between the U.S. Geological Survey and the Maine Department Environmental Protection was begun to evaluate areas in which restoration effort would best improve water quality of the ponds. Streamflow and phosphorus data were collected from 28 tributaries to the ponds, April 1 through September 30, 1978 and 1979. Phosphorus yields from each tributary watershed were compared to determine their relative importance to the phosphorus budgets of the ponds. Three tributaries to the ponds were estimated to contribute 44 percent of the phosphorus load, yet drain only 22 percent of the watershed. Phosphorus input to the ponds likely would be most easily reduced by instituting phosphorus control practices in parts of the basin drained by the three tributaries. (USGS)
W86-02859

OREGON GROUND-WATER QUALITY AND ITS RELATION TO HYDROGEOLOGIC FACTORS--A STATISTICAL APPROACH,

Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02860

OCCURRENCE OF NATURAL RADIUM-226 RADIOACTIVITY IN GROUND WATER OF SARASOTA COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
R. L. Miller, and H. Sutcliffe.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investi-

gations Report 84-4237, 1985. 34 p, 8 fig, 6 tab, 46 ref.

Descriptors: Radioactivity, Public health, Water supply, *Radium radioisotopes, *Groundwater, *Geochemistry, Solubility, Statistical analysis, Phosphates, Water treatment, *Water pollution sources, *Florida, Tampa.

Water that contains radium-226 radioactivity in excess of the 5.0-picocurie-per-liter limit set in the National Interim Primary Drinking Water Regulations was found in the majority of wells sampled throughout Sarasota County. Highest levels were found areally near the coast or near rivers and vertically in the Tamiami-upper Hawthorn aquifer where semiconsolidated phosphate pebbles occur. Analysis of data suggests that part of the radium-226 in ground water of Sarasota County is dissolved by alpha particle recoil. In slightly mineralized water, radium-226 concentrations are decreased by ion exchange or sorption. In more mineralized water, other ions compete with radium-226 for ion exchange or sorption sites. Dissolution of minerals containing radium-226 by mineralized water probably contributes a significant fraction of the dissolved radium-226. Two types of mineralized water were present in Sarasota County. One type is a marine-like water, presumably associated with saltwater encroachment in coastal areas; the other is a calcium magnesium strontium surfate bicarbonate type. In general, water that contains high radium-226 radioactivities also contains too much water hardness or dissolved solids to be used for public supply without treatment that would also reduce radium-226 radioactivities. (USGS)
W86-02861

GENERAL DESCRIPTION OF THE GEOHYDROLOGY AND BURIAL TRENCHES AT THE LOW-LEVEL RADIOACTIVE WASTE BURIAL FACILITY NEAR BARNWELL, SOUTH CAROLINA,

Geological Survey, Columbia, SC. Water Resources Div.
B. B. McDonald.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-806, 1984. 23 p, 10 fig, 1 tab, 14 ref.

Descriptors: Geology, *Radioactive waste disposal, *Groundwater hydrology, Waste burial, *Path of pollutants, Barnwell, *South Carolina, *Hydrogeology.

The Barnwell low-level radioactive solid waste burial site is located in Barnwell County, South Carolina, 5 miles west of the city of Barnwell. Approximately 1,050 feet of stratified gravel, sand, silt, clay, and limestone, ranging in age from Late Cretaceous to Holocene, underlie the burial site. Ground water within the study area occurs under water table, semi-confined, and artesian conditions. Overland flow and most precipitation that recharges the ground-water system at the burial site is discharged to Marys Branch Creek. This creek originates as a spring about 3,000 feet south of the burial site and flows to the southwest into lower Three Runs. Lower Three Runs discharges into the Savannah River. Waste shipments to the site were reduced from 200,000 cubic feet per month for the period 1971 to 1979 to 100,000 cubic feet per month by October 1981. The wastes consist of both nonfuel cycle and nuclear fuel-cycle wastes. The standard trench dimensions at the burial site are 100 feet wide by 1,000 feet long and 22 feet deep. Trench bottoms are a minimum of 5 feet above the water table. Seven soil mapping units occur at the waste disposal facility. The three major soil types are all well drained and cover approximately 84 percent of the study area. (USGS)
W86-02862

EFFECTS OF COAL MINING ON THE WATER QUALITY AND SEDIMENTATION OF LAKE TUSCALOOSA AND SELECTED TRIBUTARIES, NORTH RIVER BASIN, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-02863

EFFECTS OF SURFACE COAL-MINE RECLAMATION ON STREAM QUALITY IN A SMALL WATERSHED NEAR NELSONVILLE, SOUTHEASTERN, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
S. M. Hindall.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4179, 1984. 28 p, 6 fig, 3 tab, 9 ref.

Descriptors: *Strip mines, *Land reclamation, *Water quality, Surface water, Coal mines, *Ohio, Hocking County.

Abandoned surface coal mines in southeastern Ohio have caused degradation of the area's water resources. A study was undertaken in 1981 to determine the effects of abandoned-mine reclamation on water quality in the 'Yost tract' near Nelsonville, Ohio. Data on streamflow, water quality, and sedimentation were collected in Yost Run during reclamation of the Yost tract. In addition, some prereclamation and postreclamation data were collected. Analysis of the data indicates that there has been very little change in the chemical quality of Yost Run 10 months after reclamation; pH remains low, about 3.0-4.2, whereas specific conductance continues to be high, about 1,000-2,600 microhos per centimeter (at 25C). Concentrations of sulfate and dissolved iron also show no appreciable change, remaining about 550-1,800 milligrams per liter and 1,300 - 17,000 micrograms per liter, respectively. The sediment yield for Yost Run is 2,830 tons per square mile per year. The results indicate only that the effects on water quality have not been detected during this short study. Additional data collection is needed to observe changes in water quality. (USGS)
W86-02867

SUMMARY OF URBAN-RUNOFF STUDIES IN THE DENVER METROPOLITAN AREA, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
S. R. Ellis, and M. H. Mustard.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4072, 1985. 31 p, 3 fig, 8 tab, 32 ref.

Descriptors: *Colorado, *Urban hydrology, *Urban runoff, Tributary basins, *Land use, *Rainfall, *Storm loads, Nutrients, Water quality, Load analysis, Denver.

The Denver metropolitan area has been the subject of urban-runoff studies for several years. The first studies, started in about 1968, usually were concerned only with the quantity of urban runoff. In 1974, studies were begun that included both quantity and quality of urban runoff. In 1979, Denver was selected as one of the cities to be included in the Nationwide Urban Runoff Program. The Denver study was called the Denver Regional Urban Runoff Program and was a cooperative study between the Denver Regional Council of Governments and the U.S. Geological Survey. This report presents the major conclusions of the pre-Denver Regional Urban Runoff Program studies and a summary of the various elements of the Denver Regional Urban Runoff Program. The report summarizes and references urban-runoff studies in the Denver metropolitan area and is a reference guide for planners and other persons interested in urban runoff. (USGS)
W86-02875

EFFECTS OF APPLIED WASTEWATER ON GROUND-WATER QUALITY AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO,

Geological Survey, Pueblo, CO. Water Resources Div.
P. Edelmann.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4268, 1984. 32 p, 12 fig, 4 tab, 15 ref.

Descriptors: *Groundwater quality, Nitrogen degradation, Applied wastewater, Land treatment, *Land disposal, Water pollution sources, Fort Carson Military Reservation, Colorado Springs, *Colorado.

Fort Carson Military Reservation has used treatment wastewater for irrigation of the Fort Carson golf course since 1971. The effect of applied wastewater on groundwater quality at Fort Carson golf course was evaluated using water levels and water-quality data from 20 observation wells. The water-quality constituents analyzed included dissolved solids, major ions, nutrients, detergents, dissolved organic carbon, chemical and biological oxygen demand, and trace elements. Effects of the applied wastewater on ground-water quality for most constituents were obscured by large areal variations and by high concentrations of the constituents upgradient from the golf course. The sources of nitrogen observed in the ground water beneath the golf course were applied wastewater, applied fertilizer, leachate from the organic-rich shale, and from unknown upgradient sources. Nitrogen loading at the golf course from wastewater and applied fertilizer was estimated to be 18,900 pounds per year. After 10 years, less than 1 percent of the nitrogen applied was actually present in the ground water. Loss of nitrogen to the atmosphere as nitrous oxides, absorption, and to fixation by grass resulted in the much smaller concentrations observed in the ground water. (USGS)
W86-02877

QUALITY OF GROUND WATER IN AGRICULTURAL AREAS OF THE SAN LUIS VALLEY, SOUTH-CENTRAL COLORADO,

Geological Survey, Pueblo, CO. Water Resources Div.
P. Edelmann, and D. R. Buckles.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4281, 1984. 37 p, 11 fig, 4 tab, 24 ref.

Descriptors: *Water quality, *Groundwater, *Nitrites, *Nitrates, Groundwater contamination, Water pollution sources, *Colorado, San Luis Valley, Center, Rio Grande County, Alamosa County, Saguache County, Conejos County.

The quality of ground water in the principal agricultural areas of the San Luis Valley, south-central Colorado was evaluated using chemical analyses of water collected from 57 wells completed in the unconfined aquifer and from 25 wells completed in the confined aquifer. Ground water in both aquifers generally contains dissolved-solids concentrations of less than 500 milligrams per liter. In most areas, calcium is the principal cation in the ground water. Nitrite plus nitrate concentrations expressed as nitrogen, are generally less than 1 milligram per liter. However, the quality of ground water in certain areas may pose health and agricultural hazards. Water in the unconfined aquifer near Center contains high nitrite plus nitrate as nitrogen concentrations. The highest measured concentration in this area was 33 milligrams per liter. Water containing more than 1 milligram per liter of nitrite as nitrogen, or 10 milligrams per liter nitrate, as nitrogen, poses a potential health hazard for infants and should not be used for drinking. In addition, dissolved-solids concentration in the ground water in some areas is greater than 500 milligrams per liter and, if used for irrigation may reduce crop yields. (USGS)
W86-02878

RECONNAISSANCE OF WATER-QUALITY CHARACTERISTICS OF STREAMS IN THE CITY OF CHARLOTTE AND MECKLENBURG COUNTY, NORTH CAROLINA,

Geological Survey, Raleigh, NC. Water Resources Div.
W. H. Eddins, and J. K. Crawford.

Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-4308, 1984. 105 p, 24 fig, 27 tab, 24 ref.

Descriptors: Water quality, *Stream degradation, *Trace elements, *Nutrients, *Bacteria, Water pollution sources, Non-point sources, Point sources, *North Carolina, Charlotte, Mecklenburg County.

In 1979-81, water samples were collected from 119 sites on streams throughout the City of Charlotte and Mecklenburg County, North Carolina, and were analyzed for specific conductance, dissolved chloride, hardness, pH, total alkalinity, total phosphorus, trace elements, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc and biological measures including dissolved oxygen, biochemical oxygen demand, fecal coliform bacteria, and fecal streptococcus bacteria. Sampling was conducted during both low flow (base flow) and high flow. Several water-quality measures including pH, total arsenic, total cadmium, total chromium, total copper, total iron, total lead, total manganese, total mercury, total silver, total zinc, dissolved oxygen, and fecal coliform bacteria at times exceeded North Carolina water-quality standards in various streams. Runoff from non-point sources appears to contribute more to the deterioration of streams in Charlotte and Mecklenburg County than point-source effluents. Urban and industrial areas contribute various trace elements. Residential and rural areas and municipal waste-water treatment plants contribute high amounts of phosphorus. (USGS)
W86-02879

SEAWATER INTRUSION INTO COASTAL AQUIFER IN WASHINGTON, 1978,

Geological Survey, Tacoma, WA. Water Resources Div.
N. P. Dion, and S. S. Sumioka.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. Washington State Water-Supply Bulletin, 56, 1984. 13 p, 2 fig, 14 plates, 2 tab, 12 ref.

Descriptors: *Saline water intrusion, *Groundwater, Water quality, *Washington, Chlorides, Sea water.

The extent and severity of seawater intrusion in Washington was determined using chloride data from 1,289 wells in 14 counties of coastal Washington in 1978. In addition, comparisons were made of chloride concentrations in 680 wells sampled both in 1966-68 and in 1978 to determine long-term trends of intrusion. Seawater-intrusion conditions in 1978 were similar to those detected in the late 1960's; for the most part, intrusion continued to be only a local problem. Many of the counties surveyed in 1978, such as Clallam, Jefferson, Pierce, Thurston, and Whatcom Counties, had several areas of severe but localized intrusion. Chloride concentrations in other counties, such as Island and San Juan Counties, were moderately high throughout the coastal areas and suggest a more widespread problem. Many of the individual wells that yielded high-chloride water in the late 1960's had been abandoned or destroyed by 1978. Comparisons of chloride data from 1966-68 and 1978 indicate that, in general, concentrations decreased slightly. This decrease, however, could reflect seasonal differences caused by pumping patterns or climatic changes. (USGS)
W86-02882

CHEMICAL QUALITY OF GROUND WATER IN YOLO AND SOLANO COUNTIES, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02884

GEOHYDROLOGY AND GROUND-WATER QUALITY MONITORING NETWORK FOR THE LOWER MOJAVE RIVER VALLEY, CALIFORNIA,

Geological Survey, Santee, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02888

SUMMARY OF STATISTICAL AND TREND ANALYSES OF SELECTED WATER-QUALITY DATA COLLECTED NEAR THE BIG THICKET NATIONAL PRESERVE, SOUTHEAST TEXAS,

Geological Survey, Austin, TX. Water Resources Div.
F. C. Wells, and K. C. Bourdon.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-Filee Report 85-183, 1985. 11 p, 1 fig, 3 tab, 3 ref.

Descriptors: *Statistical analysis, *Water quality, Streamflow, Dissolved solids, *Texas, Dissolved oxygen, Biochemical oxygen demand, Nutrients, Trend analyses, Major ions, Minor elements, Indicator bacteria, Big Thicket National Preserve.

Statistical and trend analyses of selected water-quality data collected at three streamflow stations in the lower Neches River basin, Texas, are summarized in order to document baseline water-quality conditions in stream segments that flow through the Big Thicket National Preserve in southeast Texas. Dissolved solids concentrations in the streams are small, less than 132 milligrams per liter in 50 percent of the samples analyzed from each of the sites. Dissolved oxygen concentrations in the Neches River at Evadale (08041000) are generally large, exceeding 8.0 milligrams per liter in more than 50 percent of the samples analyzed. Total nitrogen and total phosphorus concentrations in samples from this site have not exceeded 1.8 and 0.20 milligrams per liter, respectively. Trend tests for dissolved solids and major ions indicate that small down-trends in total alkalinity, dissolved calcium, and hardness occurred in the Neches River at Evadale (08041000) and Pine-Island Bayou near Sour Lake (08041700). Small uptrends in dissolved sulfate were detected at all three stations in the study area. (USGS)
W86-02893

HYDROLOGY OF A SURFACE COAL MINED AREA IN RANDOLPH COUNTY, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
J. V. Borghese, and A. R. Klinger.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4256, 1984. 36 p, 9 fig, 7 tab, 19 ref.

Descriptors: *Coal mines, *Strip mines, Hydrologic aspects, *Surface water, *Groundwater, Water quality, Coal mining effects, *Illinois, Randolph County, *Water pollution sources.

Ground water was monitored from October 1980 to April 1983 and surface water was monitored from October 1980 to September 1982 in the 0.6-square-mile basin of Plum Creek Tributary in Randolph County, Illinois, to determine effects of surface mining for coal. During the study period, the basin was being surfaced mined. The mine pit advanced about 100 feet into the basin every month, reducing the basin's drainage area from an initial area of 0.6 square mile in October 1980 to 0.2 square mile in May 1982. The average daily flow of Plum Creek Tributary was 0.49 cubic foot per second. Periods of no flow occurred 18 percent of the time. Total recoverable iron at Plum Creek Tributary exceeded the Illinois Environmental Protection Agency's (IEPA) effluent standards. Mining activity may have been the cause. Ground-water levels of nine wells declined during the monitored period. The largest was a 35-foot decline in 16 months. Ground-water samples had dissolved-solids concentration that exceeded the IEPA's limit for potable supply for all geohydrologic units except the unconsolidated sand. Chloride concentrations exceeded IEPA's limits in all bedrock units except for a limestone unit. (USGS)
W86-02897

GEOHYDROLOGY OF THE CENTRAL MESILLA VALLEY, DONA ANA COUNTY, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02898

RECONNAISSANCE OF GROUND-WATER RESOURCES IN THE LOWER GUNNISON RIVER BASIN, SOUTHWESTERN COLORADO,

Geological Survey, Grand Junction, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02902

ESTIMATED WATER AND NUTRIENT INFLOWS AND OUTFLOWS, LAKE COCHITUATE, EASTERN MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
F. B. Gay.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4315, 1985. 59 p, 15 fig, 18 tab, 38 ref.

Descriptors: *Nitrogen, *Phosphorus, Surface runoff, Groundwater movement, *Runoff volume, Water budget, Hydrologic budget, *Lakes, *Water quality, Eutrophication, Precipitation, *Water pollution sources, *Nutrient loads, Water volumes, Lake Cochituate drainage basin, Sudbury River drainage basin, *Massachusetts.

Streamflow was the major source of water and nutrients (nitrogen and phosphorus) to Lake Cochituate, followed by ground water, and then precipitation during April 1978 through March 1979. Compared to all sources during that period, streams contributed 7,217 million gallons (a little over 82 percent) of water, 63,000 pounds (between 50 and 60 percent) of nitrogen, and 3,000 pounds (94 percent) of phosphorus. A little over 60 percent of all the water that entered Lake Cochituate flowed from Fisk Pond. This single source transported about 38,000 pounds of nitrogen and 2,000 pounds of phosphorus. Ground-water inflow to Lake Cochituate occurs along its shoreline except at the north end of Lake Cochituate's North Pond where natural seepage from the lake is occurring and at locations on the lake's Middle and South Ponds where municipal wells induce infiltration of lake water amounting to 1,228 million gallons for that period. Discharge of ground water to the lake was estimated to range from 462 to 816 million gallons and transported from 31,000 to 55,000 pounds of nitrogen and from 46 to 82 pounds of phosphorus. Bulk precipitation was estimated to contribute about the same volume of water to the lake as ground water but double its phosphorus load. However, the load of nitrogen, 8000 pounds, from bulk precipitation was the smallest of any source. (USGS)
W86-02904

RECONNAISSANCE EVALUATION OF CONTAMINATION OF THE ALLUVIAL AQUIFER IN THE EAST POPLAR OIL FIELD, ROOSEVELT COUNTY, MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4174, 1984. 29 p, 10 fig, 4 tab, 12 ref.

Descriptors: *Groundwater, Water quality, *Brine disposal, *Groundwater pollution, Observation wells, Surface water, Data collections, *Montana, Poplar River Valley, Poplar River, East Poplar oil field, *Oil field wastes, *Water pollution sources.

Water moving from north to south in the alluvial aquifer of the Poplar River valley becomes contaminated with sodium chloride in the area underlain by the East Poplar oil fields. Four types of ground water were identified in the study area. Type 1 is sodium bicarbonate water. Type 2 is sodium chloride water with varying quantities of

calcium and magnesium. Type 3 water contains sodium and chloride in significantly larger concentrations than Type 2. Type 4 water is the brine being injected into brine-disposal wells. Contamination of the alluvial aquifer is indicated by a brine-freshwater interface in the alluvium, by downstream increase in chloride concentration of the Poplar River, and by downstream change in water type of the Poplar River. Contamination also may be indicated by the distribution of iron and manganese concentrations in water from wells near a brine-disposal well. Possible sources of sodium chloride contamination in the alluvium are brine-disposal wells, pipelines, and storage or evaporation pits. The contamination can occur from leaks in the casing of disposal wells or in pipelines caused by the corrosive nature of the brine or from storage or evaporation pits that have been improperly sealed or have sustained tears in the sealing material. (USGS)
W86-02915

WATER-QUALITY INVESTIGATIONS OF THE JORDAN RIVER, SALT LAKE COUNTY, UTAH, 1980-82,

Geological Survey, Salt Lake City, UT. Water Resources Div.
D. W. Stephens.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4298, 1984. 45 p, 13 fig, 10 tab, 30 ref.

Descriptors: *Dissolved oxygen, Trace elements, *Coliforms, Streptococcus, *Pesticides, *Turbidity, Suspended soils, Water quality, *Utah, Jordan River, Salt Lake County, Urbanization.

Water-quality studies were conducted on the Jordan River, Utah, to investigate specific problems: dissolved oxygen, toxic substances, sanitary quality, and turbidity and suspended sediment. The dissolved oxygen decreased from 8 milligrams per liter at the Jordan Narrows to less than 5 milligrams per liter at 500 North Street. Chemical oxygen demand increased about 23 percent and biochemical oxygen demand increased 90 percent. Nearly 78 percent of the water samples analyzed for total mercury exceeded the State intended-use standard of 0.05 microgram per liter. Concentrations of ammonia, cadmium, copper, lead, and zinc exceeded the standards periodically. The pesticides DDD, DDE, DDT, dieldrin, methoxychlor, and 2,4-D were occasionally detected in bottom materials. Most were present in quantities of less than 15 micrograms per kilogram. Concentrations of three indicator bacteria (total coliform, fecal coliform, and fecal streptococcus) increased in a downstream direction. Concentrations of total coliform bacteria often exceeded 5,000 colonies per 100 milliliters and concentrations of fecal coliform bacteria often exceeded 2,000 colonies per 100 milliliters. The primary sources of turbidity in the Jordan River are Utah Lake and discharges from the wastewater-treatment plants. Large values of turbidity were measured at the Jordan Narrows with a summer mean value of 88 nephelometer turbidity units (NTU) and a winter mean value of 43 NTU. (USGS)
W86-02916

5C. Effects Of Pollution

ATTENUATION OF LEACHATE GENERATED FROM CO-DISPOSAL OF VOLCANIC ASH AND SOLID WASTE,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
K. E. Hartz, S. K. Bhagat, L. A. Starlin, H. V. Mott, and K. R. Krivanek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203990/AS, Price codes: A11 in paper copy, A01 in microfiche. Washington Water Rsearch Center Pullman, Report No. 60, May 1984. 254 p. 9 fig. 47 tab. 180 ref. C-00226. 14-34-0001-1457(1).

Descriptors: Volcanoes, Landfills, *Solid waste, Heavy metals, *Leachates, Groundwater pollution, Lysimeters, *Volcanic ash.

This project was performed in two parts. Part I consisted of analysis of the leachate character that was generated when volcanic ash and refuse were placed together in a landfill environment. Part I further considered the migration of metal through selected soil columns. Since heavy metals were of concern relative to leachate contamination, a separate study of leachate heavy metal removal was performed. Due to minimum surplus leachate generation from the lysimeters, coupled with some time constraints, conventional landfill leachate samples from a 'new' and an 'old' landfill were obtained and investigated. Part II of the investigation extended the scope beyond that which was proposed. Part I of the study described the leachate character from a codisposal landfill while Part II was an analysis of the feasibility of leachate treatment, in the event that heavy metals were a problem. The results are such that they may be applicable to leachate problems from landfills other than just those in which co-disposal is occurring. In general, the results of Part I indicate that the presence of volcanic ash will attenuate landfill leachate contamination, but may contribute to higher concentrations of selenium, lead, chromium, and arsenic.
W86-02432

EVALUATION OF NITROGEN AND PHOSPHORUS ENRICHMENT USING IN SITU ENCLOSURE BAGS WITH TEMPORAL INDIGENOUS PHYTOPLANKTON POPULATIONS,

Arkansas Univ., Fayetteville. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 2H.
W86-02449

TOXICOLOGICAL STUDIES ON AQUATIC CONTAMINANTS ORIGINATING FROM COAL PRODUCTION AND UTILIZATION: THE INDUCTION OF TOLERANCE TO SILVER IN LABORATORY POPULATIONS OF FISH AND THE CHRONIC TOXICITY OF NICKEL TO FISH EARLY LIFE STAGES,

Kentucky Water Resources Research Inst., Lexington.
W. J. Birge, J. A. Black, J. F. Hobson, A. G. Westerman, and T. M. Short.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214666/AS, Price codes: A03 in paper copy, A01 in microfiche. Research Report No 151, August 1984. 33 p, 2 fig, 9 tab, 35 ref. USGS G-844-02.

Descriptors: Aquatic environment, Aquatic populations, Toxins, Fish, Fish toxins, Mortality, Silver, Nickel, *Coal mining wastes, *Toxic wastes.

Aquatic toxicity studies were performed on two important coal-derived contaminants, silver and nickel. Silver was investigated with regard to metal-induced tolerance in laboratory populations of the fathead minnow (Pimephales promelas). Fish were exposed to acute silver concentrations following acclimation to sublethal exposures of this metal. Based on median lethal times (LT50), animals which had received 14 days prior to exposure to 1.5 and 15 micrograms Ag/L were three to four times more resistant to silver than were previously unexposed organisms. This metal-induced resistance was not a sustained response. After organisms which had been acclimated to 15 micrograms/L had been transferred to clean water for two weeks, LT50 values determined with these animals were statistically indistinguishable from those calculated with non-acclimated control fish. With respect to nickel, a 32-day continuous-flow test was performed with the fathead minnow. Nickel was administered in duplicate at six exposure concentrations ranging from 0.038 to 0.733 mg/L in medium-hard water (100 mg CaCO3/L). Animal test responses included mortality, teratogenesis, and growth. Based on frequencies of mortality after 32 days of continuous exposure, significant effects were recorded at a nickel concentration of 0.120 mg/L, and the no observed effect concentration (NOEC) was determined to be 0.057 mg Ni/L.
W86-02470

EFFECTS OF GRAVEL EXTRACTION ON THE MEADE RIVER AT ATQASUK, ALASKA,

Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 5B.
W86-02475

MERCURY IN PEAT AND ITS DRAINAGE WATERS IN EASTERN NORTH CAROLINA,

Duke Univ., Beaufort, NC. Marine Lab.
For primary bibliographic entry see Field 5A.
W86-02485

EFFECTS OF DISINFECTION TECHNIQUES ON CHESAPEAKE BAY SEDIMENTS,

Maryland Univ., Solomons. Chesapeake Biological Lab.
A. D. Uhler, S. M. Baksi, C. B. Daniels, and J. C. Means.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214849, Price codes: A04 in paper copy. A01 in microfiche. Maryland University, College Park, Water Resources Research Center, Publication No. 82, September, 1983. 49 p, 6 tab, 17 fig, 38 ref. USGS G847-03.

Descriptors: *Maryland, *Chesapeake Bay, *Disinfection, *Chlorination, Ozonation, *Sediments, Toxicity, Water pollution effects, Toxic wastes.

This report describes the chemical reactivity of Chesapeake Bay sediments with dissolved chlorine, and assesses the products of chlorination for potential mutagenicity. At pH 7, and 0% salinity the average chlorine demand of Potomac River sediment was 0.07 mole HOCl/mole adsorbed organic carbon. Trihalomethanes (THM) were produced upon chlorination, the speciation of which are a complex function of salinity. Along the salinity gradient 0-30%, THM production reaches a maximum at 5% salinity, then rapidly falls off with increasing salinity. Patapsco River sediments were found to contain both frameshift and base-pair substitution mutagens, with a higher level of mutagenic activity associated with sediments collected from a highly industrialized portion of the river. At lower chlorine concentrations, chlorine treatment caused an increase in mutagenic activity in some sediments. At higher concentrations, this relationship was masked by cytotoxicity.
W86-02487

IMPACT OF POINT AND NON-POINT NUTRIENT ENRICHMENT ON THE DYNAMICS OF NATURAL PHYTOPLANKTON,

Maryland Univ., Solomons. Chesapeake Biological Lab.
C. F. D'Elia, J. G. Sanders, and W. R. Boynton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214856, Price codes: A04 in paper copy, A01 in microfiche. Maryland University, College Park, Water Resources Research Center, Publication No. 83, September, 1983. 50 p, 6 tab, 16 fig, 17 ref. USGS G847-05.

Descriptors: *Nutrients, Enrichment, *Phytoplankton, *Maryland, Species composition, Productivity, Oxygen requirements, Nitrogen, Phosphorus, Cultures, Eutrophication, Seasonal variability.

0.5-m3 outdoor, continuous cultures, innoculated with indigenous phytoplankton from the Patuxent River estuary, Maryland were used in a series of bioassay experiments to determine nutrient enrichment potential. Biomass increased in response to the addition of a growth-limiting nutrient in the form of NO-3, NH+4, or PO4 3- to the 1.0-um filtered river water contiuously supplied to the cultures at 0.5 culture volumes/day. During the warmer, low flow seasons, NH+4 addition typically enhanced phytoplankton growth in experiments lasting two weeks each. During the late winter, high flow season, PO4 3- addition enhanced phytoplankton growth, but owing to low solar irradiance, levels of biomass reached were less than at other seasons. Replicability between triplicate tanks was excellent; biomass levels in them typically were within 20% of each other.

The results suggest that concomitant with great seasonal variability in nutrient supplies and concentrations in the river is great variability in the probable response of indigenous phytoplankton to additional nutrient enrichment. The information gained in this project should have relevance to understanding the effects of nutrient inputs to the Patuxent River.
W86-02488

ACID PRECIPITATION: SOURCE IDENTIFICATION AND ITS EFFECTS ON WATER QUALITY,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W86-02491

ACUTE EFFECTS OF ALUMINUM AND ACIDITY UPON NINE STREAM INSECTS,

New Hampshire Univ., Durham. Dept. of Zoology.
J. F. Haney, and W. Cook.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214948/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, New Hampshire Water Resources Research Institute, Curham, Research Report No. 46, Sept 1984. 33 p, 10 fig, 1 tab. USGS G856-03.

Descriptors: *New Hampshire, *Water pollution effects, *Acid rain, *Aluminum, Stream insects, Stream drift, Aluminum toxicity, Insect mortality, *Hydrogen ion concentration.

The effects of increased aluminum concentrations and decreased pH upon the larval stages of five caddisflies, two mayflies, a stonefly, and a beetle were tested. These insects were removed from two riffle habitats in southern New Hampshire, placed into artificial streams and subjected to additions of aluminum salts and sulfuric acid for a three-day period. Acute mortality and the drifting behavior over this three-day period were then analysed using multiple linear regression. Aluminum additions caused increased mortality in the stonefly Nemoura nigratta and the caddisfly Macronema spp.; aluminum additions also increased the drift of the caddisfly Potamia flava, but the response was small and likely due to the increased salinities in aluminum treatments. Aluminum, hydrogen ions, and their interaction affected the drifting behavior of the water penny beetle, Psephenus herricki. While concentrations of aluminum and hydrogen ions did not affect the drift of the mayfly Stenonema spp., high variability of aluminum concentrations caused increased drift for this genus; Macronema spp. also showed increased drift in response to large variations in aluminum concentrations. The effect of aluminum upon molt success was minor, but the effect of high acidity upon molt success was pronounced.
W86-02497

WATERSHED INTERACTIONS AFFECTING POND ACIDIFICATION,

New Hampshire Univ., Durham. Water Resources Research Center.
For primary bibliographic entry see Field 2K.
W86-02498

ACID PRECIPITATION IN THE WASHINGTON CASCADES, PHASE II,

Central Washington Univ., Ellensburg. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-02513

INTRAGRAVEL BEHAVIOR OF SALMONID ALEVINS IN RESPONSE TO ENVIRONMENTAL CHANGES,

Washington Univ., Seattle. Fisheries Research Inst.
D. E. Fast, and Q. J. Stober.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215127/AS, Price codes: A06 in paper copy, A01 in microfiche. Technical Completion Report FRI-UW-8414, Washington Water Resources Research Institute, Pullman, December 1984. 116 p, 28 fig, 21 tab, 108 ref. USGS G876-04.

Descriptors: *Salmon, Trout, Growth, Fish eggs, Water level fluctuations, *Fish behavior, *Water pollution effects, *Environmental effects, *Washington.

The purpose of this research was to study the morphologic development, survival, and behavior of chum, coho, and chinook salmon, and steelhead trout alevins from hatching through yolk absorption. The ability of alevins to respond adaptively to conditions of environmental stress was determined and a comparison of responses between species was made. The metabolic rates of chum, coho, and steelhead alevins were measured with a respirometer. All three species increased the amount of oxygen consumed per gram of total dry weight from hatching through yolk absorption. The LT50's of alevins subjected to single, long-term dewaterings were directly related to time in days after hatching. The decrease in survival time was attributed to increased metabolic rate and decreased yolk sac size. The highly vascularized yolk sac surface acted as a secondary respiratory organ when gill respiration was limited due to dewatering. Downware intragravel movement of alevins occurred within 48 hours of hatching under conditions of adequate velocity, dissolved oxygen, and darkness. The differences in number of alevins moving was attributed to size. Alevins of all four species demonstrated poritive rheotaxis by migrating into the current. Photobehavioral studies indicated that negative photoresponses increased as morphological development progressed. A transition from photonegative to photopositive behavior occurred before initiation of emergence from the gravel in each species. The transition to photopositive behavior was most rapid in chinook alevins, intermediate in chum and coho, and slowest in steelhead trout.
W86-02515

BIOLOGICAL NEUTRALIZATION OF ACID DEPOSITION IN OMBROGENOUS AND MIEROTROPHIC WETLANDS,

Massachusetts Univ., Amherst. Water Resources Research Center.
T. P. Army, and H. F. Hemond.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216901/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Massachusetts Water Resources Research Center, Publication No. 149, Amherst, January, 1985. 47 p, 3 fig, 5 tab, 42 ref, 2 append. USGS G848-03.

Descriptors: *Wetlands, *Bogs, *Sulfur, *Sufates, *Acid deposition, *Pore water *Acid rain, *Mass transfer, *Marshes, Stauration, Watersheds, Hydrology, Chemical analysis, *Massachusetts, Quabbin Reservoir, Bickford Reservoir.

The magnitude of net neutralization of atmospherically deposited acid in an ombrogenous wetland ecosystem was assessed using ion chromatographic analysis of the porewaters, laboratory incubations for sulfate and nitrate uptake under oxic and anoxic conditions, and lead-210-based deposition rates for solid sulfur species, together with rigorous statistical treatment of porewater data and an annual-averaged mass transport model for sulfate. Results indicate a biologically-dominated sulfate distribution exists in the primary study site, with nearly complete transformation of sulfate deposition within centimeters of the bog/atmosphere interface. The major product appears to be a solid phase organic sulfur species having a very long residence time in the wetland. In addition, a measurable amount of soluble organic sulfur is produced. By contrast, porewater chemistry at a second study site, a minerotrophic marsh, failed to show evidence of significant long-term sulfate transformation. It is hypothesised that hydrologic differences are responsible for the observed differences in behavior of the two systems. While the ombrogenous site remained essentially saturated throughout the year, the minerotrophic site may have experienced some desaturation, resulting in reoxidation of sulfur.
W86-02521

EFFECTS OF ACIDITY ON TREE POLLEN GERMINATION AND TUBE GROWTH,

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
D. M. Van Ryn, and J. S. Jacobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216976/AS, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, August 1984. 24 p, 4 tab, 1 fig, 18 ref. USGS G859-04.

Descriptors: *Pollen germination, *Pollen tube growth, *Acid rain, Northeastern hardwoods, Pollution effects, *New York.

Most of the northeastern hardwood forests in North America are exposed repeatedly to acidic rainfall at pH values below 5.0. Pollen germination, tube growth and fertilization, important parts of the reproductive process, are sensitive to changes in their chemical environment. Accordingly, we investigated the effects of acidity on pollen germination and tube elongation of four northeastern species, flowering dogwood, black birch, yellow birch, and sugar maple. Pollen was collected and germinated in a growth medium that was acidified to pH values ranging from 5.0 to 2.6. Pollen was found to be sensitive to acidification of the germination medium to below pH 4.2. At pH 3.0 and 2.6 no pollen germinated in any species. Between pH values 4.2 and 3.4, percent germination was reduced by over 50% from that at pH 5.0. Mean tube length was reduced at the lowest pH at which germination occurred. The pH of the growth medium increased during pollen germination to at least 5.2 when initial pH values were 3.8 and above. These results suggest that acidic rain that now occurs in eastern North America may influence reproductive processes that are necessary for seed set and regeneration in northern hardwood forests.
W86-02528

USE OF INDUCED FLUORESCENCE MEASUREMENTS TO ASSESS ALUMINUM-ORGANIC INTERACTIONS IN ACIDIFIED LAKES,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. D. Philpot, J. J. Bisogni, and A. Vodacek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216984/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, August 1984. 18 p, 10 fig, 15 ref. USGS G859-05.

Descriptors: *Acid rain, *New York, *Pollutant identification, Fluorescence measurements, Laser fluorosensing, Remote sensing, Dissolved organic matter, Aluminum, Acidified lakes.

Aluminum, which can be highly toxic in the free state, is often innocuous when associated with the dissolved organic substances (humic substances) common to natural waters. This is of particular significance in the acidified lakes of the Adirondack region of New York State since metals, notably aluminum, lose their attraction for the organics at lower pH. Natural fluorescence of the humic substances may provide a tool for monitoring aluminum. The characteristic fluorescence is reduced (quenched) when trace metals are associated with the organics. Laboratory experiments were conducted using both natural water samples and samples prepared in the Laboratory, in which fluorescence of humic substances was observed for varying concentrations of metals and at several pH levels. Fluorescence quenching was observed with the addition of Al, Fe, and Cu. Variations in pH also affected the quenching. In the absence of metal ions, the quenching effect was negligible. When metal ions (Al) were present the quenching effects of pH were more pronounced. Results suggest that the use of remote sensing to monitor aluminum-organic interactions is feasible although several important problems concerning interference of other metals and pH effects remain to be explored.

W86-02529

EFFECTS OF ACID PRECIPITATION ON COMPOSITION, ELECTROKINETIC BEHAVIOR, CATION ADSORPTION AND ION EXCHANGE CAPACITY IN VARIOUS SOIL SYSTEMS,

Tennessee Water Resources Research Center, Knoxville.
A. R. Bowers, and T. Higgs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217727/AS, Price codes: A05 in paper copy, A01 in microfiche. Research Report No. 103, September 1984. 82 p, 45 ref, 23 fig, 6 tab, 2 append. USGS G870-03.

Descriptors: *Acid rain, Ion exchange, Adsorption, Soil environment, Cations, Iron oxides, Hydrogen ion concentration, *Tennessee, *Water pollution effects.

The effects of acidic environments on the physical/chemical behavior of natural soils from Tennessee was examined in the laboratory. Primarily, the influence of increased weathering of iron oxides on electrokinetic behavior, cation exchange capacity and adsorption of 'free' and complexed heavy metals was studied. Natural soils, compared to samples in which iron oxides were removed showed little change in cation exchange capacity or electrokinetic behavior. Acid aging of one particular soil was also conducted. Studies showed that prolonged exposure to acidic environments may result in drastic changes in soil properties. Substantial changes in the electrokinetic behavior were found with the zero point of charge increaisng from a pH of 2.0 for the unaged soil to 8.0 for the acid aged one. Also, the zinc adsorptive behavior of the soils changed significantly with acid aging. This study indicates that prolonged exposure to acidic environments may create changes in physical/chemical properties of soils rich in iron oxides.
W86-02537

NUTRIENT ASSIMILATION CAPACITY OF SHALLOW COASTAL LAKES,

Louisiana Water Resources Research Inst., Baton Rouge.
R. D. DeLaune, C. J. Smith, W. H. Patrick, and M. N. Sarafyan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219004/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, August 1984, 62 p, 3 tab, 28 fig. USGS G845-02.

Descriptors: *Louisiana, Water quality, *Nonpoint source pollution, *Nutrient cycling, Nitrification-denitrification, Toxic organics, Sedimentation, P adsorption, Chlorophyll, Freshwater lakes.

Nitrogen and phosphorus cycling in relation to the trophic state of coastal freshwater lakes was studied. Nonpoint source nutrient inputs, as well as sediment-interstitial and lake water nitrogen and phosphorus fluxes, were measured seasonally. Sedimentation rates in the lake were determined using Cs-137 dating. Levels of toxic organics and fate of 2,4-D in the water bodies were determined. Phosphorus and nitrogen levels in the lake were found to be largely dependent on concentrations in the incoming bayou water from upland drainage. Nitrogen fixation on the order of 20-30 Hg/g/yr was measured. C-14 uptake studies indicated appreciable assimilation of nitrogen and phosphorus by phyto-plankton. Laboratory equilibrium studies showed bottom sediments in the lake are a major sink for the incoming dissolved orthophosphate phosphorus. Total nitrogen concentrations in water draining into the lake generally exceeded concentrations in the lakes. N-15 balance studies along with in situ and in vivo denitrification studies showed that the bottom sediment of the lakes remove appreciable nitrogen via nitrification-denitrification processes. Sedimentation ranged from 1.1 cm/yr to 1.8 cm/yr. Even though the lake is eutrophic the sediment served as a buffer by removing large amounts of nitrogen and phosphorus through sedimentation processes. Levels of toxic organic in the lakes were low. The herbicide 2,4-D which enters these lakes was found to be rapidly adsorbed from the water column by bottom sediment. The sediment oxidation-reduction potential influenced its degradation rate with degradation being considerably slower under anaerobic conditions. Results indicate that any increase in nutrient loading to the lakes has the potential to further aggravate the eutrophication problem.
W86-02547

EFFECTS OF POLLUTION ON GROWTH OF MIDWESTERN MUSSEL SHELLS,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
G. D. Rosenberg, and M. T. Henschen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225878/AS, Price codes: A02 in paper copy, A01 in microfiche. Technical Report No. 168, August 1984. 13 p, 7 ref. USGS G841-05.

Descriptors: *Mussels, *Bioindicators, *Indiana, Water pollution effects, Mississippi River, Wisconsin.

Exporters of freshwater mussel shells to the Japanese cultured pearl industry report that stains within the inner shell layers are appearing with increasing frequency. Chemical (electron microprobe) analyses of the stains suggest that the stains are due to pollution, and that mussel shells may be useful indicators of water quality. Although several species of mussels from several Midwestern states (including Indiana, Illinois, Wisconsin, Minnesota, and Iowa) were studied the focus of this report is the Threeridge (Amblema plicata) from the Minnesota--Wisconsin--Iowa area of the Mississippi River between LaCrosse and Prairie du Chien, Wisconsin. Chemical analyses reveal the presence of aluminum and silicon (clay minerals) in the stains, confirming previous suggestions that mussels are sensitive to turbidity. But the presence of unusual amounts of iron, phosphorus, sulfur, chlorine and perhaps even magnesium, nickel, sodium, and potassium point to the increased deleterious effects that a combination of pollutants can have in a synergistic system. Here, increased turbidity due to increased river traffic or farming combined with metal pollutants results in the metals being concentrated by adsorption to the clay minerals. Grossly unnatural phosphorus and sulfur concentrations in the shell indicate a consequent disturbance of calcium physiology.
W86-02563

EVALUATION OF NON-POINT POLLUTION CONTROL PRACTICES AND COPPER TREATMENTS ON CONTROL OF NUISANCE FILAMENTOUS ALGAE,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W86-02564

EFFECT OF WATER QUALITY ON THE UPTAKE AND LOSS OF BIOLOGICALLY IMPORTANT ORGANIC AND INORGANIC CHEMICALS BY ORGANISMS,

California Univ., Davis. Water Resources Center.
J. H. Swinehart, and J. H. Crowe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225894/AS, Price codes: A02 in paper copy, A01 in microfiche. Technical Completion Report, California Water Resources Center, Davis, January 1985, 12 p. USGS A-083-CAL.

Descriptors: *Pollutants, *Contamination, *Heavy metals, *Amino acids, *Carbohydrates, *Organic pesticides, Water quality, Acids, Metals, Absorption, Chemicals, Bioindicators, *California.

The objectives of this work are to measure the effects of water contaminants such as heavy metals, acids, and organic pesticides on influxes of glycine into and effluxes of amino acids, carbohydrates, and metal ions from membranes of marine and freshwater organisms, and to use these results to measure changes in water quality. The general conclusions reached from this work concerning the use of membrane fluxes to measure water quality are the following: First, for freshwater and marine organisms having an active transport process for the influx of an amino acid such as glycine, a deterioration in water quality due to the introduction of heavy metal ions, acid or organic contaminants results in the uptake of glycine. Second, for freshwater organisms, effluxes of the divalent cations Ca(+2) and Mg(+2) are enhanced by heavy metal ions and acid at low concentrations indicating reduced membrane stability which ultimately results in the loss of amino acids. Third, Hg(+2) compounds at extremely small concentrations cause large losses of amino acids from both marine annd freshwater organisms, and the observation of large amino acid losses from organisms in natural waters is a measure of Hg(+2) contamination. (Snyder-California)
W86-02565

TEMPERATURE REQUIREMENTS OF PACIFIC COASTAL STREAM FISHES,

California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
P. B. Moyle, and N. K. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225928/AS, Price codes: A03 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Sept. 1984, 30 p, 10 fig, 4 tab, 47 ref. G830-03.

Descriptors: *Temperature effects, *Temperature, *Fish, *Trout, *Sculpin, *Sucker, *Perch, *Habitat, Streamflow, Streams, Water depth, Velocity, *California.

The importance of temperature in regulating the abundance and distribution of fishes has been well-documented, although primarily for species from the eastern United States and Canada. Three sets of experiments were used to define the thermal niches of Pacific Coastal fishes - acute temperature preferences, routine metabolic rates, and critical thermal maxima. Plots of standard deviations of preferred temperatures at each acclimation temperature provided an estimate of the relative activity of each species, both intraspecifically and interspecifically. Routine metabolic rates were highest and most variable for squawfish, and most gradual (with increasing temperatures) for hardhead. Critical Thermal Maxima (CTM) generally increased with increasing acclimation temperatures for each species. Man-made alterations, such as diversion dams, channelization, or removal of riparian vegetation can change stream thermal regimes that reduce the efficiencies of these fish activities, or in extreme cases, threaten their survival. Along with temperature changes from these alterations are usually changes in oxygen levels of the water, which may be stressful to the resident species. The critical thermal maxima can be used to detect sublethal doses of pollutants or the presence of disease before mortalities occur. (Snyder-California)
W86-02568

DEVELOPMENT OF FREQUENCY FUNCTIONS FOR URBAN NON-POINT SOURCE RISK EVALUATION,

Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02575

PHYTOPLANKTON CONTROL AND WATER QUALITY IMPROVEMENT THROUGH MANIPULATION OF ANIMAL COMMUNITIES,

Nebraska Univ.-Lincoln. Dept. of Forestry, Fisheries and Wildlife.
G. L. Hergenrader.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227189/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Nebraska Water Resources Center, Lincoln, September 1984. 24 p, 5 tab, 7 ref. USGS G854-03. 14-08-0001-G854.

Descriptors: *Nebraska, *Plankton control, Water quality control, Water quality, *Eutrophication, *Predation, *Water clarity, Zooplankton, Phytoplankton, Biomanipulation, Piscivore, Planktivore.

This was a pilot study to demonstrate the feasibility of improving water quality in surface waters by enhancing natural zooplankton grazing on phytoplankton through manipulation of fish communities. Piscivorous northern pike (Esox lucius) were introduced to two eutrophic farm ponds in eastern Nebraska containing large populations of planktivorous black crappie in an effort to evaluate the effects of controlled planktivore predation on zooplankton and phytoplankton communities. Data collected from this treatment were compared to previous research on these ponds when they either lacked a fish population, contained only planktivorous black crappie, or contained both black crappie and northern pike. The stocking of piscivorous northern pike in the study ponds resulted in a marked decline in the immature black crappie densities of both ponds. This predation pressure was supplemented by wash-out of crappie during spring rains which caused both ponds to release water. As black crappie densities were reduced, a shift in the species composition and size distribution of the zooplankton community was observed in both ponds; as rotifers were reduced in dominance and crustacean zooplankton became prevalent. Concurrent with this shift in zooplankton community structure was a slight increase in overall water clarity, supporting our hypothesis concerning enhanced water quality. However, phytoplankton biomass reached higher levels throughout the year in both ponds, as compared to previous years.
W86-02583

DEVELOPMENT OF A CHLOROPHYLL MONITORING PROGRAM FOR WATER SUPPLY RESERVOIRS USING IN VIVO FLUORIMETRY,

Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5F.
W86-02661

MICROBIAL SURVIVAL IN CURED MUNICIPAL COMPOST,

New Hampshire Univ., Durham.
G. R. Zamarchi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249068/AS, Price codes: A05 in paper copy, A01 in microfiche. A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Microbiology, September 1982. 84 p, 10 fig, 13 tab, 1 append, 23 ref. B-006-NH.

Descriptors: *Sewage, *Sewage bacteria, *Sludge, *Municipal wastes, *Composting, *Survival, Salmonella, Coliforms, Streptococcus, Fungi, Aspergillus fumigatus.

Two studies were conducted to assess factors affecting survival of salmonellae in cured municipal compost. In the first study, Salmonella heidelberg was seeded into finished compost and finished compost mixed with soil. These seeded samples were monitored for salmonellae survival over a six-month period. Fecal coliforms and fecal streptococci were monitored to evaluate their usefulness as indicators of salmonellae survival. At the same time, pH, moisture content, and the survival of a fungus, Aspergillus fumigatus, were measured. The bench scale study was an attempt to measure the effect of different quantities and qualities of soil on salmonellae survival by varying the amounts and type of soil in seeded compost/soil mixtures, as well as the effect of temperature. As part of this study, fecal coliforms, fecal streptococci, pH, and moisture content were also measured. The results show that competition from indigenous fecal coliforms and fecal streptococci accounted for the inability of salmonellae to survive in the field experiments. This competition was absent from the bench scale studies. Lack of survival under the bench scale conditions can be attributed mainly to desiccation. The indicator organisms appeared to have no practical application as such under either field or bench scale conditions. The A. fumigatus population remained constant throughout the study. The changes in pH, temperature, or quantity and type of soil present had no discernible effect.
W86-02685

EFFECTS OF SUSPENDED SEDIMENTS ON STREAM INVERTEBRATE DETRITAL PROCESSING AND BIOENERGETICS,

Idaho Univ., Moscow. Dept. of Plant, Soil and Entomological Sciences.
M. A. Brusven, and C. E. Hornig.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249142/AS, Price codes: A03 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, Moscow, Completion Report, May, 1984. 22 p, 4 fig, 4 tab, 27 ref. USGA G839-02. 14-08-0001-G839.

Descriptors: *Aquatic insects, *Suspended sediments, Growth, Feeding rates, *Water pollution effects, Idaho.

The effects of suspended sediments on stream invertebrate detrital processing and bioenergetic parameters were investigated in replicated, light and temperature-controlled chambers in the laboratory. The leafshredding insects Pteronarcys californica and Hesperophylax occidentalis were studied. Mean daily ingestion rates were less among test insects than control insects for seven of the eight trials. In five of the eight trials, mean ingestion rates were suppressed by >41% when compared to insects held in 0.0 g/l suspended sediment environments. Feeding inhibition was typically greater at the end of the feeding trials (14 days) than at the beginning (0-4 days). Growth of the immature feeding stage of the insects studied in both test and control environments for all trials combined was negligable when compared to their ingestion rates. Mean daily growth rates ranged from -1.2% to 1.6% of the mean daily ingestion rates. The mean assimilation efficiencies of second-year naiads of P. californica were 17.4% and 21.3% when subjected to 3.0 g/l and 0.0 g/l suspended sediment concentrations, respectively.
W86-02693

TRANSFER OF INFORMATION AND TECHNOLOGY ON ACID MINE DRAINAGE FROM RESEARCH TO THE USER,

West Virginia Univ., Morgantown. Water Research Inst.
For primary bibliographic entry see Field 5B.
W86-02711

EFFECTS OF IRON IN STREAMS ON GILL MORPHOLOGY, OXYGEN CONSUMPTION, AND PHYTOPLANKTON/BENTHIC INVERTEBRATE DISTRIBUTION,

West Virginia Univ., Morgantown. Water Research Inst.
E. C. Keller, D. E. Hinton, D. K. Werner, R. B. Gerber, and A. J. Becker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101326/AS, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, 1984. 163 p, 53 fig, 71 tab, 48 ref. USGS G877-202. 14-08-0001-G877.

Descriptors: *West Virginia, *Acid mine drainage, Iron, Water quality standards, *Ecological effects, Fish, Benthic fauna, Bioassay, Histology, Pathology, Phytoplankton, Aquatic life, Invertebrates, Ecology, Ecosystems, Manganese, Chemical properties, Acidity, Oxygen, Water pollution effects.

This project covered many aspects of the influence of iron on aquatic organisms at a four-tier level: cellular, phytoplankton, invertebrate, and fish. One other section dealt with the statistical distribution of total iron in the waters of West Virginia. The iron content of the waters, along with manganese and conductivity, were associated with mucous cell structure changes in trout perch and bluntnose minnow. Iron, along with pH was associated with changes in the mucous-cell structure of the creek chub. Iron, with pH and total hardness, was strongly associated with the total numbers of phytoplankton in the waters. Iron, along with pH and dissolved oxygen, was associated with the total numbers of fish. An iron/acidity index of the waters studied was strongly associated with a diatom phytoplankton index and the 'Tenmile Creek' and the 'high diversity' benthic invertebrate indices. Higher iron levels were found to increase oxygen consumption rates in the amphipod Gammarus minus. Finally, the average level of iron and the frequency of exceeding the 1 mg/L total iron water quality limit in natural waters were both found to be dependent upon the region of the state from which the water samples were obtained. Overall, about 30 percent of the time, the 1 mg/L regulatory limit was exceeded from water sampled throughout the state.
W86-02713

EFFECTS OF COAL MINING ON THE WATER QUALITY AND SEDIMENTATION OF LAKE TUSCALOOSA AND SELECTED TRIBUTARIES, NORTH RIVER BASIN, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
E. F. Cole.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4310, 1985. 53 p, 34 fig, 4 tab, 23 ref.

Descriptors: *Water pollution sources, *Water pollution effects, *Lakes, *Mine drainage. Water quality, *Sedimentation, Limnology, Reservoir deposition, Water quality standards, *Alabama, North River basin.

Lake Tuscaloosa, a reservoir on North River, is the primary source of water supply for the city of Tuscaloosa, Alabama, and surrounding areas. Between October 1982 and September 1983, 14 sites in the North River basin were sampled to determine if surface coal mining has impacted the quality of water in the lake and selected tributaries. Water draining mined basins showed increases in specific conductance, sulfate concentrations, and dissolved and total recoverable iron and manganese concentrations after mining started in 1975. Although water in the reservoir has become more mineralized with only an estimated 5 percent of the basin mined, total dissolved solids concentrations are still very low, ranging from 28 to 35 milligrams per liter at the dam. The quality of water at most sites was, except for pH, iron, and manganese, within secondary drinking water standards. The pH of water from streams draining either mined or unmined basins was generally less than 6.5. Sedimentation has occurred at most measured lake cross sections since impoundment. However, natural factors such as steep overland and channel slopes, may cause more sedimentation in the lake from unmined basins than from coal mining in a different basin. (USGS)
W86-02863

ESTIMATED WATER AND NUTRIENT INFLOWS AND OUTFLOWS, LAKE COCHITUATE, EASTERN MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02904

5D. Waste Treatment Processes

DESTRUCTION OF HAZARDOUS WASTES BY ULTRAVIOLET CATALYZED OXIDATION,

Connecticut Univ., Storrs. Inst. of Water Resources.
D. W. Sundstrom, and H. E. Klei.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-265090, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, September 1984. 18 p, 7 fig, 11 ref. USGS G832-02. 14-08-0001-G-832.

Descriptors: *Chemical degradation, *Ultraviolet radiation, Hazardous materials, *Oxidation process, Ultraviolet catalyzed oxidation, *Wastewater treatment, *Benzene, Hydrogen peroxide.

Conventional wastewater treatment processes are ineffective on many hazardous organic compounds found in domestic water supplies and industrial wastes. This project investigated the destruction of benzene in water by ultraviolet catalyzed oxidation with hydrogen peroxide. The reactions were conducted in a tubular flow reactor equipped with a low pressure mercury lamp to provide the ultraviolet radiation. The course of the reactions with time were followed by analyzing for benzene with a gas chromatograph and for hydrogen peroxide by a colorimetric method. The rate of disappearance of benzene increased with increasing hydrogen peroxide concentration and ultraviolet light intensity but was relatively insensitive to temperature. Starting with 10-15 ppm benzene, concentrations were reduced below 50 ppb in 35-60 min reaction time.
W86-02421

INVESTIGATION OF METHODS FOR THE IMPROVEMENT OF THE ABSORPTION FREEZE PILOT PLANT OPERATION,

Burns and Roe Industrial Services Corp., Paramus, NJ.
A. C. F. Ammerlaan, and A. Ko.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128759, Price codes: A08 in paper copy, A01 in microfiche. Completion Report August 1984, 102 p, 19 tab, 7 fig, 3 app. C-3001-S. 3-CR-93-00040(1).

Descriptors: *Desalination, *Absorption Freezing, Absorption Freezing Vapor Compression, *Waste Heat, Waste Heat Absorption Freezing, Pilot Plant, Absorbents, Heat Transfer, Energy Consumption, Commercial applications.

The operational experience and the present condition of the Absorption Freezing Vapor Compression (AFVC) Pilot Plant in Wrightsville Beach, NC, were reviewed in order to develop methods that would improve efficiency and reliability. The mechanical components of the AFVC plant that are restricting the AFVC plant performance were identified and solutions were proposed. The possibilities of operating the plant with different absorbents and with waste heat were explored and established. The present absorbent consists of a 15% sodium chloride solution. Lithium chloride and tri- or tetra ethylene glycol were investigated for their potential as new absorbents. Glycol solutions allow operation in the 100 - 120F range thus allowing the use of waste heat and operation in the Waste Heat Absorption Freezing (WHAF) mode. A comprehensive heat transfer calculation method was developed to determine the effects of the higher viscosity of clycol solutions on heat transfer rates. Both the AFVC and WHAF process were reviewed for their commercial potential by reviewing the specific energy consumption and their applicability for desalination, waste effluent treatment and food processing. If waste heat is available the WHAF process could be a very attractive process for waste effluent treatment and the production of process water.
W86-02422

INVESTIGATION OF POSSIBLE CYCLES OF CONCENTRATION IN INDUSTRIAL COOLING TOWERS USING VARIOUS COMBINATIONS OF TREATMENT PROCESSES TO RENOVATE MUNICIPAL WASTEWATER FEED,

Montgomery (James M.), Inc., Pasadena, CA.
M. D. Umphres, G. P. Treweek, R. R. Trussell, and J. S. Gregg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128767, Price codes: A10 in paper copy, A01 in microfiche. Report No. OWRT/RU-83-9, January 1984. 151 p, 78 fig, 20 tab, 2 append. OWRT C-90139-R. 14-34-0001-9459(1).

Descriptors: *Water reuse, *Wastewater renovation, Cooling water, Corrosion, Scaling, *Cooling towers.

The objective of this investigation was to demonstrate the use of reclaimed secondary effluent as makeup to industrial cooling towers. The raw wastewater was treated by low pH lime precipitation, activated sludge aeration, secondary clarification, and filtration. This effluent was pumped through sodium ion exchangers to remove divalent cations, particularly calcium, then treated internally within the cooling tower loop with either an acid-chromate or alkaline-inhibitor program. The effectiveness of the two internal treatment programs was compared with each other and with a baseline program which provided no additional pretreatment. The acid-chromate program was the most successful in the three principal areas of concern: low corrosion rates for mild steel (0.5 mpy) and admiralty brass (0.1 mpy) heat exchangers, no mineral scaling up to 10 cycles of concentration, and good germicidal efficiency of chlorine as evidenced by minimal biological fouling. The alkaline-inhibitor program was acceptable under certain conditions: corrosion rates for admiralty brass were low (0.1 mpy) but unacceptable for mild steel (10 mpy); no mineral scaling was evident up to 10 cycles of concentration; although biological fouling was not observed, the plate counts in the alkaline program were one to two orders of magnitude higher than the acid program. The baseline program was the least acceptable of the three tested: corrosion rates for admiralty brass were low (0.1 mpy) but unacceptable for mild steel (10 mpy); mineral scaling (zinc phosphate) built up on the deposit monitors; the germicidal efficiency of the added chlorine was good at the neutral pH 7.0 with no evidence of biological fouling.
W86-02423

INDUSTRIAL WATER REUSE WITH COUPLED-TRANSPORT MEMBRANES,

Bend Research, Inc., OR.
W. C. Babcock, J. W. Brooke, D. T. Friesen, D. R. Kamperman, and E. D. LaChapelle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203925/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, January 1985, 27 p, 15 fig, 3 tab, 7 ref. BuRec C-10142-R(1). 14-34-0001-2403.

Descriptors: *Metal-Finishing wastes, *Water reuse, Wastewater treatment, *Plating waste, *Rinse water, *Polymeric membranes, Chrome plating, Chromic acid.

The objective of this program was to demonstrate the feasibility of using coupled-transport membranes to treat chrome-plating rinse waters. A major effort was directed toward field tests of a hollow-fiber membrane unit at a decorative-chrome plating shop. Membrane development aimed at improving chromium fluxes was also conducted. Field tests at Bend Plating, Inc., of Bend, Oregon were conducted using a unit containing modules with 15 sq ft of membrane area. This unit was used to recover chromium from the second rinse tank of a three-rinse counterflow system. Two types of modules were tested; the liquid membranes in one module contained Adogen 383 as the chromium complexing agent in an aromatic diluent, while the membranes in the remaining two modules contained Alamine 336 as the chromium complexing agent in an aliphatic diluent. The membrane module containing Adogen 383 operated for 100 days at an average flux of about 2.5 lb sq ft -year. The modules containing the Alamine 336 operated with an average flux of about 1.5 sq ft -year. One of these Alamine 336 modules accumulated 370 days of operating time. Two methods were investigated for converting sodium chromate--the chromium salt produced in the coupled-transport process--to chromic acid. This conversion would permit recycle of the chromium to the plasting bath. One method, relying on Donnan dialysis, was found to be unacceptable, primarily because the chromic acid produced was not sufficiently pure. On the other hand, cation exchange with conventional resins produced a pure chromic acid concentrate that could be returned to the plating bath.
W86-02425

OPTIMIZATION OF HOLLOW FIBER ULTRAFILTRATION MEMBRANE TYPE AND SYSTEM DESIGN FOR WASTEWATER REUSE IN THE TEXTILE INDUSTRY,

Romicon, Inc., Woburn, MA.
R. Breslau, and A. Fuchs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203933, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, (1984) 120 p, 24 tab, 53 fig, 7 ref. 14-34-0001-8803.

Descriptors: *Membranes, *Ultrafiltration, *Textile water reuse, Waste water treatment, Membrane processes, Separation techniques.

A year long study was conducted to evaluate the application of hollow fiber ultrafiltration for treatment and suubsequent reuse of wastewater at several major textile mills. Water jet looms effluent, batcher water effluent, untreated composite effluent and final (post-biologically treated) composite effluent streams were all tested during the pilot program. The results of both the water jet looms and batcher water effluent pilot programs suggested good technical potential. The use of hollow fiber ultrafiltration for the processing of these streams produced a treated stream greatly reduced in the contaminant species believed to restrict successful reuse. Economic evaluations of processes incorporating hollow fiber ultrafiltration are presented. At one plant, the major costs involved in water treatment are incurred by the waste treatment facility. The bulk of controlled contaminant species are introduced through relatively small (volume) streams such as the batcher water effluent. Substantial cost savings could result from segregated treatment of these streams if the large volume of remaining effluent could be discharged with reduction in, or elimination of, further treatment. Untreated composite and final composite effluent streams were tested at two locations during this study. The results of these tests indicated that hollow fiber ultrafiltration removed substantial amounts of contaminant species. The low molecular weight organic species and salts, not removed by ultrafiltration, were considered to be disadvantageous to most dyeing operations. In at least one case (acetate dyeing) the treated stream was considered acceptable for reuse. Good future potential is expected in the application of ultrafiltration for advanced waste treatment.
W86-02426

COST-EFFECTIVE DESIGN AND OPERATION OF URBAN STORMWATER CONTROL SYSTEMS: DECISION-SUPPORT SOFTWARE,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Labadie, N. S. Grigg, D. M. Morrow, and D. K. Robinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203941/AS, Price codes: A10 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Completion Report No. 135, October, 1984, 205 p, 14 fig, 4 tab, 54 ref, 4 append. OWRT 90037-U. 14-34-0001-0507(2).

Descriptors: *Storm wastewater, *Combined sewers, *Control systems, Computer programs, *Optimization, *Urban runoff, Forecasting, Dynamic programming, Hydraulic models, *Sewer systems, *Design, Cost analysis.

Although the microcomputer revolution has made powerful computer hardware available at low cost, there is still a severe lag in the availability of computer software that can aid urban water managers in finding cost-effective solutions to complex design and operational problems in stormwater and combined sewer control. A Stormwater Control Package (SWCP) is presented with user manual for introducing automation into urban stormwater control systems. The package contains state-of-the-art technology in storm inflow forecasting, fully dynamic hydraulic routing, and dynamic programming optimization. It is designed for 'simulated' real-time experimentation on application of automation to storm and combined sewer control for achieving improved performance. In addition, it is believed that application of the SWCP at the planning level can potentially save large amounts of capital in sizing of facilities through optimum regulation in real-time of storage and conveyance of

stormwater. Computational experience with the North Shore Outfalls and Channel Outfalls Consolidation projects of the Clean Water Program of San Francisco is preiented. In addition to operational software, an optimal sewer design package called CSUDP/SEWER is presented with user manual which also employs dynamic programming. As a screening tool, Program CSUDP/SEWER can find least-cost vertical layouts and sizings of storm drainage systems. Preliminary experience with an optimal horizontal layout procedure which combines nonlinear programming, network flow theory and CSUDP/SEWER is also presented, but more testing with large networks is needed for this algorithm.
W86-02427

HIGH RATE ANAEROBIC TREATMENT OF EVAPORATOR CONDENSATE FROM SPENT PULPING LIQUORS,

Washington Univ., Seattle. Dept. of Civil Engineering.
M. M. Benjamin, J. R. Ferguson, J. L. McCarthy, and N. L. Ricker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-203974/AS, Price codes: A11 in paper copy, A01 in microfiche. Technical Completion Report, March 1984. 234 p, 58 fig, 24 tab, 17 ref. B-084-WASH(2). 14-34-0001-0256.

Descriptors: *Anaerobic digestion, *Pulp wastes, Biodegradation, Toxicity, Acclimatization, Washington condensates, Wastewater treatment, Fermentation, Methane, Evaporators.

A study of the anaerobic treatment of several pulp and paper waste streams has demonstrated the degree of organic removal and concomitant methane production possible at verying organic loading rates. Evaporator condensate from the sulfite pulping process can be treated alone or with waste from the caustic extraction stage of bleaching. The neutralization requirement for those waste streams has been evaluated theorectically and empirically; toxicity and biodegradability of wastes and individual compounds have been evaluated in batch anaerobic bioassays. Pulse loading studies were conducted. Sulfur in the evaporator condensate has been shown to be partially reduced to sulfide and to reduce COD removal efficiency and methane production. Preliminary cost estimates for application of anaerobic treatment in a packed bed system have been completed for sulfite and kraft process evaporator condensates.
W86-02430

OPERATION OF A CRYSTALLIZATION PILOT PLANT ON METAL PLATING WASTE STREAMS AT NAVAL AIR REWORK FACILITY (NARF), NORFOLK, VA - PHASE 1 & 2A,

Heist Engineering Corp., Walnut Creek, CA.
J. A. Heist, K. M. Hunt, and P. J. Wrobel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-204022/AS, Price codes: A04 in paper copy, A01 in microfiche. Final Report, Oct. 1984. 51 p, 9 tab, 11 fig, 3 ref. Bu Rec 3-CR-93-00030.

Descriptors: *Water reuse, *Industrial wastes, *Water reclamation, *Electroplating, Crystallization, Freeze crystallization, *Wastewater treatment, Freezing.

Metal plating rinse water reclamation by a freeze crystallization process is being investigated in a program sponsored through an interagency agreement between the Naval Air Propulsion Center, the Norfolk Naval Air Rework Facility (NARF), and the Bureau of Reclamation's Office of Water Research. This report presents the history of the program, describes the technology and its application to the industrial wastes in the military, and outlines the current status of the program and its future plans.
W86-02435

INVESTIGATIONS OF THE MODES OF CONTAMINANT CAPTURE IN CGA (MGD) FOAMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
F. Sebba.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211704/AS, Price codes: A03 in paper copy, A01 in microfiche. OWRT/RU-82/10, 1982. 41 p, 10 fig, 3 tab, 7 plates, 7 ref. C-00069-R(1). 14-34-0001-0489.

Descriptors: *Wastewater treatment, *Flotation, *Bubbles, *Colloids, *Flocculation, Industrial wastewater, Foam separation, Surfactants, Aluminum, Iron compounds, Calcium compounds, Soap, Oil recovery.

A laboratory method for generating colloidal gas aphrons (CGA), which are dispersions of very small bubbles in water, is described. The bubble sizes were measured in a flow-through cell using a TV camera and microscope. Bubbles under 25 microns in diameter rapidly diminished until they became invisible; those larger than 25 microns were much more stable and only disappeared in creaming. Using graphite as a typical fine particle, flotation occurred by attachement to the exterior of the CGA, rather than by penetration of the bubble as in conventional flotation. Addition of flocculant, usually a polyvalent cation, was necessary. This collected the small particles in a floc which was buoyed to the surface as a whole. It was presumed that some larger particles were buoyed by invisible bubbles. Optimum conditions for flotation of oils (using kerosene as an example) and of dissolved ions (calcium, ferric, aluminum) are discussed. Nonionic surfactant was useful in oil flotation; pH control produced precipitation flotation in the metallic ion flotation.
W86-02441

USE OF MICROCOMPUTERS TO AID WASTEWATER TREATMENT PLANT OPERATIONS,

Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
D. G. Parker, and S. C. Parker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211738/AS, Price codes: A05 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project Completion Report. Pub. No. 105, September, 1984. 77 p, 42 fig, 18 ref. USGS G-829-24.

Descriptors: *Wastewater treatment, *Database management, *Microcomputers, Relational databases, *Arkansas.

This report presents the development of a microcomputer based data management system for wastewater treatment plants. The relational database model was shown to be well suited for data management applications in wastewater treatment plants. A general data management system was developed for use with a microcomputer using a commercially available relational database management system. Use of the developed system requires no special computer training. The system was tailored for use at the wastewater treatment plant at Springdale, Arkansas. The capabilities of the system were demonstrated with actual data from the Springdale plant.
W86-02444

FACTORS AFFECTING THE REMOVAL OF SUSPENDED AND DISSOLVED SOLIDS IN HIGH STRENGTH WASTEWATER FROM VEGETABLE PROCESSING,

Arkansas Univ., Fayetteville. Dept. of Food Science.
W. A. Sistrunk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211761/AS, Price codes: A04 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project Completion report, Pub. No. 108, Sept. 1984. 58 p, 17 tab, 7 fig. USGS G-829-06.

Descriptors: *Wastewater treatment, *Food processing wastes, Suspended solids, Dissolved solids, Total dissolved solids, Effluent, Wastewater, Wastewater strength, Treatment systems, Turbidity, Polymers, Inorganic salts, Flocculating agents, Coagulating, Arkansas.

Fifty or more individual factorial experiments were designed to study the effectiveness of physical-chemical and micro-biological treatments in removal of suspended and dissolved solids in effluent from potatoes, hominy, dry beans and other vegetables. The wastewaters were obtained from local processing plants and treated with 3 to 5 inorganic salts, 13 polymers, and 3 or more pH levels during 12 months. Also, selected strains of yeast and fungi were used to assimilate the effluent. Individual inorganic salts were more effective on a certain vegetable effluent than others. Polymers (anionic and cationic) were more effective in coagulating suspended solids in combination with salts than either alone. Different polymers and concentrations of polymers in combination with salts were required for each effluent tested. Saccharonyces filbuliger was the most effective yeast for reducing total solids and chemical oxygen demand in potatoes. Actively fermenting systems were capable of 90% or more reduction after centrifugation. The fungi Neurospora sitophila and Trichoderma viride assimilated the total and dissolved solids more rapidly in effluents from potato and hominy processing than any of the other fungi studied.
W86-02447

MEMBRANE-ORGANIC PHASE OXIDATION PROCESS FOR THE DESTRUCTION OF TOXIC ORGANICS IN HAZARDOUS WASTEWATERS,

Kentucky Water Resources Research Inst., Lexington.
C. E. Hamrin, D. Bhattacharyya, and W. K. Glynn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214575/AS, Price codes: A05 in paper copy, A01 in microfiche. Research Report No 152, August, 1984. 73 p, 30 fig, 7 tab, 32 ref. USGS G-844-05.

Descriptors: Hazardous materials, Toxins, Oxidation, Wet oxidation process, Phenols, Pesticides, Herbicides, Membranes, Membrane processes, *Wastewater treatment, *Toxic wastes, *Phenols, *Coal mine wastes.

The examination of the extraction/oxidation of organic solutes in a two phase oxidation process was undertaken to discern the important parameters and the process mechanism of this system. Several parameters were adjusted to measure their effect on the disappearance rate of each organic from the water phase. The water to PFD volume ratio proved to be the most sensitive parameter affecting the disappearance rate, although temperature was also significant. Comparison with one phase oxidation systems demonstrated that the water/PFD system improved on the reduction of organics from the water phase. B-naphthol oxidation increased over 50% in a 2/6 water/PFD volume ratio compared with the water phase oxidation. Phenol, which had the smallest distribution coefficient of the three organics tested, showed a significant reduction rate in the two phase system which was greater than a water phase oxidation system operating at higher pressures. Naphthalene and an H-coal wastewater also showed more oxidation in the two phase system than in a single water phase system. These results show that two-phase oxidation is a viable process and testing of the total membrane-oxidation system is in order. The feasibility of membrane concentration step is also demonstrated with model organics and actual wastewaters.
W86-02461

IDENTIFICATION OF SOIL-WATER CHEMICAL PARAMETERS FOR THE PREDICTION AND TREATMENT OF SUSPENDED SOLIDS IN SURFACE WATER RESERVOIRS OF COAL MINE LANDS,

Kentucky Water Resources Research Inst., Lexington.
V. P. Evangelou, J. H. Grove, and R. I. Barnhisel.
Available from the National Technical Information

Service, Springfield, VA 22161 as PB85-214773/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, July, 1984. 68 p, 19 fig, 21 tab, 33 ref. USGS G-844-04.

Descriptors: Suspended solids, *Sedimentation, Sedimentation basins, Spoil disposal, Colloids, Clay minerals, *Kentucky, *Water pollution control.

High concentrations of suspended solids in coal mine sedimentation ponds are a factor in lowering water quality. This study focuses on the influence dissolved solids have on concentration and settling of suspended solids. Water samples from sedimentation ponds in Eastern and Western Kentucky were used to evaluate water composition in such ponds. Spoil samples from surface mine sites in both parts of the state were used to evaluate water composition released from the spoils upon introducing water. The results demonstrate that water quality emanating from coal spoils of Eastern and Western coal mines is dependent on the type of spoil and/or geologic strata represented. Water composition of randomly selected sedimentation ponds revealed that the relationship between electrical conductance (EC) in mmhos/cm and ionic strength (I) of water is $I = 0.012(EC)$. Furthermore, it was determined that there is a linear relationship between the repulsive index, RI (based somewhat loosely on double-layer theory), and suspended solids. Kinetic data on settling of suspended solids has shown that upon increasing the ionic strength of the water (consequently decreasing RI), the rate of wetting increased dramatically. The critical RI at which complete removal of all suspended solids, estimated by graphic extrapolation, is shown to be dependent on the percent base saturation. The data also demonstrate that the critical RI (RI at maximum flocculation) varies depending on the spoils mineralogical and chemical composition. The overall study shows that decreasing in suspended solids in coal mine sedimentation ponds can be done by small increases in ionic strength.
W86-02480

EVALUATION OF COMBINED SEWER OVERFLOW MANAGEMENT STRATEGIES THROUGH PIPE NETWORK COMPUTER SIMULATION,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W86-02505

EVALUATION OF A VEGETATIVE FILTER FOR DAIRY WASTEWATER TREATMENT IN SOUTHERN APPLACHIA,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
J. D. Barker, and B. A. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215036/AS, Price codes: A05 in paper copy, A01 in microfiche. Project Completion Report, North Carolina Water Resources Research Institute, Raleigh, December 1984. 69 p, 27 fig, 31 tab, 17 ref. USGS G860-07.

Descriptors: Economic aspects, *Dairy industry, *Animal wastes, *Nutrients, *Feedlot runoff, *Feedlot wastes, Nonpoint pollution sources, Wastewater management, Wastewater treatment, Fertilizers, Dairy farms, *North Carolina.

Runoff from dairy feedlots and exercise areas and milking center wastewaters, are widely recognized as potential point and nonpoint source pollutants. Cost-effective and easily managed alternative treatment methodologies need to be evaluated for application in rural mountain areas. The effectiveness of vegetative filter for treating feedlot runoff and milking center wastewaters was tested at a small mountain dairy farm. A shallow concrete settling basin (10' x 40' x 2') was constructed to receive all wastewater. Basin effluent was distributed onto a 0.6 acre filter area on 10% slope seeded to fescue, orchardgrass, and ryegrass. The filter was terraced to intercept and retard the overland flow velocity. Automated sampling stations measured the flow and collected representative samples of the wastewater influent to the settling basin and the filter effluent. Soil and forage samples were collected and analyzed for nutrients and salt. Results of the study indicate that 66% of the total rainfall was measured as paved lot runoff. An average 7.24 gallons of water per cow per day were used for milking center cleanup. Approximately 21,000 gallons of manure solids (7.6% TS) were removed from the settling basin and field spread. Solids settling efficiency of the basin was 41%. Only 5.3% of the total wastewater influent volume was discharged from the filter into the adjacent stream with filter organic, nutrient, and solids removal efficiencies ranging from 96.7% to 99%.
W86-02506

DEVELOPMENT OF THE NUTRIENT FILM TECHNIQUE FOR RENOVATION OF WASTEWATER FOR NONPOTABLE REUSE,

Florida International Univ., Miami. Drinking Water Research Center.
L. Handley-Raven, S. Casey, L. Lopez, H. Richards, and J. Cooper.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217016/AS, Price codes: A04 in paper copy, A01 in microfiche. Final Report, May 1985. 59 p, 16 fig, 16 tab, 60 ref. USGS C-10030-R (1). 14-34-001-2406.

Descriptors: *Nutrient film technique, Para grass, Brachiaria mutica, Napier grass, Pennisetum purpureum, Water reuse, Wastewater treatment, Florida, Crop production, Pilot plants.

The specific goals of the project were: to construct a nutrient film technique (NFT) pilot plant, screen and select crop plants for use with an outdoor NFT in Florida, test the selected crops with both secondary effluent and raw wastewater, and to determine how to maximize the NFT's performance in terms of wastewater removals and crop production. Of the crops tested, only para grass (Brachiaria mutica) was suitable. Monitoring of the system removals revealed: (1) that grab sampling is an inadequate means of describing system performance; (2) that a gravel matrix was needed in the NFT channels; (3) that the crops were very sensitive in their responses to small daily weather changes; (4) that para grass uses ammonium-N better than nitrate-N; and (5) a possible need to acidify the wastewater. Testing of napier grass (Pennisetum purpureum) showed that it was unsuitable for outdoor NFT use. Neither secondary effluent nor raw wastewater was totally suitable for use with para grass; primary effluent is recommended. The investigators were unable to confirm an earlier reported plug-flow model for the NFT.
W86-02532

FUNDAMENTAL CONCEPTS OF AUTODIGESTION OF BIOMASS,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217719/AS, Price codes: A03 in paper copy, A01 in microfiche. Delaware Water Resources Research Center, Newark, Project Completion Report, 1984. 34 p, 10 fig, 15 ref. USGS G833/03.

Descriptors: *Aerobic digestion, *Biological oxidation, *Sludge disposal, Decomposing organic matter, Biological wastewater treatment, Organic wastes, *Activated sludge.

The purpose of the project is to draw together and analyze a large amount of previously unpublished experimental data obtained by the principal investigator. These data pertain to autodigestion of activated sludge and a possibly related phenomenon, the production and release of soluble organic materials during cell decay. Most of the first-year effort related to examination of the long-term fate of the 'residual' organic matter (measured as chemical oxygen demand, COD) remaining after aerobic treatment of a synthetic waste. Data were available for three long-term experiments (the longest run for 613 days) in which both the biomass and the residual COD from each daily feeding of the batch activated sludge were retained, totally, in the reactor. It was shown conclusively that over 90 percent of the so-called residual COD was metabolizabled by the biomass responsible for its production. It was also concluded that while long biomass retention times tend to decrease the specific decay rate, kd, an equilibrium value was attained; i.e., the decay rate did not approach zero.
W86-02536

BIOLOGICAL DETOXIFICATION OF HAZARDOUS WASTES,

Tennessee Water Resources Research Center, Knoxville.
J. W. Smith, and L. W. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217750/AS, Price codes: A04 in paper copy, A01 in microfiche. Research Report No. 104, September 1984. 62 p, 19 tab, 17 fig, 18 ref. USGS G870-02.

Descriptors: Hazardous materials, Organic wastes, Wastewater, *Wastewater treatment, Biological wastewater treatment, Activated sludge process; Heavy metals, Pesticides, *Tennessee.

This research focused on the potential for biological treatment of hazardous organic wastewaters using rotating biological contactors (RBC) modified to include an aeration basin and final clarifier with sludge recycle to the fixed-film media. These systems have been appropriately designated activated rotating biological contactors (ARBC). The research was designed to facilitate comparison of the ARBC system to a completely mixed activated sludge system with respect to treatability of hazardous organic wastewaters. Wastewaters examined were a medium-strength organic waste containing copper, a synthetic leachate containing heptachlor, chlordane, and endrin, a high-strength organic industrial waste, and a medium-strength organic waste containing hexavalent chromium. Compared to activated sludge systems, ARBC systems achieved higher organic removal efficiencies and, in addition, generally removed greater quantities of heavy metals and pesticides. The ARBC system also demonstrated greater capability to handle shock organic loadings as well as shock loadings of toxic substances.
W86-02540

SENSITIVITY ANALYSIS FOR AN ACTIVATED SLUDGE MODEL WHICH CONSIDERS TOXICANT CONCENTRATION,

Auburn Univ., AL. Dept. of Civil Engineering.
L. Benefield, and R. B. Reed.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217776/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Alabama Water Resources Research Institute, Auburn, September 1984. 48 p, 6 fig, 5 tab, 9 ref. USGS G880-02.

Descriptors: *Activated sludge, *Toxicity, *Waste water treatment, *Mathematical models, *Alabama, Biological toxicity model, Floc radius, Oxygen utilization, Ammonia-nitrogen removal, Ortho-phosphate removal, Biomass production, Aggregated microbial suspension.

A mathematical model has been developed which describes organics removal, oxygen utilization, ammonia-nitrogen removal, ortho-phosphate removal and biomass production in an aggregated microbial suspension containing organics as a soluble biodegradable material, toxicants, and a uniform floc size. It is applicable to both steady state and transient conditions as well as to systems experiencing only carbon oxidation or both carbon oxidation and nitrification. In devleloping the model it was assumed that a lack of either organics, oxygen, ammonia-nitrogen, ortho-phosphate or any combination of these nutrients could limit the overall rate of the process and/or that the presence of toxicants could limit the rate of the process. The primary objective of this research was to perform a sensitivity analysis on the model. This analysis indicated that the single most important factor in determining model output (based on the effluent organics

concentration) is the retention time in the reactor. The second most important factor is the floc radius.
W86-02542

ENHANCED REUSE POTENTIAL OF COAL SLURRY TRANSPORT WATER: TOXIC ORGANICS ASSESSMENT AND REMOVAL (PHASE II),

Tennessee Univ., Knoxville. Dept of Microbiology.
G. S. Sayler, R. A. Minear, M. C. Reid, and J. W. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-218063/AS, Price codes: A06 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, Knoxville, Technical Completion Report, Research Report No. 106, September 1985. 95 p, 24 fig, 20 tab, 80 ref. C-0200-R(I). 14-08-0001-G-1057.

Descriptors: *Slurries, *Water reuse, Waste water reclamation, Humic acids, *Chlorination, Coal slurry transport, Organic wastes, *Wastewater treatment, Organic carbon.

This research was conducted to evaluate organic water quality characteristics of raw and treated coal slurry wastewaters that effect potential reuse application of this water resource. The composition and biological treatability of the dissolved organic constituents of coal slurry transport wastewater was examined. In addition, the occurrence of environmental mutagens in the wastewater and potential for formation upon chlorination was determined. The results of the investigation demonstrated that the dissolved organic carbon constituents of the slurry wastewater were of humic material in origin and predominated by moderate to low molecular weight (>5000 MW to <1000 MW) fulvic and non-fulvic acid constituents. Chlorination of the wastewater resulted in the production of significant levels of chloroform primarily from fulvic acid precursor organics. However, non-volatile mutagenic agents were not detected in either raw or chlorinated slurry wastewaters. The results of this investigation demonstrate that renovation of coal slurry wastewater for potential reuse is attainable and that renovated wastewater from the perspective of the organic constituents may not pose adverse ecological or environmental health effects.
W86-02543

CONCURRENT REMOVAL OF TOXIC HEAVY METALS AND ORGANIC SUBSTANCES BY ACTIVATED CARBON PROCESS FROM CONTAMINATED GROUNDWATER,

Delaware Univ., Newark. Dept. of Civil Engineering.
C. P. Huang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-218972/AS, Price codes: A05 in paper copy, A01 in microfiche. Delaware Water Resources Research Center, Newark, Project Completion Report, 1984. 85 p, 61 fig, 4 tab, 35 ref. USGS G833/04.

Descriptors: *Activated carbon, Adsorption, Heavy metals, Toxic wastes, *Groundwater quality.

The treatability of groundwater containing both toxic heavy metals and organic substances was performed in the laboratory using synthetic solutions and activated carbon adsorption process. Two typical activated carbons, i.e., Nuchar SA (an L-type) and Filtrasorb 400 (an H-type) were selected. Three heavy metals, mercury (II), lead (II), and cadmium (II), and six organics, namely catechol, salicylic acid, sulfosalicylic acid, benzoic acid, phenol, and chloroacetic acid, were used in the preparation of synthetic water for experiment. The removability of heavy metals and organic substances was determined at different values of pH (2.5 - 10.5) and ratios of metal to organics (0:1, 10:1, 1:1, 1:10 and 1:0). The results show that L-carbon is superior for the removal of heavy metals and H-carbon is better for organic removal. The percent toxic substances removal is very high; 90 to 100% removal is achievable by proper selection of operational conditions. When heavy metals and organics are present concurrently, the removal of organics is not affected as long as the concentration (molar) of heavy metals is less than the organics except chloroacetic acid. Chloroacetic acid is not removable by either type of carbon in the absence of heavy metals. However, drastic improvement can be realized when a trace amount of heavy metal is present.
W86-02544

OPTIMUM TREATMENT FOR COAL PILE RUNOFF IN LOUISIANA,

Louisiana Water Resources Research Inst., Baton Rouge.
M. E. Tittlebaum, and P. I. Hendershot.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219020/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Baton Rouge, August 1984. 39 p, 4 tab, 8 fig, 26 ref. USGS G845-05.

Descriptors: *Coal, *Runoff, *Suspended solids, *Polymers, *Louisiana, Coagulation, Sedimentation basins, *Sedimentation rates, Electric powerplants, Polyelectrolytes.

The coming decades will see coal having an increasingly important role in Louisiana's economy, both as a fuel for production of electricity and as a bulk material to be stored and shipped through the lower Mississippi River. Coal storage facilities in south Louisiana are exposed to the nation's highest annual rainfall, resulting in significant quantities of runoff which must be contained and treated in accordance with state and federal guidelines. Effluent criteria must be met for pH and total suspended solids. Cationic organic polymers were used in laboratory settling tests to destabilize and flocculate a coal pile runoff suspension obtained from a power plant. It was found through column settling tests that the flocculated runoff suspension exhibited zone or hindered settling behavior. Essentially all of the suspended solids could be removed by flocculation with a 20 ppm dosage of cationic polymer and 20 minutes of quiescent settling. In the column settling tests, two methods of determining interfacial settling velocity were compared, with the respective results being used to calculate the area required for a clarification basin. It was concluded that coal pile runoff should be treated by a unit operation using a cationic polymer. Based on the results of combustion tests, it was concluded that the thickened sludge from such an operation may have value as an energy source.
W86-02549

DETERMINATION OF THE INHIBITORY GROWTH KINETICS OF NITRIFIERS IN BATCH AND CONTINUOUS FLOW REACTORS,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225811/AS, Price codes: A03 in paper copy, A01 in microfiche. Delaware Water Resources Research Center, Newark, Project Completion Report, 1937. 40 p, 11 fig, 6 tab, 20 ref. USGS G833/07.

Descriptors: *Nitrification, Kinetics, Inhibition, *Wastewater treatment.

The purpose of this research was to investigate the nature of the functional relationship that exists between nitrifying microorganisms and exogenous ammonia concentration. A two-state continuous culture system which was fed a synthetic ammonia waste devoid in organic carbon was utilized to collect u versus S data for nitrifiers. These experiments showed that nitrifier growth kinetics should be quantified with a substrate inhibition growth model and not the Monod equation. The continuous flow nitrifier growth data were fit to the Haldane equation which resulted in values of 1.20 days-1, 2.7 mg/e, and 19.1 mg/e for Hmax, Ks, and Ki, respectively. Batch growth studies were also performed using biomass harvested from the continuous flow system. These tests were performed by inoculating the synthetic ammonia media with the biomass whence the ammonia concentration was monitored as a function of time; this data was fit to a batch growth model which incorporated the Haldane equation. The umax values determined with the batch data were much lower than those measured in the continuous flow unit. At this time, no explanation is offered to explain this discrepancy between the measured values of the continuous flow and batch growth constants; however, for field applications, the batch constants imply a more conservative operating range in which to achieve nitrification. It would seem appropriate that, in future work, consideration should be given to investigating this aspect of nitrification kinetics.
W86-02557

TREATMENT METHODS FOR REUSE OF MUNICIPAL SEWAGE EFFLUENT FOR MINERAL FLOTATION IN THE MINING INDUSTRY,

Arizona Univ., Tucson. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W86-02587

COMPARATIVE LABORATORY STUDY OF SEWAGE TREATMENT BY A CAPILLARY SIPHON TRENCH SYSTEM VERSUS A CONVENTIONAL LEACHING TRENCH SYSTEM,

Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
T. A. Dillaha, and W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227320/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No. 47, July 1983. 25 p, 5 fig, 2 tab, 5 ref. USGS G837-04.

Descriptors: *Guam, *Biological wastewater treatment, *Wastewater treatment, Domestic wastes, Aerobic treatment, Leachates, Nitrogen removal, Phosphorus removal, Chemical oxygen demand.

Laboratory tests were conducted to investigate the performance of the 'Niimi Process' or capillary siphon trench, a soil based wastewater disposal system common in Japan. The system is similar to conventional septic tank leaching field trenches except that the trenches are filled with capillary sand instead of gravel and the lower quarter of the trench is lined with an impermeable membrane. The capillary sand and impermeable membrane are used to induce unsaturated flow of wastewater through the upper soil profile, or zone of aeration, where maximum biological activity occurs. The Niimi Process was evaluated by constructing a laboratory scale Niimi Process trench and a conventional soil absorption trench. Synthetic wastewater characteristic of domestic sewage was then applied to the two trenches in two 14-week experiments. No statistically significant differences were found between the operation of the two systems except for NO3-N and Total-N removal during the second experiment where the Niimi trench was slightly more effective. Both reactors removed 99 percent of the applied CoD, 95-99 percent of the applied phosphorus and 18-31 percent of the total nitrogen. The hypothesis that the Niimi trench was superior to the conventional trench was not demonstrated.
W86-02597

LAND TREATMENT OF SEPTAGE,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
C. J. Clanton, J. L. Anderson, R. E. Machmeier, and M. J. Hansel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233013/AS, Price codes: A02 in paper copy, A01 in microfiche. Minnesota Water Resources Research Center Completion Report, St. Paul, December, 1984. A-045-Minn.

Descriptors: *Septage, Groundwater, Soil, Water, Pollution, Water pollution sources, *Groundwater pollution, *Minnesota.

Even though 225 kg/ha nitrogen applied in septage to a loamy sand soil increased nitrate concentrations in the upper 60 cm of the soil profile, the nitrate concentrations below this point were similar to background concentrations. This indicates that for this soil type, the 225 kg/ha application rate may be considered acceptable. The nitrogen application rate of 1120 kg/ha would exceed the nitrogen storage capabilities of silt loam and clay loam soils because nitrate concentrations increased below the 105-cm depth, where crop nutrient uptake is reduced. Since nitrate concentrations from the 225 kg/ha application rate were less than or similar to background levels, the acceptable application would be between these two rates. Application of septage did not affect concentrations of fecal streptococcus and fecal coliforms in soil water. Septage application resulted in a statistically significant increase in the concentration of soil water potassium, sodium, calcium and magnesium. Application of septage produced an increase in the phosphorus and sodium concentrations in the soil profile at the completion of this project.
W86-02646

ECONOMIC IMPACT OF LIMITING ELECTROPLATING DISCHARGES TO ACHIEVE SPECIFIED WATER QUALITY OBJECTIVES,

Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5G.
W86-02664

FATE OF SELECTED PRIORITY POLLUTANTS IN REGIONAL WASTEWATER TREATMENT PLANTS IN PUERTO RICO AND THEIR IMPACT OF THE QUALITY OF COASTAL RECEIVING WATERS,

Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
R. Roman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-247948/AS, Price codes: A05 in paper copy. Puerto Rico Water Resources Research Institute, Technical completion report, Mayaguez, 1984. 92 p, 42 fig, 27 tab. USGS G866-02. 14-08-0001-G866.

Descriptors: Pollutants, *Wastewater facilities, *Heavy metals, *Fate of pollutants, Municipal wastewater, Primary wastewater treatment, Secondary wastewater, *Puerto Rico, Phenols.

A sampling program at two Regional Muncipal Wastewater Treatment Plants (Ponce and Barceloneta) in Puerto Rico was performed over a period of sixty-six days. Phenol, copper, chromium, lead, zinc, cadmium and total solids were analyzed for the influent, primary effluent, and secondary effluent from forty-eight hour composite samples. Time series, moving average series, removal efficiency analysis, and frequency analysis were performed on the data. The study showed that while some toxic compounds (copper and chromium) primary treatment may be sufficient at the observed influent levels, it is definitely not sufficient treatment for the others (phenol, lead, zinc). Therefore in wastewaters where toxics amenable to primary treatment will coexist with toxics not amenable to primary treatment a secondary treatment plant is mandatory. Even with secondary treatment, it was shown that for some toxics a heavy reliance will have to be made on the dilution effect of the respective mixing zone in order to comply with the Puerto Rico Environmental Quality Board's water quality standards. Frequency of occurrence for the toxics studied was established for the period under consideration which may serve as a baseline for future reference and further studies.
W86-02674

BOD REDUCTION AND BIOMASS PRODUCTION BY AEROBIC DIGESTION OF FERMENTATION BROTHS IN SEA WATER,

Puerto Rico Univ., Mayaguez. Dept. of Chemical Engineering.
M. Findley, and J. Benitez.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-247963/AS, Price codes: A03 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute, Technical Completion Report, Mayaguez, 1984. 36 p, 15 fig, 2 tab, 11 ref. USGS G866-06. 14-08-0001-G866.

Descriptors: *Wastewater treatment, *Aerobic digestion, *Industrial wastes, *Food chains, Fish food, Biomass, Marine bacteria, Fermentation, *Distillery wastes.

An experimental study has been conducted on the reduction of biological oxygen demand (BOD) and the simultaneous production of marine organisms by means of aerobic digestion of wastes from a rum distillery (mostos or rum slops). The results indicate that such wastes, which are presently being discharged directly into the sea, can be reduced in BOD by a least 50%, by dilution with sea water and aerobic digestion. The resulting digestion products are suitable for growing brine shrimp (Artemia salina). The microorganisms produced are naturally occurring marine organisms, and the brine shrimp are known to be useful as a fish food. Thus this method should enhance the marine food chain while reducing BOD. BOD reduction and biomass growth both increase with pH up to a value of 8, with residence time, and the BOD and mostos concentration up to the level of about 25% mostos in seawater. There are apparently toxic or inhibiting effects at concentrations of 50% and unexplained effects at low residence times. The data are presented such that digestor volume and biomass production can be estimated for a given feed and a required BOD reduction.
W86-02676

ENHANCED REUSE POTENTIAL OF COAL SLURRY TRANSPORT WATER: TOXIC ORGANICS ASSESSMENT AND REMOVAL,

Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, R. A. Minear, M. C. Reid, and J. W. Davis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249035/AS, Price codes: A06 in paper copy, A01 in microfiche. Technical Completion Report, Tennessee Water Resources Research Center Research Report 106, Knoxville, September 1985, 95 p, 24 fig, 20 tab, 80 ref. C-3109-R. 14-08-0001-G-1057(1).

Descriptors: *Coal slurry water, Water pollution sources, *Tennessee, *Slurries, *Water reuse, Waste water reclamation, Humic acids, Chlorination.

This research was conducted to evaluate organic water quality characteristics of raw and treated coal slurry wastewaters that effect potential reuse application of this water resource. The composition and biological treatability of the dissolved organic constituents of coal slurry transport wastewater was examined. In addition, the occurrence of environmental mutagens in the wastewater and potential for formation upon chlorination was determined. The results of the investigation demonstrated that the dissolved organic carbon constituents of the slurry wastewater were of humic material in origin and predominated by moderate to low molecular weight (> 5000MW to < 1000MW) fulvic and non-fulvic acid constituents. Chlorination of the wastewater resulted in the production of significant levels of chloroform primarily from fulvic acid precursor organics. However, non-volatile mutagenic agents were not detected in either raw or chlorinated slurry wastewaters. The results of this investigation demonstrate that renovation of coal slurry wastewater for potential reuse is attainable and that renovated wastewater from the perspective of the organic constituents may not pose adverse ecological or environmental health effects.
W86-02682

MICROBIAL SURVIVAL IN CURED MUNICIPAL COMPOST,

New Hampshire Univ., Durham.
For primary bibliographic entry see Field 5C.
W86-02685

EVALUATION OF HOLLOW FIBER ULTRAFILTRATION AND REVERSE OSMOSIS FOR WASTE WATER REUSE IN THE METAL FINISHING INDUSTRY,

Romicon, Inc., Woburn, MA.
B. R. Breslau, P. R. Lambert, and B. A. Milnes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126166/AS, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, (1985). 75 p, 13 fig, 29 tab. OWRT C-80268-R. 14-34-0001-8801.

Descriptors: Membranes, *Ultrafiltration, Water reuse, *Waste water treatment, Water pollution treatment, *Membrane processes, Separation techniques, *Metal finishing wastes.

Waste waters generated in the metal finishing industry contain various metal ions that must be removed to facilitate water reuse. Reverse osmosis has previously been shown to be effective in reducing the concentration of selected metal ions from well defined, non-complex metal finishing streams. This program deals with the possibility of improving the performance of the reverse osmosis membrane by pretreating the waste waters with newly developed 'charged' ultrafiltration membranes. To demonstrate technical feasibility on live streams, pilot studies were carried out at a number of production metal finishing facilities. The test program compared the performance of the uncharged, standard XM50 hollow fiber membrane as well as the newly developed charged membranes which were found to exhibit significant divalent ion rejections.
W86-02726

FOULING OF REVERSE OSMOSIS SYSTEMS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3A.
W86-02728

IDENTIFICATION OF SOIL-WATER CHEMICAL PARAMETERS FOR THE PREDICTION AND TREATMENT OF SUSPENDED SOLIDS IN SURFACE WATER RESERVOIRS OF COAL MINE LANDS,

Kentucky Water Resources Research Inst., Lexington.
V. P. Evangelou, J. H. Grove, and R. I. Barnhisel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132396/AS, Price codes: A03 in paper copy, A01 in microfiche. Research Report No. 160, July 1985. 39 p, 10 fig, 10 tab, 35 ref, append. USGS G-908-02. 14-08-0001-G-908 (FY 84).

Descriptors: *Coal mine wastes, Suspended soils, *Sedimentation, *Sedimentation basins, *Colloids, Clay minerals, Water quality, Spoil disposal.

High concentrations of suspended solids in coal mine sedimentation ponds are a factor in lowering water quality. Colloidal particle settling simulations were carried out in the laboratory to test the influence pH and dissolved solids have on concentration and settling rates of suspended solids. The results of the study reveal that the pH of colloidal coflocculation for the samples tested is between 3.5 and 4.5. Furthermore, liming simulation of acidic sediments, as expected increased colloid dispersion. This increase was dependent on the magnitude of the sodium adsorption ratio (SAR). The greater SAR systems maintained a greater concentration of colloidal suspended particles. However, for the same SAR value when the ionic strength was increased from 4 meq/L to 8 meq/L, sedimentation rate of colloidal particles decreased. The data also show evidence that for the same SAR values when substituting magnesium for calcium, the rate of particle settling increased for one sample but decreased for another. The unexpected behavior is under further investigation.
W86-02739

CONTROLS ON PHOSPHORUS MOBILITY IN THE POTOMAC RIVER, NEAR THE BLUE PLAINS WASTEWATER TREATMENT PLANT,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02762

INVESTIGATION OF GROUND-WATER RECHARGE BY INJECTION IN THE PALO ALTO BAYLANDS, CALIFORNIA--HYDRAULIC AND CHEMICAL INTERACTIONS, FINAL REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
S. N. Hamlin.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4152, 1985. 61 p, 26 fig, 4 tab, 26 ref.

Descriptors: Ion exchange, Aquifer characteristics, Adsorption, Specific capacity, *Clogging, Hydraulic permeability, Water quality, *Reclaimed water, Geochemistry, *Recharge wells, Particle size, Potentiometric level, Saline-freshwater interface, Infiltration, Isotone fractionation, Saline water, *Wastewater renovation, *Groundwater recharge, Chemical reactions, *California, *San Francisco Bay.

The U.S. Geological Survey, in cooperation with the Santa Clara Valley Water District, has completed a study of ground-water recharge by injection in the Palo Alto baylands along San Francisco Bay, California. Selected wells within the Water District's injection-extraction network were monitored to determine hydraulic and chemical interactions affecting well-field operation. The well field was installed to prevent and eliminate saline contamination in the local shallow aquifer system. The primary focus of this study is on factors that affect injection efficiency, specifically well and aquifer clogging. Mixing and break-through curves for major chemical constituents indicate ion exchange, adsorption, and dissolution reactions. Freshwater breakthrough was detected in water-level data, which reflected fluid-density change as well as head buildup. Dissolution of calcium carbonate caused by dilution of saline ground water probably accounts for an apparent increase in specific capacity possibly related to improved aquifer permeability. Adsorption evidently removed trace elements during passage of injected water through the aquifer. In terms of hydraulic and chemical compatibility, the well field is a viable system for groundwater recharge. Aquifer heterogeneity and operational constraints reduce the efficiency of the system. Efficiency may be maximized by careful attention to extraction distribution and quantity and to injection distribution, quantity, and water quality. (USGS)
W86-02837

5E. Ultimate Disposal Of Wastes

MOBILITY OF SLUDGE-BORNE DICHLOROBENZIDINE IN LAND APPLICATION SYSTEMS,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 5B.
W86-02466

EVALUATION OF A VEGETATIVE FILTER FOR DAIRY WASTEWATER TREATMENT IN SOUTHERN APPLACHIA,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W86-02506

SUITABILITY OF MARINE CLAYS AS LINERS FOR HAZARDOUS WASTE DISPOSAL SITES,
Maine Univ. at Orono. Dept. of Civil Engineering.
W. F. Brutsaert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215135/AS, Price codes: A03 in paper copy, A01 in microfiche. Maine Water Resources Institute Completion Report, Orono, November 1984. 36 p, 20 fig, 6 tab, 13 ref. USGS G846-03.

Descriptors: *Clays, *Groundwater pollution, Hazardous materials, *Hydraulic conductivity, *Maine, Hydrocarbons, *Permeability, *Seepage, *Solvent, Waste disposal, Waste storage.

The effects of acetone, toluene and methylenechloride on the marine clays of central Maine were evaluated, to determine the effectiveness of these clays in preventing groundwater contamination. The marine clays of Maine were different from those used elsewhere in similar studies in two ways: (1) mineralogically, and (2) physico-chemically. The clay mineral content is extremely small. Clay size particles consist of ground up rock minerals (mica, chlorite, feldspar, quartz). The cation exchange capacity is very low for clay and the ability to swell and shrink is very small. Measurements of the permeabilities of these clays seem to show no major increases or decreases over time. No major structural changes were observed. An apparent chemical dissolution is occurring as indicated by measurements of Al, Fe, Mn and Si in the effluent. The first impression of the marine clays of the northeast is that they may be more resistant than more mineral clays to physico-chemical alteration when permeated with solvents. Long duration permeameter testing and continued chemical analysis of the effluent would produce a more definitive statement on the long term suitability of these clays as liners.
W86-02516

FUNDAMENTAL CONCEPTS OF AUTODIGESTION OF BIOMASS,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02536

EVALUATION OF TENNESSEE SITES FOR THE DISPOSAL OF HAZARDOUS WASTES--SOCIAL, ECONOMIC AND TECHNICAL CONSIDERATIONS,
Tennessee Water Resources Research Center, Knoxville.
D. W. Weeter, T. C. Hood, J. A. Roth, F. L. Parker, and K. D. Acker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217743/AS, Price cooes: A07 in paper copy, A01 in microfiche. Research Report No. 101, September 1984. 126 p, 7 fig, 35 tab, 54 ref, 2 append. USGS G870-05.

Descriptors: Hazardous materials, Wastes, *Landfills, Environmental effects, Groundwater pollution, Social impact, Economic aspects, *Tennessee, *Waste disposal sites, *Hazardous wastes.

A model was developed to evaluate the suitability of sites for location of hazardous waste landfills. Unlike previous methodologies, the site evaluation model provides a framework whereby socioeconomic concerns can be incorporated with environmental and institutional factors to determine the overall acceptability of a site. The uniqueness of model lies in its use of multi-disciplinary criteria, and in its numerical site rating which is based on a multiplicative aggregation techniques. The model was applied to three existing waste disposal sites for which the relative security of the site is known. The results were consistent with the known hazard potential of each location. A survey was conducted to gain information on the opinions that citizens have concerning hazardous waste disposal. The survey sample consisted of elected local officials, environmental professionals, and citizen group members. The results show that the use of incentives can have a considerable effect towards gaining support for hazardous waste facilities, and confirm that greater public participation is needed to restore confidence in decisions made concerning hazardous waste disposal by demonstrating that the siting of these facilities is being done in a fair and safe manner. Investigation of the social and economic aspects of hazardous waste disposal should be continued to expand the relatively small data base developed from this survey.
W86-02539

GROUNDWATER MANAGEMENT USING CONTROL ANALYSIS AND MULTIPLE-OBJECTIVE TECHNIQUES,
Nebraska Univ.-Lincoln. Dept. of Mathematics and Statistics.
For primary bibliographic entry see Field 6A.
W86-02599

STUDY OF SOME PUERTO RICAN SOILS AS NATURAL SEALERS OF ATTENUATORS AGAINST GROUNDWATER POLLUTION FROM SANITARY LANDFILL LEACHATES,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
L. A. del Valle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101359/AS, Price codes: A05 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Final Technical Report, (Mayaguez), June 1983. 73 p, 51 fig, 2 tab, 61 ref, 2 append. A-065-PR(1). 14-34-0001-1141.

Descriptors: *Leachates, *Sanitary landfills, *Puerto Rico, *Water pollution prevention, *Soil filters, Water quality, Groundwater pollution, Landfills, Heavy metals, Soil types, Leaching, Clays, Land disposal.

Five clayey Puerto Rican soils were packed into columns of PVC pipe and tested for their ability to prevent groundwater pollution from the Mayaguez sanitary landfill. Leachate and groundwater samples collected from column effluents were analyzed for water quality parameters according to the Standard Methods for the Examination of Water and Wastewater. Soil samples were analyzed using methods developed by the American Society for Testing and Materials or by the U.S. Soil Conservation Service. Results indicated that the leachate characteristics varied widely, even for samples taken at the same site. At the Mayaguez sanitary landfill, the concentration of the different components in the leachate appeared greatly diminished in the groundwater under the landfill, except for the Ni content. The Daguey soil showed excellent retention capacity for all measured ions, except Zn which showed a net release. Increased Ni concentrations in the groundwater under the landfill were attributed to the release of heavy metals from scrap in the landfill. In general, the soils used in this study were able to retain many of the leachate components with varying degrees of effectiveness. Passage of the leachates through a soil layer does not guarantee an improvement in the groundwater quality, and may even increase the concentration of some leachate components due to their release by the soil.
W86-02716

FATE OF PHOSPHORUS IN SECONDARILY TREATED WASTEWATER APPLIED TO A FRESHWATER MARSH,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. Zoltek, and R. J. Mestan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126109/AS, Price codes: A07 in paper copy, A01 in microfiche. Florida Water Resources Research Center, Gainesville, Aug 1985. 139 p, 21 tab, 33 fig, 99 ref. OWRT B-050-FLA. 14-34-0001-1214.

Descriptors: *Marshes, Peat, *Phosphorus, Adsorption, Wastewater, *Florida, *Waste disposal, Land disposal, Wetlands.

Marsh soils from 18 locations were gathered in the field and transported to the laboratory for experimentation with synthetic secondarily treated wastewater. Batch studies were performed to determine the phosphorus adsorption as a function of soil parameters such as ash, total phosphorus, iron, aluminum or their extractable counterparts. The highest correlations were consistently between phosphorus uptake and ash, total phosphorus and Tamm extractable phosphorus. When predicting the removal of phosphorus from treated wastewater by adsorption on peat many factors must be taken into account, with the most impor-

tant consideration the type of peat soil being used. Successful phosphorus removal by a wetland system is not solely dependent on any individual component such as soil, vegetation, soil microbes, litter, etc. From the literature and from conclusions drawn in this study the best overall phosphorus removal from treated wastewater by a wetland system appears to occur as a result of treated wastewater contact with the vegetation and soil under moist but not flooded conditions.
W86-02720

GENERAL DESCRIPTION OF THE GEOHYDROLOGY AND BURIAL TRENCHES AT THE LOW-LEVEL RADIOACTIVE WASTE BURIAL FACILITY NEAR BARNWELL, SOUTH CAROLINA,

Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02862

EFFECTS OF APPLIED WASTEWATER ON GROUND-WATER QUALITY AT FORT CARSON MILITARY RESERVATION NEAR COLORADO SPRINGS, COLORADO,

Geological Survey, Pueblo, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02877

5F. Water Treatment and Quality Alteration

STUDIES OF EFFECTIVENESS OF COMMERCIAL HOME TREATMENT SYSTEMS,

Arkansas Univ., Fayetteville. Dept. of Physical Science.
W. W. Trigg, and R. D. Couser.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211720/AS, Price codes: A02 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Project completion Report No. 104, Sept. 1984. 15 p, 5 tab. USGS G-829-09.

Descriptors: *Water pollution sources, Arkansas, *Septic tanks, *Coliforms, Lactose fermenters, Escherichia coli, Enterobacter aerogenes, Chemical contamination, Groundwater quality.

Eleven home water systems were tested representing six different types of filtering systems. Tests were made for Sulfates, Nitrates, Phosphate, Iron, and Escherichia coli and Enterobacter aerogenes before and after passing through a home treatment system. All of the systems removed iron adequately but had little effect on the removal of nitrates, phosphates, sulfates or control of pH. Since none of the ground waters was contaminated by coliforms, nothing was established regarding the effectiveness of bacterial removal by these systems.
W86-02443

RESIDUAL ALUMINUM IN POTABLE WATER,

New Hampshire Univ., Durham. Dept. of Civil Engineering.
W. Sung.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214963/AS, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, New Hampshire Water Resources Research Center, Durham, Research Report No. 45, July 1984, 53 p, 8 fig, 12 tab, 37 ref. USGS G856-05.

Descriptors: Alum coagulation, *Water treatment, *New Hampshire, Water quality, Temperature, *Aluminum, Hydrogen ion concentration.

The behavior of aluminum in water treatment facilities using alum coagulation was studied with laboratory jar tests as well as actual plant monitoring. For surface waters with pH > 6, the amount of dissolved aluminum is usually less than 40 ppb. Particulates can also be a susubstantial source of aluminum in the raw water. The amount of dissolved aluminum in jar tests follow rules of hydrolysis equilibrium when the aluminum dosage is much greater than the amount of organics. The minimum soluble aluminum is about 20 ppb at 25C and occurs at pH about 6.5, and 10 ppb at 5C at pH about 6.9. These pH/solubility curves seem to give a reasonable estimate for the actual water treatment plant data. The amount of particulate aluminum must be a function of alum dosage and water treatment plant conditions. It was determined that under our conditions, 10 to 20% of the particulate aluminum are within a size range of 20 micrometers and less, and that these particulates could be very difficult to remove without the use of coagulant or filtering aids. This study points out the need for distinguishing between soluble and particulate phases and that any drinking water standards should take this as well as total dietary intake into account.
W86-02499

CLARIFICATION OF SURFACE WATERS FOR RECHARGE THROUGH WELLS,

California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-02567

DEVELOPMENT OF A CHLOROPHYLL MONITORING PROGRAM FOR WATER SUPPLY RESERVOIRS USING IN VIVO FLUORIMETRY,

Connecticut Univ., Storrs. Inst. of Water Resources.
P. H. Rich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242923/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September 1984. 68 p, 32 gif, 7 tab, 3 ref. USGS G832-05. 14-08-0001-G-832.

Descriptors: *Eutrophication, *Reservoir Management, *Water treatment, Monitoring, Algicide treatment, *Chlorophyll monitoring, *Florimetry, Pollutant identification.

The In Vivo Flow-Through Fluorimetry (IVF) technique was investigated for its potential value as a chlorophyll monitoring system for use in the drinking water industry. Water column chlorophyll concentrations were monitored in four Connecticut reservoirs by IVF and acetone extractions during summer and fall 1983. At low chlorophyll concentrations (less than 10 ug/L), background fluorescence and temperature effects were significant. At higher chlorophyll concentrations, IVF provided an accurate, fast, and relatively simple estimate of extracted chlorophyll, and documented the vertical distribution of algal chlorophyll in the reservoirs. The onset of algal growth conditions which eventually required algicide treatment was traced for up to three weeks prior to recognition by currently employed procedures. Algicide treatments were vertified by IVF. Alternative management was achieved by changing the depth of the treatment plant intake to avoid algal concentrations located by IVF. Raw intake water monitoring by IVF at the treatment plant correlated well with changes in chlorophyll content in the reservoir.
W86-02661

ENHANCED REUSE POTENTIAL OF COAL SLURRY TRANSPORT WATER: TOXIC ORGANICS ASSESSMENT AND REMOVAL,

Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W86-02682

PUBLIC WATER SUPPLIES IN PUERTO RICO, 1983,

Geological Survey, San Juan, PR. Water Resources Div.
F. Gomez-Gomez, F. Quinones, M. Lopes, and R. Munoz-Candelario.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-110244/AS, Price codes: A06 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Technical Completion Report, 1984. 102 p, 16 fig, 75 tab, 3 ref. USGS G866-22. 14-08-0001-G-866.

Descriptors: *Water supply, *Surveys, Well water, Surface waters, *Puerto Rico, Municipal water, Groundwater.

A compilation was made of public water supply facilities serving Puerto Rico's 78 municipios (municipalities). Information was obtained at the Puerto Rico Aqueduct and Sewer Authority which is responsible for development and operation of the island's public water supply system. Data on the facilities include the following: Cartesian coordinates, site name, annual production, and analyses for pH, color turbidity, and major dissolved constituents. Facilities listed include 413 wells and 170 surface-water sites in operation. These provide about 370 million gallons per day of potable water to nearly 850,000 domestic, commercial, and industrial connections.
W86-02719

PILOT STUDIES DEMONSTRATING THE FEASIBILITY OF OZONATION FOR SELECTED MUNICIPAL WATER SUPPLIES,

South Dakota State Univ., Brookings. Dept. of Civil Engineering.
D. A. Rollag.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126158/AS, Price codes: A06 in paper copy, A01 in microfiche. South Dakota Water Resources Research Institute, Brookings, October 1982. Technical Completion Report, 100 p, 27 tab, 22 fig, 129 ref. OWRT B-058-SDAK. 14-34-0001-9134.

Descriptors: *Water treatment, *Ozonation, *Chlorination, *Costs, Chemical oxygen demand, Organic carbon, Color, Odor, Pilot studies, South Dakota.

On-site ozonation pilot studies were conducted on five municipal water supplies: two sources were groundwater; two rivers; and one a lake. The primary objectives were to determine optimum ozone dosages and contact times for reducing trihalomethanes, chlorine demand, odors, organics, iron and manganese and establish capital and operating costs. At selected contact times and ozone dosages flow, power, temperature, pH, turbidity, ozone, chlorine, iron, manganese, odor, trihalomethanes, total organic carbon (TOC), absorbance, chemical oxygen demand (COD) and color were measured depending on the particular water studied. When ozonated and unozonated raw waters were chlorinated, ozonation reduced trihalomethanes. Usually there was an optimum ozone dosage and at other dosages ozonation increased rather than decreased trihalomethanes. The same was found for odor reductions, although ozonation at all dosages changed typical 'foul, fishy' odors to pleasant ones deemed acceptable to most consumers. Jar tests of raw and ozonated river waters revealed that ozonation improved flocculation in some instances. Ozonation reduced chlorine demand, TOC and COD at certain dosages and increased them at others, but usually was no more effective than coagulation alone. Ozonation oxidized manganese effectively, but the precipitates were finer. Total capital and operating costs ranged from 4.9 to 24.2 cents per 1000 gallons of water treated.
W86-02725

5G. Water Quality Control

OPERATION OF DETENTION FACILITIES FOR URBAN STREAM QUALITY ENHANCEMENT,

Washington Univ., Seattle. Dept. of Civil Engineering.
L. K. Dally, D. P. Lettenmaier, S. J. Burges, and M. M. Benjamin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-204030/AS, Price codes: A13 in paper copy, A01 in micro-

fiche. Water Resources Series Technical Report No. 79, July 1983. 267 p, 41 fig, 15 tab, 53 ref. Bu Rec C-00198-U(0504)(1). 14-34-0001-0504.

Descriptors: *Urban hydrology, *Storm runoff, *Water detention, *Storm water detention, *Water quality enhancement, *Water quality control, Storm water quality, Seattle, *Washington.

The results of a 2-1/2 year sampling program designed to assess the potential use of urban/suburban detention facilities for water quality control as well as runoff volume control are presented. Monitoring was conducted during five storms at each of two field sites which varied significantly in land use: a 31 ha residential subdivision and a 6 ha transit coach operating base, both in the Seattle, Washington area. At each site, inflow and outflow hydrographs were estimated along with pollutant concentrations measured at intervals ranging from 3.75 minutes to one hour. The principal water quality concern at the residential facility, which is a dry pond, was suspended sediment. Resuspension of sediment was a major problem at this site and resulted in negative pollutant removal efficiencies for most storms. Water quality constituents of concern at the second site, which consist of paved transit coach storage and maintenance areas, were oil and grease, cadmium, lead, zinc, phosphorus, suspended sediment and trace organics associated with diesel fuel combustion products (primarily polycyclic aromatic hydrocarbons). The pollutant removal efficiencies at this site were negative for most pollutants for modest storms, while for lesser storms, and for particulate pollutants, removal efficiencies were generally positive. In addition to the esthetic problem and the direct effects of the oil and grease on the receiving water, the results of this study suggested that the pond provides a sink for sediments with concentrated levels of various heavy metals and organic compounds.
W86-02436

REMOVAL OF ARSENIC FROM CONTAMINATED WATER WITH PARTIALLY DEACETYLATED SHELLFISH WASTE,

Alaska Univ., Fairbanks. Inst. of Water Resources.
H. V. Luong, and E. J. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214716/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report I84.15, July, 1984. 11 p, 3 fig. USGS G827-03.

Descriptors: *Arsenic, Placer mining, Gold mining, Chitosan, *Water treatment, *Flocculants, Contamination(Water), *Alaska, Groundwater, Streams.

Arsenic is often enriched in placer and lode gold deposits. In Alaska, USA, and Yukon Territory, Canada, there is concern that recently increased activity in gold mining may result in arsenic contamination of pristine streams and groundwaters. Chitosan, a very good cationic flocculant, might be used to remove this arsenic. Shellfish wastes are composed of protein, calcium carbonate and large amounts of chitin. Mucor rouxii spore transformation of shellfish waste could be considered as a nontoxic agent for removing dissolved arsenic (and other heavy metal contaminants) and particulates from placer mine wastes in Alaska. This project attempted to evaluate the arsenic removal capability of partially deacetylated chitin derived from shellfish waste. Chitosan will remove substantial amounts of dissolved arsenate from water, whereas chitin is much less effective. When chitin is transformed by growing cultures of M. rouxii, the modified chitin is no better for the sorption of arsenate than is native chitin. This finding was initially unexpected in that M. rouxii is known to produce an enzyme thought to deacetylate chitin. Native chitin is not the preferred substrate for this enzyme. Thus, while we could not successfully modify chitin with growing cultures of M. rouxii to use as an arsenate sorbant, we have been able to characterize the sorption affinity of chitosan for levels of arsenic commonly found contaminating waters affected by placer mine drainage in Alaska.
W86-02474

IDENTIFICATION OF SOIL-WATER CHEMICAL PARAMETERS FOR THE PREDICTION AND TREATMENT OF SUSPENDED SOLIDS IN SURFACE WATER RESERVOIRS OF COAL MINE LANDS,

Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 5D.
W86-02480

AQUATIC RESOURCES MANAGEMENT OF THE COLORADO RIVER ECOSYSTEM: PROCEEDINGS OF THE 1981 SYMPOSIUM ON THE AQUATIC RESOURCES MANAGEMENT OF THE COLORADO RIVER ECOSYSTEM, NOVEMBER 16-18, 1981, LAS VEGAS, NEVADA,

Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6G.
W86-02484

EVALUATION OF COMBINED SEWER OVERFLOW MANAGEMENT STRATEGIES THROUGH PIPE NETWORK COMPUTER SIMULATION,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
R. M. Wright, and M. J. Mulhare.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215028/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, Rhode Island Water Resources Research Center, Kingston, 1984, 48 p, 10 fig, 16 tab, 55 ref. USGS G867-05.

Descriptors: *Combined sewers, *Storm runoff modeling, *Urban runoff, Water pollution control, Mathematical modeling.

Through field investigations CSO hydraulic and water quality characteristics were determined. Data was developed to calibrate and verify the Stormwater Management Model (SWMM). SWMM was used in conjunction with a non-conventional quasi-continuous modeling framework for evaluation of selected CSO abatement strategies. The quasi-continuous framework couples the detail of storm event simulation with historical rainfall record. The modeling approach is based on selected reference storms with nominal frequency of occurrence ranging from 22 events per year to 1 event in 10 years. Baseline conditions were simulated for each reference storm. Pollutant load response curves were developed based on peak rainfall intensity and total rainfall. These curves were used to determine annual pollutant loadings for selected years of rainfall record. The quasi-continuous approach was proven to be a valid alternative to the more costly conventional continuous simulation by directly comparing the annual load predictions of each method. Peak rainfall intensity, in comparison to total rainfall, provided a more accurate validation. The quasi-continous technique was used to simulate proposed abatement strategies. Results indicate for an average year of precipitation the optimum use of interceptor capacity through modification and relocation of slot structures provided pollutant load reductions to local receiving waters approaching the equivalent of secondary treatment levels.
W86-02505

ROLE OF NITRIFICATION IN CONTRIBUTING TO LOW OXYGEN CONDITIONS IN AN URBAN WATERWAY,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5B.
W86-02508

FURTHER INVESTIGATIONS OF GOLDFISH IN EASTERN WASHINGTON LAKES AND EVALUATION OF ELECTROFISHING AS A TOOL FOR CONDUCTING REMOVAL OPERATIONS,

Eastern Washington Univ., Cheney. Dept. of Biology.
A. T. Scholz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215085/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, Washington Water Resources Research Institute, Pullman, 1984. 17 p, 2 tab, 14 ref. USGS G87-07.

Descriptors: Goldfish, Carassius, *Rotenone, *Fish behavior, *Fish control agents, *Washington, *Electrofishing, *Fish removal.

In eastern Washington, goldfish (Carassius auratus L.) population control through wholelake application of rotenone is not effective and may actually contribute to the roughfish problem. Rehabilitation records of area lakes receiving chronic rotenone treatment reveals that following each application of rotenone, a reduction in species diversity accoumpanied by a shift in population structure toward roughfish has occurred. Therefore, one long-term effect of chronic rotenone treatment may be selection of resistant fish species that increase the rate of eutrophication and decrease water quality. The purpose of this study is to develop new techniques for effective roughfish control utilizing seasonal behavior patterns.
W86-02511

EFFECTS OF LAND USE PRACTICES ON WATER RESOURCES IN VIRGINIA,

George Mason Univ., Fairfax, VA. Dept. of Biology.
R. C. Jones, and B. H. Holmes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216927/AS, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report, Virginia Water Resources Research Institute, Blacksburg, April 1985. 130 p, 5 tab, 259 ref, append. USGS G874-02.

Descriptors: *Water pollution sources, *Land use, *Water management, Agricultural runoff, Agricultural hydrology, Forest hydrology, Forest management, Urban hydrology, Urban runoff, *Virginia.

This study reviews the relationship between land use and water resources in Virginia. It examines three major land uses in the state--agricultural, urban, and forestry activities. For each land use, the relevant literature and state management programs are reviewed. In addition, the report outlines research needs in each area. Agricultural activities affect the receiving waters of Virginia through increased loads of sediment, nutrients, pesticides, and pathogens. In general, pollutant loads are greatest from more intensive agricultural activities. Sediments and particulate nutrient losses can be controlled by soil conservation BMPs. However, dissolved nutrient losses may require other strategies. Urban land uses have the potential to increase sediment, nutrient, and heavy metals loads. Forestry practices may damage receiving waters through sediment loadings and alteration in stream habitat due to removal of riparian vegetation. Recommended future research includes documentation and refinement of the effectiveness of existing BMPs, investigation of the effectiveness of urban sediment BMP enforcement, determination of the significance of pathogen indicator organisms in urban and agricultural runoff, evaluation of the long-term cost of BMP structures, demonstration of agricultural and forestry BMPs, and exploration of the pollutant delivery problem in watersheds.
W86-02523

STUDY AND PREDICTION OF BACTERIAL AND VIRAL CONTAMINATION OF GROUNDWATER FROM LANDFILLS AND SEPTIC TANK SYSTEMS,

Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-02535

EVALUATION OF TENNESSEE SITES FOR THE DISPOSAL OF HAZARDOUS WASTES--SOCIAL, ECONOMIC AND TECHNICAL CONSIDERATIONS,

Tennessee Water Resources Research Center, Knoxville.
For primary bibliographic entry see Field 5E.
W86-02539

CONCURRENT REMOVAL OF TOXIC HEAVY METALS AND ORGANIC SUBSTANCES BY ACTIVATED CARBON PROCESS FROM CONTAMINATED GROUNDWATER,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02544

OPTIMUM TREATMENT FOR COAL PILE RUNOFF IN LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 5D.
W86-02549

EVALUATION OF NON-POINT POLLUTION CONTROL PRACTICES AND COPPER TREATMENTS ON CONTROL OF NUISANCE FILAMENTOUS ALGAE,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
C. A. Lembi, D. F. Spencer, and S. W. O'Neal.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225886/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 170, December 1984, 54 p, 11 fig, 5 tab, 10 ref, 2 append. USGS G841-04.

Descriptors: *Non-point pollution sources, *Nuisance algae, *Water pollution control, Algal control, Algicides, Surrey Lake, *Indiana.

Runoff studies were initiated in May 1984 on an erodible soil with slopes ranging from 4.6 to 13.8%. 100 ft2 plots were divided into two tillage treatments: 1) no-till and 2) conventional plow system. Within each tillage treatment, three nitrogen application techniques were used: 1) surface application of ammonium nitrate pellets (33.5% N), 2) injected anhydrous ammonia, and 3) injected anhydrous ammonia stabilized with the nitrification inhibitor nitrapyrin. A fourth set of plots was left unfertilized. All application rates were at 200 lbs nitrogen per acre. Two light rainfalls of 1.4 inch and 0.2 inch were followed a month later by a heavier rainfall of 2.5 inch. The only significant effect of nitrogen application technique on nitrogen runoff was a greater NH3-N runoff from surface applications (in both conventional and no-till plots) than other application methods at the 2.5 inch rainfall date. No differences could be detected in NH3-N or NO3-N runoff from untreated control, injected nitroge, or stabilized injected nitrogen plots. Use of the runoff data in conjunction with a model of the growth of the nuisance filamentous alga Pithophora in Surrey Lake, Indiana suggests that conversion of the agricultural land in the watershed from a conventional till, anhydrous ammonia injected management system to a no-till system with either anhydrous ammonia injected alone or injected with nitrapyrin should lead to a noticeable reduction (approximately 40%) in Pithophora growth. The analysis further suggests that use of conventional tillage in combination with injected ammonia with nitrapyrin or surface applications of ammonium nitrate would lead to increased growth of Pithophora.
W86-02564

PHYTOPLANKTON CONTROL AND WATER QUALITY IMPROVEMENT THROUGH MANIPULATION OF ANIMAL COMMUNITIES,
Nebraska Univ.-Lincoln. Dept. of Forestry, Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-02583

SEDIMENT AND PESTICIDE/HERBICIDE TRANSPORT RELATIONSHIPS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5B.
W86-02642

ECONOMIC IMPACT OF LIMITING ELECTROPLATING DISCHARGES TO ACHIEVE SPECIFIED WATER QUALITY OBJECTIVES,
Connecticut Univ., Storrs. Inst. of Water Resources.
R. L. Leonard, and G. E. Hoag.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242956/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1984. 35 p, 15 tab, 31 ref. USGS G832-03. 14-08-0001-G-832.

Descriptors: *Electroplating economics, *Electroplating waste discharges, Electroplating, Industrial wastewater, *Wastewater treatment, *Economic impact, *Connecticut, *Pretreatment requirements, *Copper, Naugatuck River, *Water quality standards.

Federal regulations established on July 15, 1983, substantially reduced the economic significance of interstate differences in technology based effluent limitations for direct discharges of electroplating wastewater. However, Federal regulations regarding pretreatment of existing discharges to municipal sewage systems are extremely lax compared to either Federal direct discharge standards or Connecticut pretreatment requirements. Of six regionally competitive states only Connecticut has a general set of pretreatment standards for electroplating wastewater. Municipal pretreatment standards in neighboring states vary widely and are generally lax compared to Connecticut standards. Research regarding water quality management was focused on copper in the upper third of the Naugatuck River. The copper load and concentration were estimated for each point of discharge with existing and advanced treatment of industrial wastewater. A 90 percent reduction in existing industrial discharges would make only limited progress toward achievement of a tentative, site-specific water quality standard of 0.0102 mg/1. Approximately 68 percent of the copper being discharged to the River is from domestic sewage. Estimated costs per unit of copper removed by advanced treatment vary widely among discharges.
W86-02664

RIPARIAN SHRUBBY VEGETATION PROTECTION AGAINST HERBIVORE BROWSING,
Oregon State Univ., Corvallis. Dept. of Rangeland Resources.
For primary bibliographic entry see Field 4D.
W86-02670

FINANCING WATER PROJECTS IN NORTH CAROLINA: THE STATE ROLE,
North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 6C.
W86-02709

STUDY OF SOME PUERTO RICAN SOILS AS NATURAL SEALERS OF ATTENUATORS AGAINST GROUNDWATER POLLUTION FROM SANITARY LANDFILL LEACHATES,
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-02716

PRELIMINARY EVALUATION OF HYDROLOGIC PROPERTIES OF CORES OF UNSATURATED TUFF, TEST WELL USW H-1, YUCCA MOUNTAIN, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02792

INVESTIGATION OF GROUND-WATER RECHARGE BY INJECTION IN THE PALO ALTO BAYLANDS, CALIFORNIA--HYDRAULIC AND CHEMICAL INTERACTIONS, FINAL REPORT,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5D.
W86-02837

HYDROGEOLOGIC SETTING EAST OF LOW-LEVEL RADIOACTIVE-WASTE DISPOSAL SITE NEAR SHEFFIELD, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02871

GEOHYDROLOGIC AND DRILL-HOLE DATA FOR TEST WELL USW H-4, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02895

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

COST-EFFECTIVE DESIGN AND OPERATION OF URBAN STORMWATER CONTROL SYSTEMS: DECISION-SUPPORT SOFTWARE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02427

VOLUNTARY BASINWIDE WATER MANAGEMENT: SOUTH PLATTE RIVER BASIN, COLORADO,
Colorado Water Resources Research Inst., Fort Collins.
N. S. Grigg, H. P. Caulfield, N. A. Evans, J. E. Flack, and D. W. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214799/AS, Price codes: A08 in paper copy, A01 in microfiche. Project Completion Report, September, 1984. 160 p, 28 fig, 174 ref, 2 append. USGS G831-02.

Descriptors: *Colorado, South Platte River basin, *Water management, *Resources management, Groundwater management, *Public policy, *Water supply development, Computer models.

Demands for water in the South Platte River Basin are the most intense in Colorado and the result is increasing conflict over water use. The resulting litigation places financial burdens on water right owners and stresses one capability of the state administrative agencies to respond with water management decisions. A voluntary association of water right owners is proposed as a mechanism to increase the options of water users and reduce conflict over water use. The initiative for organizing it would be by the water right owners themselves. The South Platte Research Team believes that such an association could help achieve voluntary integrated basinwide water management. The associaton of water right owners would need information on management and exchange possibilities and the resulting impacts. Computer-based models can provide the information. Two hydrologic and decision models which are available at Colorado State University for this purpose are described. Other hydrologic models and economic models can also be utilized by the association. This report points out possible actions. It must be followed by discussions and debate, by demonstrations of what the models can accomplish, by organizational activity, and perhaps by new legislation. The research team plans to conduct workshops to discuss the next steps.
W86-02482

OPTIMAL EXPANSION AND OPERATION UNDER UNCERTAINTY OF A WATER SUPPLY SYSTEM WITH MULTIPLE WATER SYSTEMS,

Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
C. A. Shoemaker, and J. M. Kersnar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216992/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, Sept 1984. 8 p, 5 fig, 7 ref. USGS G859-06.

Descriptors: *Linear programming, *Municipal water, *Risks, *Water shortage, *Water supply systems, Contamination, Drought, Expansion, Frequency analysis, Groundwater management, Mechanical Failure, Operating policies, Reservoir operation, Systems analysis.

A scenario-consequence approach is used to assess the risk of water shortages occurring in water supply systems with single or multiple types of water supply sources. Total deficits-scenario duration relationships are found using a linear program model of the water supply systems for different scenarios. Information about the probability of occurrence of these scenarios can be used to determine the probability of occurrence of water shortages of certain magnitudes. Knowledge of the magnitude, duration and frequency of water shortages for different alternative expansions or operating policies of a water supply system can be used to determine the optimal alternative in terms of reducing the risk of water shortages. The methodology developed was demonstrated using the water supply system of the Elmira-Horseheads-Big Flats area of New York.
W86-02530

DEVELOPMENT OF A SIMPLE, RELIABLE, INDEX OF DROUGHT WARNING AND DROUGHT EMERGENCY TO AID MUNICIPAL WATER SUPPLY MANAGEMENT,

Delaware Univ., Newark. Dept. of Geography.
For primary bibliographic entry see Field 2A.
W86-02545

ECONOMIC APPROACH TO THE ESTIMATION OF A DYNAMIC PRODUCTION FUNCTION FOR AN IRRIGATED CROP,

California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W86-02569

DESIGN OF A DROUGHT MANAGEMENT EXERCISE: SIMULATION GAMING APPLIED TO THE INDIANAPOLIS WATER SUPPLY SYSTEM,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. T. Diamond, J. R. Wright, M. H. Houck, and D. Randall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-226330/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No. 166, August 1984. 51 p, 14 fig, 3 tab, 32 ref. USGS G841-23.

Descriptors: Technology transfer, *Drought, Management planning, Simulation analysis, Indianapolis, *Indiana, *Drought management, Water supply, Decision making.

The potential use of simulation gaming to enhance the effectiveness of drought management planning in Indianapolis is described. First, the probability of experiencing a severe drought in Indianapolis is examined using historical streamflow data. The effects of such a drought on the municipal water supply system are then analyzed using a recently developed simulation model of the Indianapolis water system. Consideration is given to the water resource decision making problems which might arise under drought conditions, along with a discussion of the benefits of employing simulation gaming in the analysis of these problems. A basic outline for the design of a drought management simulation exercise is provided. References to relevant literature are included.
W86-02580

GROUNDWATER MANAGEMENT USING CONTROL ANALYSIS AND MULTIPLE-OBJECTIVE TECHNIQUES,

Nebraska Univ.-Lincoln. Dept. of Mathematics and Statistics.
J. P. Dauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227346/AS, Price codes: A02 in paper copy, A01 in microfiche. Technical Completion Report, Nebraska Water Resources Center, Lincoln (1984). 19 p, 44 ref. USGS G854-02. 14-08-0001-G854.

Descriptors: *Nebraska, *Mathematical models, Water resources management, *Optimization, *Linear programming, Control systems, Groundwater models, Multiple objective control system.

The overall objective of this project was to develop mathematical optimization techniques, theory and models which are applicable in the management of groundwater systems. The motivation for this research was to improve the analytical techniques that can be used in solving certain groundwater problems. A primary objective was to analyze mathematical systems using a control theoretic approach and multiple-objective techniques. Specific major accomplishments were as follows: (1) A multiple objective waste disposal model was developed and analyzed. The model is a modification of the single objective waste disposal model of Alley, Aguado and Remson. The solution structure was obtained using the method of constraints so that dual variables (shadow prices) are available with the solutions. This model proved to be significantly better for analyzing the system than previous models. (2) An analysis of the objective space for a multiple objective linear program was completed with the development of an algorithm for determining the nondominated objective values that are extreme points. Since not all extreme points (nor edges) of the constraint space map to extreme points (edges) of objective space, this algorithm analyzes a simpler structure than that analyzed by algorithms based on the extreme points of the constraint space. This technique thus proves to be very powerful in analyzing large, multiobjective systems.
W86-02599

IMPROVING EFFECTIVENESS IN PLANNING AND EQUITY FINANCING OF STATE WATER RESOURCES MANAGEMENT,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 6E.
W86-02643

APPLIED MODELS FOR IMPROVED URBAN WATER MANAGEMENT,

Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
F. Tannian, and Y. D. Wang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101243/AS, Price codes: A05 in paper copy, A01 in microfiche. Delaware Water Resources Center Technical Completion Report, Newark, July 1983. 75 p, 14 fig, 7 tab, 10 ref, 1 append. A-037-DEL(1). 14-34-0001-6008.

Descriptors: *Water demand, *Delaware, *Water supply development, *Model studies, *Metropolitan water management, Decision making, Water rates, Water management, Future planning, Municipal water, Models, Mathematical models, Economic aspects, Prices, Income.

Aspects of water demand and supply conditions for two municipal water systems in Delaware, those of Wilmington and Neward, were investigated. These two water systems are the major public water suppliers in Delaware. All residential and commercial customers in the city limits of both places depend on these systems for water. In addition, large areas outside the city limits are also served by these two systems. Water management practices were evaluated by a structure of analysis based on microeconomics. This theory suggests that user behavior for any resource, not merely water, can be affected by incomes and by the price of the resource. Generally income variation is positively related with water demand and use, while price variation is inversely related to water use. Several sub-models were developed to state certain expected relations between water and several other variables such as cost, volume production, and water demand estimates. Once the ideas of the model frameworks were adapted to the form of equations, variables in the equations could be measured. Statistical analyses were used to estimate, for example, how price, income or perceptions of water quality are related to water use, water production or satisfaction with urban water systems. Implications for practical urban water management decisions and evaluation of the models and their outcomes are discussed.
W86-02705

POLICY ANALYSIS OF RESERVOIR OPERATION, VOLUME I: EXECUTIVE SUMMARY; VOLUME II: COMPONENT STUDIES,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. Cohon, C. ReVelle, J. Wright, J. Smith, and R. Steiner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-127289/AS, Price codes: A08 in paper copy, A01 in microfiche. Final Report, July 1982. 139 p, 7 fig, 6 tab, 75 ref. OWRT C-90308-C. 14-34-0001-0407.

Descriptors: *Water consumption, *Rainfall, *Drought, *Mathematical studies, *Model studies, Times series analysis, *District of Columbia, *Potomac River Basin, *Municipal water consumption, *Point process models, Poisson process, Cox process, Clustered point processes.

The effects on municipal water consumption of weather variables and of the change from a uniform rate structure to one with multiple blocks were investigated. The study consisted of building a model to predict water consumption based on price and weather variables and determining whether a new rate structure led to significant conservation. A least squares linear regression model was developed using aggregated water use per connection as the dependent variable and price of water, personal per capital income, precipitation and maximum daily temperature as explanatory variables. The criteria for analysis of the models consisted of examining the adjusted coefficient of determination and the standard error of estimate. Also the error terms were analyzed, and hypothesis tested and confidence intervals were specified for the estimated parameters. The models using daily data provided significant parameter estimates of the weather variables, that is, weather influences showed up clearly. The coefficient of the price variable was not significant. A set of point process models was derived for summer season rainfall in the Potomac River basin for application to drought management problems. The models were developed for application to streamflow prediction problems during drought periods and as a means to infer information on the processes that create and sustain droughts in the Potomac River basin. The modeling is termed as RCM process (for Renewal Cox process with Markovian intensity). Three topics pertaining to clustering in point process models of rainfall are discussed. First a frame work for interpreting clustering based on properties of the Poisson processes is presented. Clustering is viewed in terms of departures from the properties of Poisson (homogeneous) processes. The second topic, Cox processes (Poisson processes with randomly varying rates of occurrence) are presented. Thirdly, the overlaps among three classes of point processes are discussed; these three classes of point processes have commonly been used to model 'clustered' point process data: renewal processes, Poisson cluster processes, and Cox processes. The results that are presented have particular importance for model selection and interpretation.
W86-02730

6B. Evaluation Process

WATER MANAGEMENT SIMULATOR PRESENTATIONS,

Arkansas Univ., Fayetteville.
E. Mack.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211803, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, Pub No 112, 7 p, September 1984. G-829-22.

Descriptors: *Water management, Simulation analysis, Information exchange, *Arkansas, *Public participation, *Public education.

One of the larger stumbling blocks to comprehensive water management is the lack of public understanding of the multitude of variables that operate at the same time within the hydrologic cycle. With more public understanding, there is greater public support for various water projects. Dr. John R. Amend, Montana State University, developed a water management simulator which could handle a large number of variables simultaneously of natural surface and groundwater flow plus a number of water-use variables on an accelerated time sequence. By using several remote control devices, participants can 'control' their water use but have no control over other participants competing for the same water molecule. The purpose of this information transfer project was to demonstrate the use of the water management simulator and to begin to develop experienced teams of people from government agencies and academia to explain its operation to local professional and civic groups. The interest level is very high for the team members to learn about the operation of the water management simulator. The simulator demonstrations have been well received by various audiences.
W86-02451

IDENTIFICATION AND PRIORITIZATION OF THE WATER RESOURCES PROBLEMS AND RESEARCH NEEDS IN THE DISTRICT OF COLUMBIA,

District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, and S. A. Besse.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225969/AS, Price codes: A05 in paper copy, A01 in microfiche. Report No. 61, Sept. 1984. 81 p, 4 tab, 5 append. USGS G834-23.

Descriptors: *Washington(DC), *Urban hydrology, Priorities, *Problem identification, *Research needs, Objectives, Survey, Questionnaire, Statistical methods, Water quality, Non-point source pollution.

A survey was conducted to identify and prioritize the water resources problems and research needs in the District of Columbia. The survey was directed to individuals knowledgeable of the District's water resources. Using uni-objective ranking techniques, the three problem areas highlighted as most important were: (1) the water quality of the Anacostia River, (2) combined sewer overflows, and (3) degradation of surface waters from non-point source pollution. In the past the water quality and associated pollution problems of the Potomac River and Rock Creek Park have received much more attention. It is now understandable that the Anacostia River should be given more attention. It is well known that the Anacostia River is severly impacted by a concert of water pollution problems and that it is being considered for planned waterfront development. It has also been established that both non-point source pollution and combined sewer overflows are in one way or the other impacting the Anacostia and its tributaries and contributing to the overall poor health of its waters.
W86-02572

DERIVATION OF UNIT-DAY-VALUES FOR RECREATION BENEFIT VALUATION IN WATER RESOURCE PLANNING, BASED ON A COMPREHENSIVE THEORETICAL FRAMEWORK,

George Washington Univ., Washington, DC. Dept. of Engineering Administration.
R. C. Waters, and R. Valderrama.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225977/AS, Price codes: A03 in paper copy, A01 in microfiche. D.C. Water Resources Research Center, Washington, District of Columbia, Report N No 58, September 1984. 30 p, 40 ref. USGS G834-06.

Descriptors: *Recreational benefits, *Willingness-to-pay, *Contingent valuation, *Unit-day-values, *Travel cost method, Federal water resource planning, Valuation board, Economics, Planning.

The study concerns the provision of water-based recreation from federal investments. Access to water-based recreation opportunities are provided without charge. Since the user does not pay, the issue becomes: how much recreation access should be provided by the federal government for private consumption. The agencies have assumed that as long as benefits exceed costs then additional increments of recreation opportunities should be provided to the extent that Congress authorizes and appropriates the funds. The federal agencies have attempted to develop benefit valuation procedures consistent with the theoretical notion, which is based on welfare economics, of willingness-to-pay. These procedures are the travel cost method and the contingent valuation or survey method. Furthermore, as an interim measure, they have developed the unit-day-value method (UDVM). UDVM consists of an administratively determined value. This study evaluates the arguments associated with the various methods. Also, it weights the arguments and suggests a course for future action. The evidence suggests that federally provided water-based recreation is in reality a political process, furthermore the present recommended procedures even if correctly implemented do not lead to Parato optimal economic efficiency. They are faulty from both a theoretical and an operational basis. The UDVM is a more realistic approach to a complex problem which goes beyond economic efficiency. A valuation board of the Congress should be established to set appropriate values or guidelines for water-based recreation. Until then, leaving the valuation issue to each agency seems appropriately expedient.
W86-02573

UNCERTAINTY IN MODERN IMPOUNDMENT MODELS: EFFECTS AND METHODS OF ANALYSIS,

Nevada Univ. System, Las Vegas. Water Resources Center.
For primary bibliographic entry see Field 5B.
W86-02623

DEVELOPMENT AND MANAGEMENT OF WATER FACILITIES FOR SMALL COMMUNITIES: PROCEEDINGS OF A CONFERENCE,

Virginia Water Resources Research Center, Blacksburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242881/AS, Price codes: A06 in paper copy, A01 in microfiche. September 1981. 95 p. Edited by W. R. Kerns. OWRT C-00176-T(No. 0518)(4).

Descriptors: *Virginia, *Water resources development, *Water supply development, *Community development, *Resources development, Economic aspects, Water management, Resources management, Water demand, Water law.

The objective of this conference was to provide a forum for exchange of information and for discussion of issues and problems related to providing water for small communities and rural areas. Participants included owners and managers of water systems, elected and appointed officials, state and federal management personnel, and members of the scientific community. Presentations and discussion focused on the current state of water facilities, availability and protection of water supplies, organization of delivery systems, regionalization of systems, available resources for planning and development, rural water associations and management and financial analysis.
W86-02657

OPPORTUNITY COSTS: IRRIGATION VS. HYDROPOWER,

Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6C.
W86-02679

APPLIED MODELS FOR IMPROVED URBAN WATER MANAGEMENT,

Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
For primary bibliographic entry see Field 6A.
W86-02705

RED RIVER GORGE RESIDENTS: A CULTURAL AND HISTORICAL PERSPECTIVE,

Kentucky Water Resources Research Inst., Lexington.
P. L. Brinegar, B. R. DeWalt, and E. C. Scott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101318/AS, Price codes: A05 in paper copy, A01 in microfiche. Research Report No 156, June 1985. 74 p, 4 fig, 6 tab, 81 ref. A-079-KY. 14-34-0001-1119.

Descriptors: *Kentucky, *Recreation facilities, Recreation demand, Wild rivers, Tourism, Management planning, Social aspects, River recreation management, Landownership, National forests.

This study investigates the relationship between the remaining residents of Appalachian Eastern Kentucky's Red River Gorge area and their environment with special emphasis on the historical and current social factors that play a role in their refusal to vacate the area. For two decades, these people have faced the possibility of losing their land and homes to area development projects while they have simultaneously become aware of what it can mean to be labeled 'Appalachian'. Currently, they are contending with the implications of a management plan proposed by the U.S. Forest Service. Cross-cultural research on areas developed as recreational arenas indicates that the residents as a whole stand only to lose in such situations. The optimum solution from the perspective of the people along the Red River is to be left alone, but this is not going to happen as the popularity of the Gorge has steadily grown over the past years and as the Forest Service has greatly increased its holdings. Appropriate planning to reduce the losses of the locals who view their land as irreplaceable is suggested as a primary consideration in this area and in others where recreational development is planned.
W86-02712

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS PHASE II,

Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
R. G. White, A. E. Bingham, J. H. Milligan, M. A. Brusven, and C. A. Corraino.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214922/AS, Price codes: A10 in paper copy, A01 in microfiche. Technical Completion Report, Idaho Water Resources Research Institute, Moscow, March, 1985. 181 p, 64 fig, 28 tab, 77 ref. B-053-IDA(1). 14-34-0001-0216.

Descriptors: *Fish behavior, Fish populations, *Flow control, Invertebrates, *Idaho trout, Discharge fluctuations.

Two man-made test channels were used to investigate the effect of reduction of stream discharge on juvenile rainbow-steelhead trout and invertebrate

populations. Wild juvenile rainbow-steelhead trout responded to seasonal 95% reductions in discharge by emigrating from the test channel. An intermediate (50%) reduction in discharge during 1980 tests resulted in little change in number or biomass. Most emigration occurred during the first night following the 95% flow reduction and was predominantly upstream. Since aquatic insects drifted catastrophically during the 24 hours following flow reduction, habitat changes, rather than food limitation, are indicated as the causative factor. A poor relationship was observed between facing velocity and the corresponding 0.6 depth velocity utilized in several predictive models. The 95% flow reduction resulted in no decrease in benthic insect density except during spring. However, numbers of Baetis tricaudatus were reduced in all experiments. Species diversity and insect functional groups showed little response to reduced flows. Moderate numbers of insects were stranded in the spring; most insects were stranded in the fall. Reduced flows had little effect on the hyporheic insect community.
W86-02495

FINANCING URBAN WATER: EFFICIENCY AND EQUITY OF MAJOR ALTERNATIVES,

Arizona Univ., Tucson. Dept. of Economics.
R. B. Billings, E. F. McElwain, and W. M. Day.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227205/AS, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, Arizona Water Resources Research Center, Tucson, Sept 1984, 92 p, 1 fig, 24 tab, 96 ref. USGS G828-03.

Descriptors: *Arizona, *Water costs, *Water policy, Finance, *Cost repayment, Taxes, *Water pricing, Administration, Water management, Budgeting, Water demand, Prices, Forecasting, Water conservation, Economic efficiency.

Urban water utility costs will increase greatly in the future to expand capacity and repair deterioration. Alternative methods of financing increased costs are analyzed to trace effects on the economic efficiency of water use and on the equity of the distribution of costs. Effects on water demand and utility revenues are reviewed. The analytical framework is applied to a case study of how Tucson, Arizona and the Central Arizona Water Conservancy District (CAWCD) might finance their shares of the cost of Central Arizona Project (CAP) water. Numerical estimates of required extra sales, property and pump tax rates, and water user fee levels are estimated for a range of possible costs. The CAWCD could finance its CAP capital payments by the currently anticipated user fees and property tax, an additional property tax rate of 17 cents per $100 AV or a pump tax between $12 and $20 per acre foot. Tucson could finance its CAP-related costs with an extra retail sales tax rate of 0.1% to 0.2%, an additional 18 cents to 66 cents property tax rate, or a 12% to 21% increase in the real price of water, allowing for the price-induced drop in use by 2000.
W86-02585

OPPORTUNITY COSTS: IRRIGATION VS. HYDROPOWER,

Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
B. A. McCarl, and M. Ross.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-247997/AS, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-96, Corvallis, September 1984. 39 p, 3 fig, 7 tab, 20 ref. USGS G864-06. 14-08-0001-G-864.

Descriptors: *Opportunity costs, *Welfare costs, *Economic evaluation, *Hydroelectric power, Irrigation, *Irrigation requirements, *Water allocation, *Water management, Water use, Alternative water use, Competing use, Value, Costs, Economic aspects, *Cost analysis, *Electric power costs, Social costs, Economic models, *Columbia River Basin.

Costs imposed on participants in the electricity market arising from irrigation diversions from the Columbia River are analyzed. Six hypotheses are examined: a) that electricity consumers' welfare is not affected by irrigation diversions, b) that hydropower loss estimates derived using time- and location-specific data do not differ from those derived using average data, c) that water year chosen does not affect welfare losses, d) that demand elasticity does not affect welfare losses, e) that farmer repayments do not affect welfare losses, and f) that interruption of water in critical low-flow does not affect welfare losses. Electricity consumers are found to lose welfare when diversions are increased. Considering a potential diversion in Central Washington, the annual loss to electricity consumers is in excess of $100 per acre developed. When the government delivers water to farmers' fields, this loss exceeds $200 per acre. In addition, the welfare loss estimates are found to be sensitive to the amount of pumping costs diverters pay and to the potential interruption of diversions. The results under the diversion interruption simulation show potential for reducing the tradeoffs between irrigation development and hydroelectric power generation.
W86-02679

FINANCING WATER PROJECTS IN NORTH CAROLINA: THE STATE ROLE,

North Carolina Univ. at Chapel Hill. Dept. of City and Regional Planning.
T. Snyder, D. Whittington, and D. Hillstrom.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101284/AS, Price codes: A04 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Completion Report No 220, August, 1984. 62 p, 4 fig, 12 tab, 50 ref.

Descriptors: *Financing, *Water treatment facilities, Wastewater facilities, *User charges, *North Carolina.

Over the past decades, federal and state grants have been a major source of capital to build public-owned water and wastewater facilities in North Carolina. However, recent changes in policies at both levels have shifted the burden to local governments, some of whom may not have the financial capacity to expand and replace necessary facilities. This report reviews past patterns of grants for these facilities in North Carolina and their impact on recipient communities. Alternative financing options for state and local governments are examined, including a review of approaches either taken or being considered in other states. Criteria for evaluating alternatives as they may be adapted to the needs of North Carolina are also considered. The study examined the advantages and disadvantages of various policy options available to the State of North Carolina for assisting with the financing of water services. Five water-financing alternatives are evaluated: state grant and aid programs; state subsidization of loans and water bonds; user fees, special assessments, and local taxes; revision of state bonding authority; and private or public-private ownership of water facilities. From their examination of the current water-financing situation in North Carolina, the authors conclude that there is no magic, easy, or 'innovative' solution that will avoid the reality that water services are now generally underpriced in this state, and consumers will ultimately have to pay higher prices for water and sewer services or higher taxes to ensure high-quality water services.
W86-02709

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02885

6D. Water Demand

IMPACT ASSESSMENT OF COAL SLURRY PIPELINES ON WATER RESOURCES UTILIZATION AND ALLOCATION,

Kentucky Water Resources Research Inst., Lexington.
M. N. Saquib, M. L. Kavvas, D. T. Kao, and L. Ormsbee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214609/AS, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 153, August 1984. 100 p, 27 fig, 4 tab, 21 ref, 2 append. USGS G-844-06.

Descriptors: Water demand, Slurry pipelines, Pipelines, Slurries, Water consumption, *Kentucky, *Coal mining.

Pike county, the largest coal producing and exporting county from the state of Kentucky was studied to assess the impact of a possible coal slurry pipeline project on the water resources allocation and utilization in the region. Potential coal slurry pipelines from the region were identified and water requirement for operating several hypothetical pipelines were computed by using a recently developed computer program. Climatological data for the country were collected and analyzed for a 29-year period of record with a view to determining the monthly net consumptive use in the region. Available groundwater data for the region was also collected in an effort to assess the groundwater situation of the region. Present urban demand was quantified and an estimate of urban demand in 2010 A.D. was made by using the population projections. Streamflow data from three flow gaging stations encompassing almost the entire drainage basin of the streams in Pike county were collected. On the assumption that the water required for coal slurry pipelines would be withdrawn from a location near Pikeville, only the streamflow records from the USGS gaging station No. 03209500 on the Levisa Fork at Pikeville were analyzed to determine the risk in meeting the total demand (urban demand and minimum baseflow requirement plus combined demand for operating all seven hypothetical coal slurry pipelines) in any month of the year. The allowable demand at 5% risk defined as sustainable withdrawal was also computed on a monthly basis.
W86-02464

HOUSEHOLD CONSERVATION DURING WATER EMERGENCIES, TWO CASE STUDIES,

New Hampshire Univ., Durham. Dept. of Sociology.
L. Hamilton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214930/AS, Price codes: A06 in paper copy, A01 in microfiche. Project Completion Report, New Hampshire Water Resources Research Institute, Durham, Research Report No. 44, July 1984. 100 p, 19 fig, 13 tab, 11 ref. USGS G856-02.

Descriptors: *Water conservation, *Public opinion, Attitudes, Behavoir, *Water contamination, *New Hampshire, *Massachusetts, Water quality.

This report describes public reactions to water conservation programs in two New England communities (Milford, New Hampshire and Acton, Massachusetts) which recently lost water supplies due to chemical contamination. In both towns, data were collected from mailed questionnaires sent to random samples of households on the town water systems. These survey data were analyzed to shed light on patterns in the adoption of water-saving behavoirs by individual households, and on changes in public opinion regarding water issues following the crisis. The Milford and Acton data confirm several findings from an earlier study (Hamilton, 1983a) regarding the underlying 'types' of conservation behavoir, and their demographic and attitudinal predictors. The Milford data also supported earlier conclusions that larger users make the largest absolute reductions, but middle-use households make reductions that represent a larger percentage of their total consumption. In addition, these data show that discoveries of chemical contamination are viewed with considerable alarm among the general public, and there is broad support for strong remedial measures. Town officials who took such measures met with public approval. Water resources planning and protection

become high-priority issues in the wake of a contamination incident.
W86-02496

INCENTIVES FOR INDUSTRIAL CONVERSION TO SURFACE WATER,

Mississippi State Univ., Mississippi State. Div. of Business Research.
L. R. Cheatham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214989/AS, Price codes: A08 in paper copy, A01 in microfiche. Mississippi Water Resources Research Institute, Mississippi State, Technical Completion Report, September 1984, 151 p, 2 exhibits, 31 tab, 45 ref. USGS G-851-04.

Descriptors: *Ground water management, *Mississippi, *Overdraft, *Water policy, *Industrial development, Economic aspects, Water demand, Legislation, Water allocation, Water costs,.

The purpose of this study was to investigate alternative incentives which may be capable of inducing industrial firms, especially those classified as large volume water users, to convert to surface water for all or a major portion of their needs. Various legal restrictions and allocation rules applied to ground water overdraft situations in other states were evaluated for applicability to industrial users in Mississippi. State ground water law and ownership doctrine were investigated for impact they may have on ground water management policies and practices. Economics of water supply source selection for firms was examined to determine why they choose a public supply system, a self-supply ground water system and/or a self-supply surface water system. Existing water user firms in the state as well as national corporate offices were surveyed to determine types of feasible incentives along with potential undesirable economic side effects when present. A summary selection of the most promising legal and economic incentives was prepared for Mississippi along with justifications and limitations of each tool.
W86-02501

COMPLEXITY AS A MEASURE OF SIMULATION MODEL APPROPRIATENESS: COLUMBIA RIVER CONFLICT AS A CASE STUDY,

Washington Univ., Seattle. Dept. of Civil Engineering.
J. L. Cohan, R. N. Palmer, and D. P. Lettenmaier.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215093/AS, Price codes: A07 in paper copy, A01 in microfiche. Technical Completion Report No. 89, Washington Water Resources Research Institute, Pullman, August 1984. 135 p, 33 fig, 9 tab, 53 ref, append. USGS G876-05.

Descriptors: *Mathematical models, *Washington, *Water demand, Model complexity, Monte Carlo simulation, Hydropower production, Fish production, *Conflict resolution, Planning, Model studies.

This report addresses the problem of simulation model complexity in water resource systems planning. The level of complexity incorporated into a model is shown to be a primary determinant of the value of the model for use in decision-making. This is illustrated with a review of models being applied for management of the conflict between fish production and hydropower production in the Columbia River Basin. A two-part test is proposed for determining whether a model has incorporated an appropriate degree of complexity and is applied to the models reviewed. It is concluded that the models currently used to generate trade-offs between conflicting uses of water in the basin are too complex for conflict resolution.
W86-02512

TEMPERATURE REQUIREMENTS OF PACIFIC COASTAL STREAM FISHES,

California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 5C.
W86-02568

DESIGN OF A DROUGHT MANAGEMENT EXERCISE: SIMULATION GAMING APPLIED TO THE INDIANAPOLIS WATER SUPPLY SYSTEM,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W86-02580

COMPARISON OF FRESHWATER USE CUSTOMS ON ULITHI ATOLL WITH THOSE OF SELECTED OTHER MICRONESIAN ATOLLS,

Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
For primary bibliographic entry see Field 3B.
W86-02598

PROJECTIONS OF WATER AVAILABILITY IN THE AWR AND PECOS RIVER BASINS TO THE YEAR 2005,

New Mexico Univ., Albuquerque. Bureau of Business and Economic Research.
J. C. Tysseling, and B. McDonald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229789/AS, Price codes: A11 in paper copy, A01 in microfiche. Technical Completion Report, New Mexico Water Resources Institute Las Cruces, October 1984, 218 p, 69 tab, 34 ref, append. USGS G-858-05.

Descriptors: *New Mexico, *Available water, Water demand, *Economic growth, Water requirements, Water supply.

The management of New Mexico water resources requires an understanding of the magnitude of future water scarcity conditions so that planning can be provided which attempts to mitigate social costs associated with competition for available water supplies. Current and projected water supply and demand conditions are analyzed here for the Arkansas, White and Red River (AWR) and the Pecos River Basins in eastern New Mexico based on 1980 economic, demographic, and water use information. The combination of 1980 water use data reported by the State Engineer and economic and demographic data (provided by several sources) allows calculation of water use coefficients per unit of economic activity and per capita water demand requirements. The analysis is provided for each county served by the water resources of the two basins. Future water scarcity conditions are assessed at both the county and basin-wide level in relation to 1980 water supplies and potential increases in those supplies as identified by the State Engineer. Evident from the analysis is the limited growth and corresponding limited increased water scarcity conditions, which are expected to be found in the AWR Basin by 2005. In contrast, growth in the economy and population of the Pecos River Basin, and particularly the southern portion of that basin, results in significant demand increases in a region which for many years has been experiencing water scarcity conditions. Uncertainties with respect to future water supplies and demands are also identified for these two water basins.
W86-02607

WATER-USE COEFFICIENTS AND RESOUCE MULTIPLIER FOR OAHU, HAWAII,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. L. Bowen, P. S. Leung, and M. H. Vesenka.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232841/AS, Price codes: A03 in paper copy, A01 in microfiche. Hawaii Water Resources Research Center, Technical Report 164, August, 1984. 36 p, 12 tab, 1 fig, 24 ref, append. USGS G838-06. 14-08-0001-G838.

Descriptors: *Input-outcome analysis, *Leontief models, *Water use, Model studies, *Hawaii, Input-output model, Water use coefficients, Water multipliers, Oahu.

The proliferation of the number of water multipliers in recent years has increased the likelihood that misunderstanding and misuse will occur by practitioners not well trained in the interindustry analysis. What is needed is a more standardized terminology and a more critical evaluation of the meaning and use of these multipliers. To this purpose, water resources multipliers were estimated for Oahu, and the usefulness of such multipliers for public planning and decision making in Hawaii are critiqued. The method of analysis used is the Leontief input-output or interindustry model. The Oahu model was developed from data used to construct the state input-output (I-O) model. Water use by economic sector was estimated from primary and secondary data. Three general types of water multipliers were estimated and evaluated for Oahu. The water-final demand coefficients can be useful in estimating water use under alternative development scenarios. The water-own multiplier was found to have limited value for planning in Hawaii. The water-income ratio is supposed to quantify the tradeoff between sectoral income and water use. However, this ratio is conceptually troublesome and it takes multiplier analysis beyond its traditional positive role into the normative arena.
W86-02629

METHODOLOGY TO INCREASE PRECISION IN MEASUREMENT OF IRRIGATION EFFICIENCY,

Kansas Water Resources Research Inst., Manhattan.
R. D. Black, H. L. Manges, and D. B. Erickson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233047/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September, 1984, 47 p, 16 fig, 6 tab, 15 ref, 6 equations, 2 append. USGS G843-03.

Descriptors: *Kansas, Irrigators, Irrigator information, Enterprise information, *Water management information, Field information, *Groundwater management, Questionnaires, Water meters, *Water rights.

A twenty percent sample of the total population of 537 irrigators in the Equus Beds Groundwater Management District No 2 in south central Kansas was selected at random and surveyed. Data were obtained on a questionnaire administered by personal interview in four categories: irrigator information, farming enterprise information, water management information, and individual field information. The irrigators of the study area are a middle-aged group(52 years) on modest sized (< 500 acres or less) family farms. They grow and irrigate the common crops of the region: Wheat, grain sorghum, soybeans and corn. They are rather new in irrigation with about half having ten years or less experience but they have farmed all their lives, average 33 years. There is much room for improvement, but one third have water meters and nearly one quarter measure soil moisture and use consulting services to schedule irrigation. They do not, as a group, use all the water their water rights would permit. The twenty percent sample was generally large enough to measure the average response within plus or minus 10 percent error at a confidence limit of 95 percent. Procedures were found in the literature which, when combined with this data base, will allow estimates of sample size required for other irrigation surveys. The results also point out areas of questioning where the answers will most probably contain large errors unless the entire population is sampled.
W86-02649

APPLICABILITY OF MICROCOMPUTERS FOR MANAGING WATER IN SMALL RIVER BASINS,

Portland State Univ., OR. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W86-02681

6E. Water Law and Institutions

LEGAL CONSTRAINTS ON ALASKA'S WATER RESOURCE MANAGEMENT,

Alaska Univ., Fairbanks. Inst. of Water Resources.
R. E. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214732/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report I84-15, September, 1985. 20 p. USGS G827-06.

Descriptors: Laws, Legal aspects, Planning, Prior appropriation, *Water Law, *Alaska, *Legal constraints.

Alaska has a modern and efficient Water Use Act. From the position of western water law the Water Use Act is the most recent stage in the evolution of prior appropriation. The administration of both surface and groundwater as part of the same system is a major advantage over most western states. Alaskan communities, near population centers, are experiencing shortages in groundwater and some streams are over appropriated. The current program to establish the navigability of Alaska's water courses is most valuable and should establish new criteria as to what constitutes navigability for title. Large scale water transfers are becoming a modern reality with the Eklutna Water Project. The state needs to institute adequate safeguards to insure against undesirable transfers of water.
W86-02476

VOLUNTARY BASINWIDE WATER MANAGEMENT: SOUTH PLATTE RIVER BASIN, COLORADO,

Colorado Water Resources Research Inst., Fort Collins.
For primary bibliographic entry see Field 6A.
W86-02482

INSTITUTIONAL FRAMEWORK FOR CONJUNCTIVE USE OF SURFACE AND GROUND WATER,

Mississippi Univ., University. Bureau of Governmental Research.
R. E. McArthur, and D. B. Brammer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214906, Price codes: A05 in paper copy. A01 in microfiche. Mississippi University, Mississippi State Water Resources Research Institute, Technical Completion Report, September, 1984. 72 p, 41 ref, 3 append. USGS G851-02.

Descriptors: *Mississippi, *Management planning, *Institutional constraints, *Conjunctive use, Groundwater management, Water supply, Groundwater availability, Surface water availability.

Officials and citizens in two Mississippi counties considered their water supply situations, including proposals for alternative institutional arrangements for financing and managing water systems which would provide conjunctive use of surface and ground water to furnish more dependable water supplies and to protect the underlying aquifer from further decline. At the request of the Appalachian Regional Commission and the Tombigbee River Valley Water Management District, two engineering studies were undertaken earlier to determine the potential for ground and surface water resources in Alcorn and Lowndes counties, as well as economic constraints on development of those resources. This report concerns governmental factors which might affect the implementation of the recommendations suggested in those engineering studies. The research objectives were: (1) to analyze current relevant institutional arrangements which affected water resources planning and management in each county; (2) to present a Model Institutional Framework to encourage conjunctive use; and (3) to propose a program of action to implement the Model Institutional Framework.
W86-02493

INCENTIVES FOR INDUSTRIAL CONVERSION TO SURFACE WATER,

Mississippi State Univ., Mississippi State. Div. of Business Research.
For primary bibliographic entry see Field 6D.
W86-02501

POVERTY, POWER AND WATER RESOURCES ON THE PAPAGO RESERVATION,

Arizona Univ., Tucson. Dept. of Political Science.
H. M. Ingram, T. R. McGuire, and M. Wallace.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229714/AS, Price codes: A09 in paper copy, A01 in microfiche. Arizona Water Resources Research Center Completion Report, Tucson, Sept 1984. 170 p, 1 map, 15 tab, 153 ref. USGS G828-06.

Descriptors: *Indian water rights, *Legislation, Water development, Policy making, Political aspects, Public opinion, Groundwater management, *Arizona.

The relationship between poverty, lack of political power, and water resources on the Papago Reservation is examined. Through an examination of anthropological literature, the public record of newspaper reports, Congressional hearings, agency documents, and personal interviews with important actors, the report establishes the historic lack of Papago influence over water allocation and management in Southern Arizona. It finds that lack of Papago participation is the root cause of underdevelopment of the economy on the reservation. The Southern Arizona Water Rights Settlement Act of 1981 establishes how water resources can become a vehicle for enhanced Papago participation. A variety of alternative uses for Papago water are analyzed. Taking into account the responses of Papago people to several opinion surveys, the report recommends certain strategies for utilizing water and for coping with the political environment external to the reservation affecting water allocation and management.
W86-02600

NEW MEXICO WATER RIGHTS,

New Mexico Water Resources Research Inst., Las Cruces.
L. G. Harris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229763/AS, Price codes: A04 in paper copy, A01 in microfiche. Miscellaneous Report No. 15, March 1984. 54 p, 4 fig. USGS G858-23.

Descriptors: *Water law, *New Mexico, *Water rights, Riparian rights, Appropriation, Reservation Doctrine.

This booklet summarizes water rights concepts in general, and specifically, how those concepts apply to water law in New Mexico. Topics covered include: a historical perspective of water, the nature of water, the riperian doctrine of water use, the doctrine of prior appropriation, what is a water right, constraints on water rights, how to obtain a water right, water rights transactions, and penalities for the misuse of water. In addition, the book contains a glossary of water terms and a resource list of references and agencies for further information.
W86-02605

REPPUN V. BOARD OF WATER SUPPLY: PROPERTY RIGHTS, ECONOMIC EFFICIENCY AND ENSURING MINIMUM STREAMFLOW STANDARDS,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
W. B. C. Chang, and J. E. T. Moncur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232874/AS, Price codes: A04 in paper copy, A01 in microfiche. Hawaii Water Resources Research Center Technical Report 165, Honolulu, Sept. 1984. 45 p, 1 tab, 14 ref. USGS G838-04. 14-08-0001-G838.

Descriptors: *Water rights, *Public Trust Doctrine, *Water transfer, Economic efficiency, Streamflow, Riparian rights, *Hawaii, Reppun v. Board of Water Supply, Riparian Doctrine, Public Use Doctrine.

Two recent decisions of the Hawaii Supreme Court have substantially modified the ground rules governing water rights in the state. The principal economic result of these decisions is the limitations they impose, if they survive appeals, on rights of individual water users to exchange water rights. This report inquiries into the values the Court appears to have had in mind in imposing such restrictions. From a legal standpoint, the paper argues that the Court's decision in Reppun v. Board of Water Supply sought not so much to protect the taro famers from loss of water as to protect in-stream water uses such as fishing and aesthetics. A brief summary of the economics of growing taro in Waihee Valley suggests that the water in question has much higher-valued uses than traditional taro cultivation, and notes a broad framework of principles that would allow efficient allocation of water between users, uses and places of use, covering traditional as well as in-stream uses.
W86-02632

IMPROVING EFFECTIVENESS IN PLANNING AND EQUITY FINANCING OF STATE WATER RESOURCES MANAGEMENT,

Kansas Water Resources Research Inst., Manhattan.
J. C. Peck, and R. L. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232981/AS, Price codes: A07 in paper copy, A01 in microfiche. Kansas Water Resources Research Institute Completion Report, Manhattan, January 1985, 124 p, 11 ref, 3 append. USGS G843-06.

Descriptors: *Water resources planning, *Kansas State government expenditures, Project development, Cost recovery, Administrative costs, Property tax, Severence tax, Ad valorem tax, *Water rights, Groundwater, Irrigation.

An analysis of the nature and scope of state water resources planning programs is undertaken. The results clearly indicate state water planning programs can and should serve more than project development issues. Typically, state government expenditures in water resources management can be classified under broad functional headings of planning, regulation, data collection and research and physical project development. It is concluded that the best opportunities for significant cost recovery of state water management efforts are found within the regulatory and project development functions. The possibility of recovering administrative costs via a tax or fee related to water rights is explored. Other states tax water rights in various ways, the most common method as a tax on real property, since a water right is generally deemed to be a real property interest appurtenant to land. Water is sometimes taxed based on the amount of withdrawal. Kansas arguably taxes water rights as part of its ad valorem tax on real property and as part of the groundwater management district water use charges. The Kansas severence tax does not include water as a mineral to be taxed. Under the Kansas property tax, water rights are not expressly included in the tax, and practice varies widely throughout the state. The water right is not even noted in eastern Kansas, while it is more often included in the assessment in western Kansas where groundwater is used for irrigation. The legislature could amend Kansas laws to clearly include water rights as part of property taxes, and it could enact a separate tax on water withdrawals as a kind of exise or pump tax.
W86-02643

APPLICABILITY OF MICROCOMPUTERS FOR MANAGING WATER IN SMALL RIVER BASINS,

Portland State Univ., OR. Dept. of Civil Engineering.
R. W. Koch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-248011/AS, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-97, Corvallis, August 1984. 51 p, 6 fig, 6 tab, 20 ref. USGS G864-07. 14-08-0001-G-864.

Descriptors: *Water management, *Water use, *Water rights, *Water allocation, Available water, Computers, *Computer applications, Computer models, Modeling, Routing, *Streamflow routing, Soil moisture, Soil water, Tualatin River Basin, *Oregon.

The task of managing water resources under the appropriative system of water rights normally is one of simply assuring that the legal priority is satisfied. To maximize availability of water in a tightly constrained system requires the cooperation of users by increasing their efficiency of water use. To accomplish this, information on the best timing and amount of water application is required. To aid the local individual such as a watermaster or irrigation district manager in making decisions and providing information to water users on water availability, given the complex nature of the hydrologic system, software has been developed in this project to allow the necessary analysis. Water rights information such as priority date, location, amount of use, and type of use is computerized in combination with descriptions of the water use component, principally irrigation, and the river system. The water use component accounts for soil moisture while the river model accounts for the time-varying reaction of streamflow to various water withdrawals and inflows. The application of efficient computer algorithms allows use of the microcomputer. Applying these models, the water manager can investigate the effects of decisions regarding water distribution as well as provide short-term forecasts of demand and availability to aid the water users in increasing their efficiency, thus providing greater supply.
W86-02681

HYDROLOGIC AND LEGAL ASSESSMENT OF GROUND WATER MANAGEMENT ALTERNATIVES FOR IDAHO,

Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
For primary bibliographic entry see Field 4B.
W86-02687

DEVELOPMENT AND IMPLEMENTATION OF A PROCEDURE TO RESOLVE TRANSBOUNDARY ISSUES BETWEEN MONTANA AND THE CANADIAN PROVINCES OF ALBERTA, SASKATCHEWAN AND BRITISH COLUMBIA,

Montana State Univ., Bozeman. Forty-Ninth Parallel Inst.
C. Martin, A. Stanley, S. Maly, and L. McKinsey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101276/AS, Price codes: A03 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Bozeman, Report No. 144, 1985. 34 p, 99 ref. USGS G-853-06. 14-08-0001-G-853.

Descriptors: *International disputes, *International waters, *Treaties, Equitable apportionment, *Water allocation(Policy), *International Joint Commission, Canada, Montana, Administrative agencies, Transboundary water issues, *Intergovernmental relations, *Boundary Waters Treaty.

Four separate international river basin issues affect Montana and three neighboring Canadian provinces. Several federal and state government agencies are involved, usually on an intermittent ad hoc and reactive basis. Gaining results has been costly, time-consuming, and not always satisfactory to U.S. interests. This project explored an alternative strategy for more effective monitoring and resolution of river basin issues. The research design consisted of two phases. The first phase involved building a process for mediating transboundary water issues between Montana and the bordering provinces. The second phase was to test the process on two critically important transboundary water issues in the Milk/St. Mary and Poplar River Basins. The results of the project included recommendations for future negotiations, establishing a clearinghouse for inter-governmental negotiations, establishing a task force to respond to Canada's initiatives on the Milk River, and a positive response to the International Joint Commissions recommendations on the Poplar River.
W86-02708

6G. Ecologic Impact Of Water Development

DESIGN AND MANAGEMENT OF IRRIGATION PROJECTS FOR THE SUSTAINED BENEFIT OF WILDLIFE: A BIOECONOMIC ANALYSIS OF THE EAST HIGH AREA OF THE COLUMBIA BASIN PROJECT,

Washington State Univ., Pullman. Dept. of Agricultural Economics.
S. C. Matulich, J. E. Hanson, and J. Buteau.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211696/AS, Price codes: A13 in paper copy, A01 in microfiche. State of Washington Water Research Center, Pullman, Technical Completion Report No. 53, November, 1983. 276 p, 20 tab, 56 fig, 59 ref, 4 append. OWRT B-086-WASH(1). 14-34-0001-9160.

Descriptors: Wildlife habitat enhancement, *Wildlife management, Planning, *Irrigation effects, Environmental effects, *Economic analysis, *Washington, *Columbia Basin, Irrigation project, Mallards, Pheasant, Model studies, Bioeconomic models, Cost effectiveness, Habitat evaluation procedures.

A bioeconomic modeling framework is developed to incorporate wildlife habitat enhancement planning into the proposed East High area of Washington's Columbia Basin Irrigation Project. The planning framework developed here provides the essential linkage between modeling the biological response to habitat manipulation, and an economic criterion to choose among alternative habitat management strategies or plans. The Habitat Evaluation Procedures (HEP) developed by the U.S. Fish and Wildlife Service served as the biological response model. However, HEP was expanded/linked to technically feasible habitat management actions and a mathematical programming model to determine alternative cost effective enhancement plans. The modeling procedure is detailed. Empirical analysis targeted breeding habitat enhancement for the mallard (Anas platyrhynchos) and year-round habitat enhancement for the ring-necked pheasant (Phasianus colchicus). Centralized, off-farm enhancement opportunities were investigated on three land strata: unirrigable class 6 lands, the carriage and distribution system, and miscellaneous class 1 to 3 irrigable lands. The most significant and cost effective enhancement opportunity was found to be on unirrigable lands. To a large extent, this finding is a consequence of the unique physiographic features of the project setting. Both project specific and general enhancement recommendations are made.
W86-02440

BIOHYDROLOGY OF MOUNTAIN FLUVIAL SYSTEMS: THE YELLOWSTONE (PARTS I AND II),

Montana Univ., Missoula.
A. J. Silverman, and W. D. Tomlinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211811, Price codes: A99 in paper copy, E04 in microfiche. Montana Water Resources Research Center Completion Report 147, December, 1984. 691 p, 17 tab, 16 fig, 3 append. USGS G-853-02.

Descriptors: Riparian waters, Riparian land, Riparian plants, Surface water, Water quality, Fisheries, Wildlife, Amphibians, Mammals, Reptiles, Birds, *Yellowstone River, Riparian zone, *Riparian ecology, Water withdrawals, *Montana.

This project compiled principal research and investigative reports that have been performed on the Yellowstone River, and has organized and annotated them in a uniform fashion. From this informational base some insights into the character and function of the Yellowstone riparian community have developed as well as some perspective of historical extent, current size, activities influencing its condition and mechanisms for mitigating loss and damage to the zone, particularly prime river bottom cottonwood. The report text consists of nine chapters pertaining to 1) general riparian sone properties, form and function; 2) geology and geomorphology of the river; 3) history of cultural activity and resources of the Yellowstone; 4 & 5) Yellowstone River riparian vegetation and wildlife; 6) the river's fisheries; 7) river based recreational use and trends; 8) threats to the Yellowstone river and its riparian zone; and 9) riparian protective or mitigative measures. The report also contains a series of matricies that display occurrence, distribution, use, and current status information for the birds, mammals, reptiles, and amphibians found in the 7 latilongs through which the Yellowstone flows.
W86-02452

EFFECT OF HYDROPERIOD ON FLOODPLAIN FOREST PRODUCTION,

Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2I.
W86-02462

WETLANDS AND COAL SURFACE MINING: A MANAGEMENT HANDBOOK WITH PARTICULAR REFERENCE TO THE ILLINOIS BASIN OF THE EASTERN INTERIOR COAL REGION,

Kentucky Water Resources Research Inst., Lexington.
M. A. Cardamone, J. R. Taylor, and W. J. Mitsch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214682/AS, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 154, September 1984. 113 p, 15 fig, 6 tab, 65 ref, append. G-844-23.

Descriptors: Wetlands, Coal surface mining, Ecosystems, *Kentucky, *Environmental protection.

This report outlines management operation for protecting wetlands during the surface mining of coal, particularly for the portion of the Eastern Interior Coal Region that is found in Kentucky, Indiana, and Illinois. It is presented in manual form for use by coal mine operators, regulatory agencies and research institutions. The previous phases of the project produced an atlas of the most heavily-mined areas of the western Kentucky coal field, which classified and identified wetlands in these areas, and discussed some specific impacts of mining on these wetlands. The need to present information that will lead to action by coal operations and regulatory agencies to protect wetland areas, is the incentive for this work. The main issues addressed in this manual include: basic information for identifying wetlands; wetland values, and methods used for values assessment; how coal mining can affect wetlands; a method for addressing wetland protection needs and some prevention and mitigation actions; reclamation alternatives, including wetland restoration and the creation of wetlands as alternative ecosystems on mined areas; and general legal and regulatory information concerning wetland protection and surface mining of coal. Information was gathered through a search of current literature and by contact with state and federal agencies, some coal mining operations, and other concerned organizations. A detailed listing of places to go for more information is included.
W86-02471

AQUATIC RESOURCES MANAGEMENT OF THE COLORADO RIVER ECOSYSTEM: PROCEEDINGS OF THE 1981 SYMPOSIUM ON THE AQUATIC RESOURCES MANAGEMENT OF THE COLORADO RIVER ECOSYSTEM, NOVEMBER 16-18, 1981, LAS VEGAS, NEVADA,

Utah Water Research Lab., Logan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214815/AS, Price codes: A99 in paper copy, E04 in microfiche. Ann Arbor Science, Ann Arbor, MI. 1983. 697 p. Edited by V.D. Adams and V.A. Lamarra. OWRTC-00176-T. 14-34-001-0518.

Descriptors: *Environmental effects, *Watershed management, Reservoirs, *Ecosystems, Rivers, *Aquatic habitats, *Water quality, *Oil shale, *Salinity, Fish management, Economic aspects, Legal aspects, Wildlife, Aquatic life, Recreation, Lakes, Water rights, *Colorado River, Mountain watersheds, Water management, Weather modificaton, Cloud seeding, Nutrients, Phosphorus, Algae, Energy, Lake Powell, Lake Mead, Arid lands.

The symposim addresses the problems confronting managers of the Colorado River system, which has been called the most regulated river system in the world. Millions of people in 7 relatively arid states and Mexico depend on this water resource for irrigation, municipal and industrial water supplies, energy development, fish and wildlife activities, and recreation. Topics included in the symposium are reservoirs (operation, effects on water quality, nutrients), main streams (effects of recreation on the ecosystem, availability of phosphorus to algae, characterization of tributaries), weather modification by cloud seeding in the watershed, oil shale development (effect on ecosystems and water quality), salinity (source, fate, and control), fisheries management, and economic and legal aspects.
W86-02484

CONTROL OF ALGAL DOMINANCE THROUGH CHANGES IN ZOOPLANKTON GRAZING, LAKE WASHINGTON: PHASE II,

Washington Univ., Seattle. School of Fisheries.
H. J. Hartmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215119/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, August 1984. 53 , 17 fig, 7 tab, 18 ref. USGS G876-08.

Descriptors: *Fish behavior, *Washington, *Algae, *Zooplankton grazing, Selective feeding, Feeding morphology, Zooplankton-phytoplankton interactions, Phosphorus recycling, Phytoplankton species succession, Daphnia pulicaria, Diaptomus ashlandi, stephenodiscus hantzschii, ankistrodesmus sp., Oscillatoria aghardii, Lake Washington, Claderocerans, Copepods, Diatoms, Blue-green algae, Water clarity.

Food gathering and selective grazing behavior of the calanoid copepod Diaptomus ashlandi and the cladoceran pulicaria from Lake Washington were compared as part of a larger study that examines the grazing and phosphorus-recycling roles of pelagic lacustrine zooplankton in relation to phytoplankton abundance and species succession. Proportionally mixed double-isotope (32P-33P) labeled pairs of a diatom (stephanodiscus hantzschii), a green alga (ankistrodesmus sp.) and a filamentour blue-green bacterium (Oscillatoria aghardii) were fed to Diaptomus copepodites to measure clearance and ingestion rates and examine selectivity behavior. Both grazers preferred Stephanodiscus over Ankistrodesmus, but the feeding niches were separated along boundaries determined by totl algal biomass and the relative abundance of each alga. When algal density was great (>1000 cells/ml), Diaptomus selected for Stephanodiscus to a greater extent than Daphnia. With lower algal density (< 1000 cells/ml), or when Stephanodiscus were relatively common (>60% of total algal biomass), Daphnia selected the diatom more consistently than Diaptomus. Oscillatoria strands interfered with the feeding of small neonate Daphnia, but not with larger adult Daphnia or Diaptomus. The divergent feeding behavior patterns were interpreted through scanning microscope examination of the animals' feeding morphologies.
W86-02514

STUDY OF THE MECHANICS OF GROUND-WATER AQUIFER/AQUITARD EXPANSION CAUSED BY HEATING,

Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-02553

DISTRIBUTION OF DENITRIFYING AND SULFATE REDUCING BACTERIA WITHIN A RIPARIAN ZONE ALONG A MOUNTAIN STREAM,

Wyoming Univ., Laramie. Coll. of Agriculture.
Q. D. Skinner, and J. C. Adams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229748/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Wyoming, Water Research Center, Laramie, October 1984. 69 p, 3 fig, 7 tab, 78 ref, 6 append. USGS G879-07.

Descriptors: *Wyoming, *Soil bacteria, *Forest hydrology, Bacteria, Distribution patterns, Riparian vegetation, Soil environment, *Nashfork Hydrological Observatory, *Medicine Bow National Forest, *Telephone Creek.

The presence and activity of denitrifying bacteria, as well as bacteria capable of reducing sulfate in one upland and five riparian soils of a mountain watershed in Wyoming, were studied during the summer and fall of 1983. Research was conducted on the Nashfork Hydrologic Observatory west of Laramie, Wyoming within the Medicine Bow National Forest. A 30 x 100 m study site was located along Telephone Creek 40 m upstream from a stream flow gaging station. Bacteria were enumerated from soil samples collected along transects placed perpendicular to stream flow across three plant communities; wet meadow, moist meadow, and upland. Soil samples were taken from 5, 15, and 30 cm below the soil surface. Six sampling periods were utilized to develop the database, three during August and three during September. Soils were characterized by soil water content, soil pH, and percent organic matter. This study found that: 1) Nitrous oxide production was higher at 5 cm than at 15 or 30 cm for the soils of riparian habitat in a high mountain watershed; 2) Nitrous oxide production appeared greater in soils containing more organic matter, higher water contents, and located nearer to the stream; 3) Denitrifying, sulfate-reducing, and heterotropic aerobic bacteria appeared more abundant at 5 to 15 than at 30 cm depths, and, in general, increased with proximity to stream side; and 4) Organic matter content and water content increased with decreasing depth and proximity to the stream edge. The greater apparent abundance and activity of microorganisms in close proximity to the edge of the stream indicates that these soils could be of importance in protecting and regulating nutrient inputs to the stream from adjacent lands.
W86-02603

COMPARISON OF HABITATS NEAR SPUR DIKES, CONTINUOUS REVETMENTS, AND NATURAL BANKS FOR LARVAL, JUVENILE, AND ADULT FISHES OF THE WILLAMETTE RIVER,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
H. W. Li, C. B. Schrenck, and R. A. Tubb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246783/AS, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-95, Corvallis, September 1984. 15 p, 7 tab, 18 ref. USGS G864-05. 14-08-0001-G-864.

Descriptors: *Aquatic habitats, Habitats, Riprap, *Bank protection, *Bank stabilization, Aquatic life, *Stream fisheries, Fish, Aquatic ecosystems, Alluvial rivers, Stream banks, Dikes, Spur dikes, Revetments, *Ecological effects, *Willamette River, Oregon.

Natural banks, because they are diverse in structure, afford the best habitat for resident fishes of the mid-Willamette River. Spur dikes contain a diversity of habitats, in terms of velocities, depths, and cover, that is unavailable at continuous revetments. The numbers of species of fishes and the densities of larval and juvenile fishes at spur dikes are intermediate between those at natural banks and at continuous revetments. The numbers of species of adult fishes found were similar at spur dikes and continuous revetments. Juvenile chinook salmon were found to use the slack water between spur dikes during early spring but were not captured near continuous revetments. Wood debris was observed to accumulate between spur dikes. As more debris accumulates and riparian vegetation develops, habitat for adult fishes should improve, especially during the winter. Relationships between habitat variables and juvenile fish density changed between major sampling periods. This is due to changes in habitat needs during fish growth, but also reflects that physical gradients such as temperature and velocities became less severe as time passed. Two factors were consistent: juvenile fishes avoided velocities greater than 11 cm/sec and were found at depths not greater than 30 cm.
W86-02672

FISH ABUNDANCE UPSTREAM FROM DWORSHAK DAM FOLLOWING EXCLUSION OF STEELHEAD TROUT,

Idaho Univ., Moscow. Dept. of Fish and Wildlife.
C. M. Moffitt, and T. C. Bjornn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249167/AS, Price codes: A04 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute, Moscow, Completion Report, June, 1984. 54 p, 5 fig, 3 tab, 8 ref. USGA G839-04. 14-08-0001-G839.

Descriptors: *Idaho, *Anadromous fish, *Trout, *Dam effects, *Fish barriers, Fish population, Fish management, Dworshak Dam.

Fish abundance was determined by underwater fish counts in selected locations on twelve tributary streams of the North Fork Clearwater River, Idaho. Fish numbers, species composition and fish density were compared to results from previous studies of the watershed to determine what changes have occurred in the fish populations fifteen years after anadromous fish were excluded from the watershed by the construction of Dworshak Dam. Rainbow trout, Salmo gairdneri, continue to be the most abundant species in most tributaries of the North Fork Clearwater River. Average fish densities have decreased markedly since the elimination of anadromous forms of rainbow trout (steelhead trout). Historically, large numbers of juvenile steelhead trout utilized the habitat in the tributaries of the North Fork of the Clearwater River, but resident forms of rainbow and cutthroat trout, Salmo clarki, are not fully utilizing this space. Further studies to increase the potential for fish production are suggested, including evaluation of introducing adfluvial or later-maturing stocks of rainbow and cutthroat trout.
W86-02695

GROUND-WATER CONDITIONS IN AND NEAR THE GILA RIVER INDIAN RESERVATION, SOUTH-CENTRAL ARIZONA,

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02804

SALINITY CHARACTERISTICS AND DISTRIBUTION AND EFFECTS OF ALTERNATIVE PLANS FOR FRESHWATER WITHDRAWAL, LITTLE MANATEE RIVER ESTUARY AND ADJACENT AREAS OF TAMPA BAY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2L.
W86-02883

7. RESOURCES DATA

HARMONIC ANALYSES OF STREAM TEMPERATURES IN THE UPPER COLORADO RIVER BASIN,

Geological Survey, Lakewood, CO. Water Resources Div.
T. D. Steele.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4290, 1985. 51 p, 9 fig, 10 tab, 20 ref.

Descriptors: *Time series analysis, *Water temperature, Regional analysis, Stream temperature, Upper Colorado River Basin, Harmonic analysis, *Piceance Basin, *Colorado River Basin.

Harmonic analyses were made for available daily water-temperature records for 36 measurement sites on major streams in the Upper Colorado River Basin and for 14 measurement sites on streams in the Piceance structural basin. Generally (88 percent of the station years analyzed), more than 80 percent of the annual variability of temperatures of streams in the Upper Colorado River Basin was explained by the simple-harmonic function. Significant trends were determined for 6 of the 26 site records having 8 years or more record. In most cases, these trends resulted from construction and operation of upstream surface-water impoundments occurring during the period of record. Regional analysis of water-temperature characteristics at the 14 streamflow sites in the Piceance structural basin indicated similarities in water-temperature characteristics for a small range of measurement-site elevations. Evaluation of information content of the daily records indicated that less-than-daily measurement intervals should be considered, resulting in substantial savings in measurement and data-processing costs. (USGS)
W86-02917

7A. Network Design

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN IOWA,

Geological Survey, Iowa City, IA. Water Resources Div.
I. L. Burmeister, and O. G. Lara.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4171, 1984. 66 p, 11 fig, 3 tab, 22 ref.

Descriptors: *Hydrologic data collections, *Network design, *Cost-benefit analysis, *Operating costs, Optimization alternative planning, Scheduling, *Iowa.

Data uses and funding sources were identified for the 122 surface-water stations (including reservoir, lake, stage only, and miscellaneous stations) operated by the U.S. Geological Survey in Iowa. There are 110 continuous streamflow stations currently being operated in Iowa with an annual budget of $592,000. The average standard error of estimation in continuous-streamflow records is 11.4 percent. Under the existing budget, it was shown that this overall degree of accuracy at the 110 continuous streamflow stations could be improved to 10.5 percent if the gaging schedule was optimized. A minimum budget of $543,000 is required to operate the present stream-gaging program in Iowa, with an average standard error of 12.5 percent. The maximum budget analyzed was $1,235,000, which resulted in an average standard error of 4.2 percent. A realistic budget of $656,000 would result in a standard error of 8.4 percent. There are still a few basins with drainage areas greater than 200 square miles that have no continuous streamflow data. Continuous streamflow stations need to be established in these basins as funds become available. Data simulated by using the flow-routing and regression methods for stations in six river basins do not meet the accuracy required for their data use. (USGS)
W86-02773

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NORTHEASTERN CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
S. H. Hoffard, V. F Pearce, G. D. Tasker, and H. W. Doyle.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4127, 1984. 107 p, 13 fig, 39 tab, 17 ref.

Descriptors: *Hydrologic data, Stream gages, *Stream discharge, *Data collections, *California, Program analysis, Uncertainty.

Results are documented of a study of the cost effectiveness of the stream-gaging program in northeastern California. Data uses and funding sources were identified for the 127 continuous stream gages currently being operated in the study area. One stream gage was found to have insufficient data use to warrant cooperative Federal funding. Flow-routing and multiple-regression models were used to simulate flows at selected gaging stations. The models may be sufficiently accurate to replace two of the stations. The average standard error of estimate of streamflow records is 12.9 percent. This overall level of accuracy could be reduced to 12.0 percent using computer-recommended service routes and visit frequencies. (USGS)
W86-02774

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAM IN ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
D. M. Mades, and K. A. Oberg.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4123. 107 p, 10 fig, 11 tab, 25 ref.

Descriptors: Error analysis, *Cost effectiveness, *Networks, Operating policies, *Optimization, *Stage-discharge relations, *Stream gages, *Streamflow, Operating costs, Rivers, Statistics, Data use, *Illinois, Kalman Filter, Streamflow routing.

Data uses and funding sources were identified for 138 continuous-record discharge-gaging stations currently (1983) operated as part of the stream-gaging program in Illinois. Streamflow data from five of those stations are used only for regional hydrology studies. Most streamflow data are used for defining regional hydrology, defining rainfall-runoff relations, flood forecasting, regulating navigation systems, and water-quality sampling. Based on the evaluations of data use and of alternative methods for determining streamflow in place of stream gaging, no stations in the 1983 stream-gaging program should be deactivated. The current budget (in 1983 dollars) for operating the 138-station program is $768,000 per year. The average standard error of instantaneous discharge for the current practice for visiting the gaging stations is 36.5 percent. Missing stage record accounts for one-third of the 36.5 percent average standard error. (USGS)
W86-02782

PRESENT AND PROPOSED GROUND-WATER LEVEL PROGRAM IN MAINE,

Geological Survey, Augusta, ME. Water Resources Div.
J. T. Adamik.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report, 84-4235, 1984. 37 p, 11 il, 6 tab, 17 ref.

Descriptors: *Observation wells, *Network design, Aquifers, Groundwater, Water-level fluctuations, *Maine.

A statewide observation-well program was designed for Maine. Three networks were designed to provide reliable data to describe the effects of natural and manmade stress on water levels in the State. They are a climatic-effects network, a terrain-effects network, and a local-effects network. Review of the 32 observation wells in the current program showed that only 17 wells should be retained. Each of these wells was assigned to one of the three types of networks. Fourteen wells were deactivated because of reliability problems and one was deactivated because it provided redundant data. The installation of seven additional wells in climatic-effects network is the highest priority of the proposed program. The next priority is to install 22 additional wells in the terrain-effects network. Implementation of local-effects network sites will be responsive to increases in ground-water usage and the data needs of water-resources managers. (USGS)
W86-02788

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
G. B. Engel, K. L. Wahl, and J. A. Boohar.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4098, 1984. 76 p, 5 fig, 7 tab, 21 ref.

Descriptors: *Surface water, *Streamflow, *Gaging stations, *Cost analysis, Discharge measurements, *Nebraska, *Cost effectiveness.

This report documents the results of a study of the cost-effectiveness of the streamflow information program in Nebraska. Presently, 145 continuous surface-water stations are operated in Nebraska on a budget of $908,500. Data uses and funding sources are identified for each of the 145 stations. Data from most stations have multiple uses. All stations have sufficient justification for continuation, but two stations primarily are used in short-term research studies; their continued operation needs to be evaluated when the research studies end. The present measurement frequency produces an average standard error for instantaneous discharges of about 12 percent, including periods when stage data are missing. Altering the travel routes and the measurement frequency will allow a reduction in standard error of about 1 percent with the present budget. Standard error could be reduced to about 8 percent if lost record could be eliminated. A minimum budget of $822,000 is required to operate the present network, but operations at that funding level would result in an increase in standard error to about 16 percent. The maximum budget analyzed was $1,363,000, which would result in an average standard error of 6 percent. (USGS)
W86-02885

GEOHYDROLOGY AND GROUND-WATER QUALITY MONITORING NETWORK FOR THE LOWER MOJAVE RIVER VALLEY, CALIFORNIA,

Geological Survey, Santee, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02888

DESIGN OF A GROUND-WATER QUALITY MONITORING NETWORK FOR THE SALINAS RIVER DRAINAGE BASIN, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
P. Showalter, J. P. Akers, and L. A. Swain.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225 USGS Water-Resources Investigations Report 83-4049, 1984. 73 p, 10 fig, 5 pl, 10 tab, 21 ref.

Descriptors: *Groundwater hydrology, *Alluvial aquifer, *Surface-ground water relations, Water quality, *Network design, Monitoring, Geohydrologic units, *California, Salinas River basin, Paso Robles Basin, Monterey County, San Luis Obispo County.

A regional ground-water quality monitoring network for the entire Salinas River drainage basin was designed to meet the needs of the California State Water Resources Control Board. The project included phase 1--identifying monitoring networks that exist in the region; phase 2--collecting information about the wells in each network; and phase 3--studying the factors--such as geology, land use, hydrology, and geohydrology--that influence the ground-water quality, and designing a regional network. This report is the major product of phase 3. Based on the authors' understanding of the ground-water-quality monitoring system and input from local offices, an ideal network was designed. The proposed network includes 317 wells and 8 stream-gaging stations. Because limited funds are available to implement the monitoring network, the proposed network is designed to correspond to the ideal network insofar as practicable, and is composed mainly of 214 wells that are already being monitored by a local agency. In areas where net-

work wells are not available, arrangements will be made to add wells to local networks. The data collected by this network will be used to assess the ground-water quality of the entire Salinas River drainage basin. After 2 years of data are collected, the network will be evaluated to test whether it is meeting the network objectives. Subsequent network evaluations will be done very 5 years. (USGS)
W86-02909

7B. Data Acquisition

MEASUREMENT OF LOW FLOW VELOCITIES FOR SHALLOW BODIES OF WATER,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
J. P. Laible, and A. Booth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214559/AS, Price codes: A04 in paper copy, A01 in microfiche. Vermont Water Resources Research Center Completion Report, Burlington, December, 1984. 60 p, 6 fig, 20 ref, append. USGS G873-06.

Descriptors: Lakes, Shallow lakes, Currents, *Current measurement, *Velocity measurement, *Flow meters.

The development of a low cost, low velocity (0-15 cm/sec) current meter is described. Several low velocity current measurement techniques are also surveyed. The developed current meter uses a thermistor, operating in a low overheat quasi-constant current mode, as the flow sensor. Velocity is determined by measuring the thermistor bead temperature by measuring the time to charge a capacitor through the thermistor between two known voltage levels. The useable velocity range was found to be 0-5 cm/sec making the probe useful for near bottom sampling but not for open flow situations. The limited velocity range can be avoided by converting the probe to a constant temperature mode using a microprocessor for positive control. Work on this technique is proceeding. Current direction is measured with a commercially available optically coupled direction head. The developed current meter is very low in cost, has a low power requirement and is suitable for remote operation.
W86-02459

USE OF INDUCED FLUORESCENCE MEASUREMENTS TO ASSESS ALUMINUM-ORGANIC INTERACTIONS IN ACIDIFIED LAKES,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5C.
W86-02529

DEVELOPMENT OF A PRIMER ON WELL WATER SAMPLING FOR VOLATILE ORGANIC SUBSTANCES,
Arizona Water Resources Research Center, Tucson.
P. W. Holden, L. G. Wilson, and J. M. Dworkin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230043/AS, Price codes: A04 in paper copy, A01 in microfiche. Technical Completion Report, Arizona Water Resources Research Center, Tucson, Sept 1984, 8 p. plus 44 p, append. USGS G828-24.

Descriptors: *Arizona, *Sampling, *Water wells, Pumps, Groundwater pollution, Volatile organic compounds.

A primer was written as a guide for establishing and implementing a program for sampling volatile organic compounds (VOC's) in drinking water wells. In addition to providing a simple review of the principles of ground-water movement and water well construction, the document summarizes the principal sources of VOC's in ground water and describes the importance of sampling water wells to detect the presence of health threatening chemicals. The document outlines approaches for developing a sampling protocol, including sampling frequency, sampling sites, preparation for field sampling, purging prior to sampling, sampling point location, sample collection, sample preservation and transportation, and documentation. Inasmuch as the results of the sampling effort may lead to litigation, chain of custody procedures are discussed together with methods for selecting an analytical laboratory. Finally, recommendations for interpreting and managing the data are outlined. The primer will be useful reference to public health agencies interested in establishing sampling programs and to field workers responsible for data collection. The primer is included as a separate appendix in the report.
W86-02612

MEASUREMENT OF DISCHARGE USING TRACERS,
Geological Survey, Reston, VA. Water Resources Div.
F. A. Kilpatrick, and E. D. Cobb.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Techniques of Water-Resources Investigations Book 3, Chapter A-16, 1984. 104 p, 28 fig, 6 tab, 19 ref.

Descriptors: *Discharge measurement, Dilution, *Tracers, *Dye releases, Fluorometry, Mixing, Background levels, Unsteady flow, Water sampling, *Dilution gaging, Dispersion, Constant injection, Slug injections, Measurements beneath ice, Measurements in pipes.

The development of fluorescent dyes and fluorometers which can measure these dyes at very low concentrations has made dye-dilution methods practical for measuring discharge. These methods are particularly useful for determining discharge under flow conditions which are unfavorable for making current-meter measurements. This manual describes the slug injection and constant-rate injection methods of performing tracer-dilution measurements. Emphasis is on the use of fluorescent dyes as tracers and the equipment, field methods, and laboratory procedures for performing such measurements. Measurements in streams, canals, pipes, and under ice are discussed. Tracer-velocity measurement of flow in pipes and other man-made structures having known geometries are also discussed. (USGS)
W86-02776

GROUND-WATER LEVELS IN OBSERVATION WELLS IN OKLAHOMA, 1982-83 CLIMATIC YEARS,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02784

INERTIAL INSTRUMENT SYSTEM FOR AERIAL SURVEYING,
Geological Survey, NSTL Station, MS. Water Resources Div.
R. H. Brown, C. E. Mongan, W. H. Chapman, W. F. Hanna, and J. W. Hursh.
Available from: OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-184, 1985. 196 p, 49 fig, 7 tab, 28 ref.

Descriptors: *Surveying instruments, Data collections, Terrain data, Topography, *Aerial profiling of terrain, *Aerial surveying, *Inertial navigation, *Laser profiler.

An inertial guidance system for aerial surveying has been developed under contract to the U.S. Geological Survey. This prototype system, known as the aerial profiling of terrain (APT) system, is designed to determine continuously the positions of points along an aircraft flight path, or the underlying terrain profile, to an accuracy of + or - 0.5 ft (15 cm) vertically and + or - 2 ft (61 cm) horizontally. The system's objective thus is to accomplish, from a fixed-wing aircraft, what would traditionally be accomplished from ground-based topographic surveys combined with aerial photography and photogrammetry. The two-part strategy for measuring the terrain profile entails: (1) use of an inertial navigator for continuous determination of the three-coordinate position of the aircraft, and (2) use of an eye-safe pulsed laser profiler for continuous measurement of the vertical distance from aircraft to land surface, so that the desired terrain profile can then be directly computed. The APT system, installed in a DeHavilland Twin Otter aircraft, is typically flown at a speed of 115 mph (105 knots) at an altitude of 2,000 ft (610 m) above the terrain. Performance-evaluation flights have shown that the vertical and horizontal accuracy specifications are met. (USGS)
W86-02790

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1985,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02812

WATER RESOURCES DIVISION WATER LEVEL RECORDER RENTAL PROGRAM - HISTORY AND OPERATION,
Geological Survey, NSTL Station, MS. Water Resources Div.
S. R. Jeffers, and C. R. Wagner.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report OFR 84-735, 1984. 27 p, 4 fig, 3 tab.

Descriptors: *Instruments, *Equipment, *Water level recorder, Cost analysis, Optimization, Rent, Management planning.

The U.S. Geological Survey introduced a new water level recorder in the early 1960's to automate computation of streamflow records. At the same time it developed a rental program as a means of providing the recorders to field offices. This report documents the experience gained over the past 20 years and offers suggestions for operation of a rental program in the future, as we prepare to introduce a third generation of water level recorders. (USGS)
W86-02819

COMPILATION OF SELECTED HYDROLOGIC DATA FROM THE MX MISSILE-SITING INVESTIGATION, EAST-CENTRAL NEVADA AND WESTERN UTAH,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02903

7C. Evaluation, Processing and Publication

USE OF MICROCOMPUTERS TO AID WASTEWATER TREATMENT PLANT OPERATIONS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-02444

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1983, VOLUME 4. NORTHERN CALIFORNIA VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02771

WATER RESOURCES DATA FOR CALIFORNIA, 1983, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02772

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02773

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NORTHEASTERN CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02774

WATER-DATA PROGRAM OF THE U.S. GEOLOGICAL SURVEY IN KANSAS, FISCAL YEAR 1983,
Geological Survey, Lawrence, KS. Water Resources Div.
R. K. Livingston, and K. D. Medina.
Available from OPSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4306, 1984. 44 p, 11 fig, 4 tab, 22 ref.

Descriptors: *Data collections, Quality control, *Network design, Hydrologic data, Data program, *Kansas.

The U.S. Geological Survey is the principal Federal agency responsible for the collection of hydrologic data needed for the planning, development, use, and management of the water resources in Kansas. Hydrologic-data collection by the U.S. Geological Survey in Kansas began in 1895. The fiscal-year 1983 water-data program, operated in cooperation with several Federal, State, and local agencies, included 270 stations for collection of river, lake, and reservoir data, 1,940 wells for collection of ground-water data; 53 sampling stations and 215 wells for collection of water-quality data. This report provides a detailed description of the water-data program, including coordination and funding, data-collection activities, quality-assurance plans, availability of data, network design, and future needs for water data. (USGS)
W86-02778

COST EFFECTIVENESS OF THE U.S. GEOLOGICAL SURVEY'S STREAM-GAGING PROGRAM IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02782

GENERALIZED CONFIGURATION OF THE BASE OF THE HIGH PLAINS AQUIFER IN KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02791

GENERALIZED POTENTIOMETRIC-SURFACE MAP OF THE HIGH PLAINS AQUIFER IN WYOMING, 1981,
Geological Survey, Cheyenne, WY. Water Resources Div.
C. Avery, and R. A. Pettijohn.
Available from: OPSS, USGS box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report (map) 84-4033, 1984. 1 pl. 1 fig, 11 ref.

Descriptors: *Groundwater, *Water level, Aquifers, Maps, *Wyoming, *High Plains aquifer, *Potentiometric contours.

A potentiometric-surface map shows the general configuration of the water surface for the High Plains Aquifer, which is composed of Oligocene age and younger rocks in southeastern Wyoming. The potentiometric contours are shown at 100-foot intervals on a map at a scale of 1:250,000. The High Plains Aquifer in Wyoming underlies an area of 8,190 square miles and geologically consists of the White River Formation of Oligocene age, the Arikaree Formation of early Miocene age, the Ogallala Formation of late Miocene age, and alluvial deposits of Quaternary age. The altitude of the potentiometric surface declines from about 7,100 feet in southwestern Laramie County to about 4,100 feet in eastern Goshen County. Typically, the slope is between 20 and 30 feet per mile; the general direction of flow is eastward. (USGS)
W86-02795

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02799

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, OREGON,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02800

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND PROVINCE, NEVADA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02801

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02802

MAPS SHOWING DISTRIBUTION OF DISSOLVED SOLIDS AND DOMINANT CHEMICAL TYPE IN GROUND WATER, BASIN AND RANGE PROVINCE, ARIZONA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2k.
W86-02803

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND SILICIC SHALLOW-INTRUSIVE ROCKS, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-02805

MAP SHOWING OUTCROPS OF ASH-FLOW TUFFS, BASIN RANGE PROVINCE AND VICINITY, TRANS-PECOS TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-02806

U.S. GEOLOGICAL SURVEY URBAN-STORM-WATER DATA BASE FOR 22 METROPOLITAN AREAS THROUGHOUT THE UNITED STATES,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02808

HYDROLOGIC DATA FOR AQUIFERS IN PHILADELPHIA, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
G. N. Paulachok, C. R. Wood, and L. J. Norton.
Available from OPSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 83-149, 1984. 104 p, 5 fig, 7 tab, 8 ref.

Descriptors: *Hydrologic data, *Well data, Water quality, Water level fluctuations, *Data collections, *Aquifers, *Philadelphia, *Pennsylvania, Geophysical Log Index.

Selected data on the ground-water resources of Philadelphia, Pennsylvania are presented in this report. Information including water levels and data for aquifers is tabulated for 828 wells and 3 sumps. Chemical analyses are given for 1,449 water samples obtained from 207 sites, including 105 analyses for trace elements and 70 analyses for volatile organic compounds. An index of geophysical logs including gamma ray, neutron, caliper, fluid conductivity, fluid velocity, single-point resistance, spontaneous potential, and temperature determinations made in 51 wells is also presented. Data-collection points are shown on a 1:50,000 scale location map. (USGS)
W86-02815

PARTIAL COMPILATION AND REVISION OF BASIC DATA IN THE WATEQ PROGRAMS,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02816

WATER-RESOURCES REPORTS PREPARED BY OR IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY, KANSAS, 1886-1983,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 10C.
W86-02818

SEDIMENT DATA FOR GEORGIA STREAMS, WATER YEARS 1958-82,
Geological Survey, Doraville, GA. Water Resources Div.
H. A. Perlman.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-722, 1985. 101 p, 1 fig, 4 tab, 10 ref.

Descriptors: *Sediment data, *Sediment concentration, *Bed sediment, *Particle size, Sediment transport, Stream discharge, *Data collection, *Georgia.

Sediment data have been collected regularly in Georgia by the U.S. Geological Survey since 1957. The data were collected in cooperation with a number of State and Federal agencies. The frequency of data collection varied and several sampling methodologies were used. This report presents suspended-sediment-concentration data for 179 sites, suspended-sediment particle-size for 16 sites, and bed-material particle-size data for 19 sites collected from October 1957 to September 1982. (USGS)
W86-02821

GENERALIZED POTENTIOMETRIC SURFACE OF AQUIFERS OF PLEISTOCENE AGE, SOUTHERN LOUISIANA, 1980,
Geological Survey, Baton Rouge, LA. Water Resources Div.
A. Martin, and C. D. Whiteman.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4331, 1985. 1 sheet (map), 1 fig, 1 tab, 12 ref.

Descriptors: *Water levels, Aquifers, *Aquifer systems, *Water table, *Artesian aquifers, *Louisiana, Pleistocene age, Tertiary age, *West Gulf Coastal Plain, *RASA, *Maps.

A map of potentiometric surface defines generalized water levels for 1980 in the Pleistocene

aquifers of southern Louisiana. The map was prepared as part of the Western Gulf Coast Regional Aquifer-System Analysis study. The Pleistocene deposits in southern Louisiana consist of alternating beds of sand, gravel, silt, and clay deposited under fluvial, deltaic, and near-shore marine conditions. The aquifers are mainly under artesian conditions and the regional flow direction is primarily southward. Areally definable cones of depression result from heavy pumpage in the Baton Rouge, Lake Charles, and New Orleans metropolitan areas and in the rice irrigation area of southwestern Louisiana. Where water levels differ vertically within the aquifer, the lowest water levels in the vertical section were used because these levels represented the thickest and most heavily pumped unit in the aquifer. The map represents regional water levels in the Pleistocene aquifers, and is not intended to show localized variations near pumping centers. (USGS)
W86-02835

APPRAISAL OF THE WATER RESOURCES OF THE EASTERN PART OF THE TULARE AQUIFER, BEADLE, HAND, AND SPINK COUNTIES, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02836

SELECTED CLIMATOLOGICAL AND HYDROLOGIC DATA, RATON BASIN, HUERFANO AND LAS ANIMAS COUNTIES, COLORADO, AND COLFAX COUNTY, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02839

GROUND WATER IN UTAH'S RAPIDLY GROWING WASATCH FRONT AREA--THE CHALLENGE AND THE CHOICES,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02843

GROUND-WATER RESOURCES OF NORTHERN UTAH VALLEY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02844

GROUND WATER HYDROLOGY OF THE ELIZABETHTOWN AREA, KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02845

REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE HIGH PLAINS AQUIFER IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING--GEOHYDROLOGY,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02850

PERCENTAGE CHANGE IN SATURATED THICKNESS OF THE HIGH PLAINS AQUIFER, WEST-CENTRAL KANSAS, 1950 TO AVERAGE 1982-84,

Geological Survey, Garden City, KS. Water Resources Div.
M. E. Pabst, and B. J. Dague.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4357, 1984. 1 p (map), 1 fig, 11 ref.

Descriptors: *Approximation method, *Hydrologic data, Maps, *Hydrologic maps, *Water levels, Water yield, Aquifers, Kriging, *Kansas.

Water-level altitudes at the center of each 1-square-mile section (1,859 values) in Western Kansas Groundwater Management District No. 1 were interpolated from 292 measured water levels using a statistical technique referred to as kriging. The kriging technique involves the use of a series of computer programs that convert selected geohydrologic data into map form. A map that illustrates the percentage change in saturated thickness of the High Plains aquifer from 1950 to average 1982-84 in west-central Kansas was constructed by comparing kriged water-table altitudes (based on average 1982-84 data) with estimated 1950 water-table altitudes and bedrock-surface altitudes. (USGS)
W86-02855

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN KANSAS--FISCAL YEARS 1983 AND 1984,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02865

STATISTICAL SUMMARY OF DAILY VALUES DATA AND TREND ANALYSIS OF DISSOLVED-OXYGEN DATA AT NATIONAL STREAM QUALITY ACCOUNTING NETWORK (NASQAN) STATIONS,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02873

INTERPOLATING WATER-TABLE ALTITUDES IN WEST-CENTRAL KANSAS USING KRIGING TECHNIQUES,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02880

SUMMARY OF WATER RESOURCES DEVELOPMENT AND HYDROLOGIC DATA OF SAIPAN, MARIANA ISLANDS,

Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02887

MAPS SHOWING GROUND-WATER UNITS AND WITHDRAWAL, BASIN AND RANGE PROVINCE, NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
B. T. Brady, M. S. Bedinger, and D. L. Hart.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4118-A, 1984. 6 p, 1 pl, 3 fig, 36 ref.

Descriptors: Groundwater, *Groundwater movement, Selected withdrawal, Hydrogeology, Water use, *Basin and Range province, *New Mexico, *Maps.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing selected hydrologic information of the New Mexico part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and man-induced and natural-discharge areas. A second map at a scale of 1:1,000,000 shows areas and quantity of groundwater withdrawal. (USGS)
W86-02889

MAPS SHOWING GROUND-WATER UNITS AND NUMBER OF LARGE-CAPACITY WELLS, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Reed, M. S. Bedinger, J. B. Gonthier, and W. D. McFarland.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-A, 1984. 4 p, 3 fig, 1 pl, 15 ref.

Descriptors: *Groundwater, Groundwater movement, Groundwater data, *Maps, Selected withdrawal, *Basin and Range province, *Oregon.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing hydrologic properties of the Oregon part of the Basin and Range province. The first map, at a scale of 1:500,000, divides the area into ground-water units, which approximate ground-water drainage. In addition to ground-water units, the map shows consolidated-rock areas, basin fill, generalized ground-water flow directions, and natural-discharge areas. A second map at a scale of 1:1,000,000 shows quantity of ground-water withdrawal. (USGS)
W86-02890

MAPS SHOWING GROUND-WATER LEVELS, SPRINGS, AND DEPTH TO GROUND WATER, BASIN AND RANGE PROVINCE, OREGON,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Reed, M. S. Bedinger, J. B. Gonthier, W. H. Langer, and W. D. McFarland.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4120-B, 1984. 5 p, 3 fig, 1 pl, 15 ref.

Descriptors: *Groundwater levels, Springs, *Maps, Groundwater data, *Basin and Range province, *Oregon.

This map report is part of a U.S. Geological Survey project to characterize the geology and hydrology of the Basin and Range province. The report consists of two maps describing hydrologic properties of the Oregon part of the Basin and Range province. The first map, at a scale of 1:500,000 shows the approximate altitude of the water table, and the location, temperature, and flow of large springs. The altitude of the water table is shown by contours where sufficient data exists; otherwise it is shown by data points. Springs with flows of 10 gallons per minute or more have been mapped. A second map at a scale of 1:1,000,000 shows the depth to ground water and areas of basin fill or consolidated rocks. In areas where the depth to water is less than 500 feet, the depth is shown by lines of equal depth to water or data points where data are insufficient to draw lines. Areas where the depth to the water table is generally greater than 500 feet are shown as shaded areas. (USGS)
W86-02891

MAPS SHOWING OUTCROPS OF BASALTIC ROCKS OF EARLY QUARTERNARY AND TERTIARY AGES, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
K. Roggensack, and K. A. Sargent.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4119-F, 1984. 20 p, 3 fig, 113 ref.

Descriptors: *Basaltic rocks, Aquifers, Geology, Hydrogeology, *Basin and Range province, *Nevada, *Maps.

Outcrops of basaltic rocks in Nevada have been delineated as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The sources of data, lithologic character, thickness, and distribution of basaltic units, ranging in age from early Quarternary to Tertiary, are described. (USGS)
W86-02892

HYDROGEOLOGY OF THE CLIFTON PARK AREA, SARATOGA COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
R. J. Reynolds.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4031, 1985. 6 pl, 6 fig, 15 ref.

Descriptors: *Hydrogeology, Confined aquifers, Unconfined aquifers, Glacial aquifers, Glacial drift, Land use, *Maps, Groundwater data, Colonie Channel aquifer, Clifton Park, Saratoga County, *New York, Land use, Soil permeability, Surficial geology, Bedrock topography, Saturated thickness.

The hydrogeology of the 75-square mile Clifton Park suburban area near Albany, N.Y., is presented in six maps at 1:24,000 scale. The maps show: (1) location of wells and test holes; (2) bedrock topography; (3) surficial geology and geologic sections; (4) saturated thickness of the confined aquifer; (5) generalized soil permeability; and (6) land use. The aquifers in the Clifton Park area serve approximately 22,000 people through 32 public distribution systems. Average daily pumpage from these systems is approximately 1.85 million gallons per day. The most productive aquifer is the Colonie Channel aquifer, a confined, buried bedrock channel aquifer of glacial material from which wells may yield more than 500 gallons per minute. A water-table aquifer of fine sand is present over most of the area and is separated from the confined aquifer by a thick sequence of lacustrine silt and clay. Recharge to the confined aquifer occurs primarily where kame-delta deposits that are exposed at land surface are hydraulically connected to the buried aquifer. Saturated thickness of the confined aquifer varies from less than 5 feet to approximately 70 feet. In recharge areas, where the aquifer is locally under water-table conditions, saturated thickness may exceed 100 feet. Pumping interference between wells tapping the confined aquifer has been observed over distances of 3/4 mile. (USGS)
W86-02894

PRELIMINARY REPORT ON A STUDY TO ESTIMATE FLOOD VOLUMES OF SMALL RURAL STREAMS IN OHIO: METHODS, SITE SELECTION, AND DATA BASE,

Geological Survey, Columbus, OH. Water Resources Div.
J. M. Sherwood.
Available from OFSS, USGS Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-470, 1985. 138 p, 2 fig, 7 tab, 8 ref.

Descriptors: *Flood data, *Small watersheds, Agricultural watersheds, Data collections, Runoff, Storm runoff, *Flood volumes, *Ohio.

In April 1981, the U.S. Geological Survey, in cooperation with the Ohio Department of Transportation and the Federal Highway Administration, initiated a 7-year flood-volume study of small (less than 10 square miles) rural basins in Ohio, 32 of which were selected for detailed analysis. The report summarizes the methods of study and describes reconnaissance and site selection procedures, locations and characteristics of the stations, instrumentation, and methods of collecting and storing data. Five years of 5-minute rainfall-runoff data were collected to calibrate and verify a rainfall-runoff model for each basin. The calibrated model is used in conjunction with 80 years of National Weather Service 5-minute precipitation data to synthesize a representative 80-year streamflow record at each site. A Log-Pearson Type III frequency distribution defines the magnitudes and frequencies of flood volumes at each site. The report also summarizes rainfall-runoff data collected from July 1981 through September 1983 but does not interpret the data. (USGS)
W86-02906

PENNSYLVANIA GAZETTEER OF STREAMS - PART II,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02907

STATE HYDROLOGIC UNITS MAPS,

Geological Survey, Reston, VA. Water Resources Div.
P. R. Seaber, F. P. Kapinos, and G. L. Knapp.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-708, 1984, 22 p, 5 fig, 1 pl, 21 tab, 28 ref.

Descriptors: *Maps, *Mapping, *Hydrology, *Drainage basins, United States, *Hydrologic Unit Maps.

A set of maps depicting approved boundaries of, and numerical codes for, river-basin units of the United States has been developed by the U.S. Geological Survey. These 'State Hydrologic Unit Maps' are four-color maps that present information on drainage, culture, hydrography, and hydrologic boundaries and codes: (1) the 21 major water-resources regions and the 222 subregions designated by the U.S. Water Resources Council; (2) the 352 accounting units of the U.S. Geological Survey's National Water Data Network; and (3) the 2,149 cataloging units of the U.S. Geological Survey's Catalog of Information on Water Data. The maps are plotted on the Geological Survey State base-map series at a scale of 1:500,000 and, except for Alaska, depict hydrologic unit boundaries for all drainage basins greater than 700 mi squared (1,813 km squared). A complete list of all the hydrologic units, along with their drainage areas, their names, and the names of the States or outlying areas in which they reside, is contained in the report. These maps and associated codes provide a standardized base for use by water-resources organizations in locating, storing, retrieving, and exchanging hydrologic data. The Hydrologic Unit Codes shown on the maps have been approved as a Federal Information Processing Standard for use by the Federal establishment. (USGS)
W86-02908

STREAMFLOW AND SEDIMENT DATA COLLECTED AT SEVEN STREAM-GAGING STATIONS IN THE JAMES RIVER BASIN DOWNSTREAM FROM FORESTBURG, SOUTH DAKOTA, FROM OCT 1, 1982 - SEP 30, 1983,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02912

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, 1980,

Geological Survey, Garden City, KS. Water Resources Div.
M. E. Pabst, and L. E. Stullken.
Available from: OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4009, 1985. 1 p, 3 fig, 5 ref.

Descriptors: *Water table, *Potentiometric level, Groundwater, Unconfined aquifers, Underflow, Underground storage, Water-bearing formations, *Kansas, *High Plains.

The High Plains aquifer in Kansas is a part of a regional system that extends from South Dakota to Texas. The aquifer in Kansas underlies an area of 31,000 square miles in the western and south-central part of the State. This aquifer is a hydraulically connected assemblage of unconsolidated water-bearing deposits of Tertiary and Quaternary age. Maps published at a scale of 1:500,000 show the altitude and configuration of the water table in Kansas during 1980. Ground water moves from higher altitudes in the western part of the high Plains to lower altitudes in the eastern part at an average rate of 10 feet per mile. The up-gradient flexure of water-table contours along some of the valleys indicates that ground water discharges to the streams in those areas. (USGS)
W86-02919

8. ENGINEERING WORKS

8A. Structures

STREAMBANK EROSION PROTECTION AND CHANNEL SCOUR MANIPULATION USING ROCKFILL DIKES AND GABIONS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
P. C. Klingeman, S. M. Kehe, and Y. A. Owusu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246718/AS, Price codes: A09 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-98, Corvallis, September 1984. 169 p, 48 fig, 18 tab, 57 ref, append. USGS G864-09. 14-08-0001-G-864.

Descriptors: *Bank erosion, Channel erosion, Stream erosion, *Erosion control, *Bank protection, *Bank stabilization, *Stream stabilization, Scour, *Channel scour, Dikes, Spur dikes, Gabions, Riprap, Aquatic habitats, Stream fisheries, Stream improvement, Stream stabilization, Model studies, *Hydraulic models, *Willamette River, *Oregon.

Uses of rockfill spur dikes and of gabion groins and gabion weirs for streambank erosion protection and streambed scour control were examined through literature review, laboratory model studies and field investigations. The summarized literature review includes general design features and recommended structure orientation angles and spacing/length ratios. Model studies of streamflow patterns and bed scour patterns for various structure arrangements allowed evaluation of best configurations for protecting eroding banks and manipulating the scour patterns. Influences were evaluated due to dike/groin length, orientation angle and spacing. Typical protection was for two to five times the structure length. Upstream-oriented structures were more effective than perpendicular or downsteam-oriented structures in deflecting the current away from the bank and in causing extensive scour holes. V-shaped weirs pointing upstream caused large scour holes in mid-channel, with angles of 90-120 degrees giving the maximum scour depth and volume. V-shaped weirs pointing downstream caused holes near each bank. Field studies allowed comparison with laboratory results and with results of other researchers. Local scour and bed and bank adjustments to a groin on a small creek and to a new spur dike field on the Willamette River were documented, as were flow patterns, velocities and depths in the dike field.
W86-02665

8B. Hydraulics

LOW FLOW HYDRAULICS IN ALLUVIAL CHANNELS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. A. Miller, and H. G. Wenzel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249274/AS, Price codes: A04 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana-Champaign, Research Report No 192, September 1984. 51 p, 14 fig, 6 tab, 19 ref. USGS G840-06. 14-08-0001-G840.

Descriptors: Pools, Riffles, *Low flow, Open-channel flow, River flow, Steady flow, Streamflow, Surface flow, Nonuniform flow, Varied flow, *Alluvial channels, Alluvial rivers, Hydraulic models, Computer models, *Mathematical models.

The investigation of the low flow condition has become important in recent years as a means of determining critical levels of water pollution, aquatic habitat and instream flow needs. To assess these critical conditions, it is necessary to predict the hydraulic response of a river system to a given low flow discharge. Conventional flow models, however, are often inaccurate at low discharges

due to the geometric and hydraulic channel features peculiar to these flow conditions. The dominant channel feature at low stages is the pool-riffle sequence, where pools are distinguished by deep, slow moving water and riffles by shallow, relatively rapid moving flow. Conventional flow models have difficulty effectively representing the highly nonprismatic channel geometry, the rapidly changing flow hydraulics, and the dominating influence of flow resistance characteristic of pool-riffle sequences. In this research, a one-dimensional mathematical model has been developed to simulate accurately channel characteristics under low flow conditions. For a given steady discharge, channel geometry, and channel bed particle size distribution, the model predicts the flow depth, the mean velocity, and the flow resistance. Energy losses generated by the contractions and expansions occurring through the pool-riffle sequence. The model has been verified using field data, as well as laboratory data collected in conjunction with the project.
W86-02698

DIFFUSION AND ADVECTION IN TWO-DIMENSIONAL ROTATING FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-02699

8E. Rock Mechanics and Geology

HYDRAULIC CONDUCTIVITY OF ROCKFILL: VOLUME 1,
New Orleans Univ., LA. Dept. of Civil Engineering.
A. A. Hannoura, and K. L. McManis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219087/AS, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, July 1983. 63 p, 8 fig, 136 ref. OWRT B-012-LA(1). 14-34-0001-9150.

Descriptors: Hydraulic conductivity, Friction equation, *Rock fill, Rubble mounds, *Rockfill dams, Flow characteristics, Porous media, Friction.

This final report is published in two volumes. The first volume includes the state-of-the-art, and the second is based on the test results of this project. An extensive survey was made of previous research findings on the subject of the hydraulic conductivity of coarse granular media which is the common construction material for rockfill dams; rubble-mound structures; and filter type structures. Experimental procedures and results of permeability tests of four crushed rock sizes ranging from 0.95 cm to 15.24 cm., and five rounded gravel sizes ranging from 1.27 cm to 25.4 cm. are given. Flow regimes are identified and dimensionless equations are developed for each regime. A generalized equation covering a wise flow range, i.e., low to high Reynolds number is developed. Surface roughness, wall effect, shape factor, angularity, porosity function, and grain size distribution are considered.
W86-02555

HYDRAULIC CONDUCTIVITY OF ROCKFILL: VOLUME II,
Louisiana Water Resources Research Inst., Baton Rouge.
A. A. Hannoura, and K. L. McManis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219095/AS, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, August 1983. 67 p, 17 fig, 18 ref, 1 append. OWRT B-012-LA(1). 14-34-0001-9150.

Descriptors: *Hydraulic conductivity, Friction equation, Rock fill, Rubble mounds, Porous media, Hydraulics, Flow characteristics, Friction, *Rockfill dams.

An extensive survey was made of previous research findings on the subject of the hydraulic conductivity of course granular media which is the common construction material for rockfill dams, rubble-mound structures, and filter type structures. Experimental procedures and results of permeability tests of four (4) crushed rock sizes ranging from 0.95 cm to 15.24 cm are given in the second volume. Flow regimes are identified and dimensionless equations are developed for each regime. A generalized equation covering a wide flow range, i.e., low to high Reynolds number is developed. Surface roughness, wall effect, shape factor, angularity, porosity function, and grain size distribution are considered.
W86-02556

MAP SHOWING OUTCROPS OF GRANITIC ROCKS AND SILICIC SHALLOW-INTRUSIVE ROCKS, BASIN AND RANGE PROVINCE, SOUTHERN CALIFORNIA,
Geological Survey, Lakewood, CO. Water Resources Div.
F. A. Hills.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4116-D, 1984. 38 p, 2 fig, 174 ref.

Descriptors: *Granitic rocks, *Silicic shallow-instrusive rocks, Geology, Hydrogeology, *Basin and Range Province, *California, *Maps.

Outcrops of granitic rocks and silicic shallow-intrusive rocks have been delineated in southern California as part of a study by the U.S. Geological Survey of the Basin and Range Province of the western United States. The lithologic character, geologic age, distribution, and sources of data of the geologic units are described. (USGS)
W86-02805

MAP SHOWING OUTCROPS OF ASH-FLOW TUFFS, BASIN RANGE PROVINCE AND VICINITY, TRANS-PECOS TEXAS,
Geological Survey, Lakewood, CO. Water Resources Div.
C. D. Henry, and G. L. Fisher.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4121-E, 1984. 8 p, 6 fig, 38 ref.

Descriptors: *Ash-flow tuffs, *Geology, Hydrogeology, *Basin and Range Province, *Trans-Pecos Texas, *Texas, *Maps.

Outcrops of ash-flow tuffs have been delineated in Trans-Pecos Texas as part of a study by the U.S. Geological Survey of the Basin and Range Province of the western United States to evaluate potentially suitable areas for future study for isolation of high-level radioactive waste. In this map report the name, location, isotopic age, caldera source, volume, lithologic character and reference sources for each ash-fall unit is described. (USGS)
W86-02806

8G. Materials

PASSIVE FILMS ON IRON: THE MECHANISM OF BREAKDOWN IN CHLORIDE-CONTAINING SOLUTIONS,
Texas A and M Univ., College Station. Dept. of Chemistry.
T. E. Pou, J. Carbajal, G. L. Campbell, and P. Nilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211670/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Report: A Research Program on Alloys for Marine Environments. March 1983. 46 p, 12 fig, 4 tab, 52 ref. C-90274-S(1). 14-34-0001-9446.

Descriptors: *Corrosion, *Metals, *Iron, *Films, *Marine environment, *Seawater, Alloys, Passive films, Chlorides, Texas.

Electrochemical and spectroscopic techniques were applied to the problems of distribution of hydrogen or water within passive films and the distribution of chloride ions in the bulk of passive films after exposure to chloride-containing films. Criteria derived from electrochemically derived kinetic data was sharply inconsistent with several models for passive film breakdown: adsorption-displacement, pore or flaw, and chemico-mechanical. It is not inconsistent with the following: ion exchange processes, point defect models, and hydrated polymetic oxide models. Spectroscopic data pointed to a dehydrated structure. It was also concluded that the thickness of passive films remains unchanged for various times of exposure to chloride ions before and after breakdown.
W86-02438

8I. Fisheries Engineering

FURTHER INVESTIGATIONS OF GOLDFISH IN EASTERN WASHINGTON LAKES AND EVALUATION OF ELECTROFISHING AS A TOOL FOR CONDUCTING REMOVAL OPERATIONS,
Eastern Washington Univ., Cheney. Dept. of Biology.
For primary bibliographic entry see Field 5G.
W86-02511

CONTROL OF ALGAL DOMINANCE THROUGH CHANGES IN ZOOPLANKTON GRAZING, LAKE WASHINGTON: PHASE II,
Washington Univ., Seattle. School of Fisheries.
For primary bibliographic entry see Field 6G.
W86-02514

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

FINAL PROGRAM REPORT FOR THE FY1983 NEVADA WATER RESEARCH INSTITUTE PROGRAM,
Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 9D.
W86-02622

FISCAL YEAR 1984 PROGRAM REPORT (NEVADA WATER RESOURCES CENTER).
Nevada Univ. System, Reno. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132321/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-919-01, September 1985, 23 p. USGS G919-01. 14-08-0001-G919.

Descriptors: *Research, *Information transfer, *Training, *Nevada, Artificial recharge, Groundwater management, Budgetary, Water demand, Hazards, Mass wasting, Salinity, Lake shores, Water conservation, Water harvesting.

The Nevada research program for FY 1984, funded in part by the U.S. Department of the Interior as authorized by the Water Resources Research Act of 1984 (P.L. 98-242), is described. Five research projects were undertaken, namely: Water Harvest and Artificial Recharge--This research is directly related to (a) water conservation; (b) conjunctive use of surface waters and groundwaters; and (c) legal/institutional aspects of allocation of new and newly quantified water supplies and reallocation of existing supplies in Golden Valley, Nevada. An Applications of Risk and Uncertainty in Rural Water Systems in Nevada--This project examined the allocation of financial resources for improvement and expansion of water supply systems in rural areas of Nevada. Identification and Assessment of Water-Related Hazard Zones of the Eastern Sierra Nevada--This project deals with the use of remote sensing techniques for identification of water related hazard zones. This has direct application for such problems as mass wasting and flooding which are being recognized

as serious problems in the Arid West. Contribution of Salt Bearing Formations to Salinity Concentrations in Lake Mead--A study to evaluate the effects of salt bearing shoreline formations on the salt load of Lake Mead and the lower Carson River Basin. Rainfall Runoff Harvesting in the Carson Desert--The water harvesting technique investigated may provide an efficient method for use of water which is currently being evapotranspired, providing an additional source of water supply in regions of critically low rainfall.
W86-02732

9D. Grants, Contracts, and Research Act Allotments

1983 INSTITUTE PROGRAM REPORT, (ARKANSAS WATER RESOURCES RESEARCH CENTER),

Arkansas Water Resources Research Center, Fayetteville.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-211712/AS, Price codes: A05 in paper copy, A01 in microfiche. Annual program report, Sept 1983. 81 p. USGS G829-01.

Descriptors: *Arkansas, *Water Resources Institute, *Research priorities, Water quality, Water use, Water law, Economic evaluation, Agriculture, Data interpretation, Institutions, Information exchange.

Summarization of water programs includes discussion of key water related problems for Arkansas, prime research and development priorities, including water quality, water quantity, water use, agriculture, institutional, water economics, water law, water data gases. Regional research priorities, examples of effective research and development results, and information dissemination activities are also described.
W86-02442

FISCAL YEAR 1983 INSTITUTE PROGRAM REPORT (VERMONT WATER RESOURCES RESEARCH CENTER),

Vermont Water Resources Research Center, Burlington.
L. L. Arris, and E. A. Cassell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214500/AS. Price codes: A04 in paper copy, A01 in microfiche. Program report, Burlington, December, 1984. 47 p. USGS G873-01.

Descriptors: *Water resources institutes, Research priorities, *Vermont.

Using the Center's Five-Year Plan for Water Research as a guide, investigators studied water management problems of the highest priority in Vermont, including: Water Quality/Watershed Management, Lake Processes, Groundwater, Acid Precipitation, Water Resources Data Management, and Allocation of Water Resources. The Water Center supported five major water research/information dissemination projects during the year. For the second year the Vermont Water Center has supported research dealing with acid precipitation. Also the Center carried out in-service training of state-of-the-art data management systems for water and natural resource professionals. The funded research projects included: (1) Streptococci as Indicators of Source and Type of Surface Water Contamination (G873-03); (2) Acid Precipitation: Compositional Changes During Throughfall (G873-04); (3) Characterization of Aluminum Chemistry in Acid Precipitation (G873-05); (4) Temporal and Spatial Variability of Streamflow in Vermont (G873-02); (5) Measurements of Low Flows in Shallow Bodies of Water (G873-06).
W86-02454

FY 1983, NORTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE, FINAL PROGRAM REPORT.

North Carolina Water Resources Research Inst., Raleigh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214591/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report (1984). 28 p. USGS G860-01.

Descriptors: *Water resources research, *Groundwater quality, Hydrilla, Eutrophication.

A report has been prepared describing the program of the Water Resources Research Institute of The University of North Carolina. The Institute, in cooperation with the U.S. Department of Interior, supported research, graduate training, and technology transfer programs in response to major water problems of concern to the state and federal water agencies. Progress reports are included for three continuing research projects: (1) Arresting Eutrophication in Rivers, (2) Environmental Control of Phytoplankton in a Piedmont Reservoir, and (3) Pollutant Removal Effectiveness and the Hydraulics of Wetland Filter Areas for Pumped Agricultural Drainage Water. Final completion reports and synopses are provided for three projects: (1) Integrated Management of the Aquatic Weed Hydrilla, (2) Effects of Peatland Drainage on Mercury Dynamics in Coastal Plain, and (3) Evaluation of Vegetative Filter for Dairy Waste Treatment in Southern Appalachia. All senior colleges and universities in North Carolina are eligible to participate in the Institute program. In addition to Department of Interior financial support, the Institute received support from eight other sources. A program of technology transfer supported primarily from state funds is described. These efforts include workshops, research review meetings, newsletters, and an extensive public service role by both the Institute Director and Associate Director.
W86-02463

(MICHIGAN) INSTITUTE OF WATER RESEARCH FY 1983, PROGRAM REPORT.

Michigan State Univ., East Lansing. Inst. of Water Research.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214617/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, Michigan Institute of Water Research, East Lansing, (1984). 30 p, 3 fig. USGS G849-01.

Descriptors: *Michigan, *Water resources research, *Toxic wastes, *Groundwater quality, Nonpoint sources, Urban hydrology, Atmospheric deposition, Lakes, Eutrophication.

The research projects in the Institute of Water Research's 1983 program were selected to address those research priorities which constitute major problems not only with respect to Michigan's water resources, but also that reflect regional and national water resources concerns. Michigan demonstrates a multitude of water quality management and pollution problems. Clearly, they cannot all be attacked at once. Therefore, research priorities were identified in the Institute of Water Research Five-Year Water Research and Development Plan, and the 1983 Institute of Water Research program focused its research and information dissemination and retrieval efforts in the following major areas: (1) Definition of the mechanisms affecting the fate, transport, and effect of toxic and hazardous materials which enter the water and groundwater as waste products or pollutants; (2) Investigation of physical, chemical, and biological variables controlling groundwater quality and quantity; (3) Investigation of mechanisms influencing non-point source pollutants including urban and agricultural land runoff, residual waste disposal, on-site sewage disposal systems, atmospheric deposition of waste products, and water conservation through irrigation scheduling; (4) Identification of control mechanisms affecting lake eutrophication and development of management strategies to minimize the impact on inland lakes and the Great Lakes.
W86-02465

FISCAL YEAR 1983 PROGRAM REPORT (ALASKA INSTITUTE OF WATER RESOURCES).

Alaska Univ., Fairbanks. Inst. of Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214690/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report I84-08, September, 1984. 18 p. USGS G827-01.

Descriptors: *Alaska, Arsenic, Water treatment, Flocculants, Law, *Legal aspects, *Planning, Turbidity, Water chemistry, Oxygen content, *Fisheries.

The report contains synopses of the completion reports for three projects. A fourth, on the geochemistry of saline lakes, was delayed by equipment problems but has been completed most successfully. It will provide valuable insights into geochemistry and will be forwarded soon under separate cover. Funding arrived so late that the project on snowmelt infiltration could not begin in the anticipated field season, and so had to be delayed a year. The report should be forwarded in about 60 days. The report on microcomputer software will also be forthcoming in the near future. Each project contributes important new information or capabilities to problems facing the northern community. Several have broad implications that transcend geographic areas.
W86-02472

REPORT OF THE UNIVERSITY OF KENTUCKY WATER RESOURCES RESEARCH INSTITUTE FOR FISCAL YEAR 1983,

Kentucky Water Resources Research Inst., Lexington.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214757/AS, Price codes: A02 in paper copy, A01 in microfiche. September, 1983. 20 p. USGS G-844-01.

Descriptors: Research, Technology transfer, *Kentucky, *Water pollution effects, *Coal mining effects, Toxic wastes.

The report of the University of Kentucky Water Resources Research Institute for fiscal year 1983 consists of a synopses of all research reports and Institute technology transfer projects funded with the grant G-844. Each synopses includes a statement of the project's purpose, a brief explanation of methods and procedures, principal findings, a conclusion and a list of publications produced. The project synposes included are: G-844-02, Toxicity, Leachability, and Environmental Transport of Aquatic Pollutants Originating from Coal Production and Utilization; G-844-03, Finite Element Analysis of Coupled Flow and Contaminant Transport in Saturated-Unsaturated Porous Media; G-844-04, Identification of Soil-Water Chemical Parameters for the Prediction and Treatment of Suspended Solids in Surface Water Reservoirs of Coal Mine Lands; G-844-05, A Membrane-Organic Phase Oxidation Process for the Destruction of Toxic Organics in Hazardous Waste-Waters; G-844-06, Impact Assessment of Coal Slurry Pipelines on Water Resources Utilization and Allocation; G-844-07, Determination of Conveyance and Other Parameters of the Inner Bluegrass Karst Aquifer; G-844-23, Guidelines for Wetland Practice in Coal Mine Areas; and G-844-22; Fiscal Year 1983 Technology Transfer Activities. A Cooperative Agreement with the University of Louisville is included.
W86-02478

RESEARCH IN ACTION: SOLVING COLORADO WATER PROBLEMS, FY 1983 ANNUAL REPORT,

Colorado Water Resources Research Inst., Fort Collins.
A. Evans, and W. L. Raley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214781/AS, Price codes: A05 in paper copy, A01 in microfiche. Annual Report No. 28, September, 1984. 40 p, 17 append. USGS G831-01.

Descriptors: *Research and development, *Water resources development, Programs, Administration, *Technology transfer, *Colorado.

The Colorado Water Resources Research Institute conducted a single research project in FY 1983 to integrate results of prior research on water management problems of the South Platte Basin. The results and products of this program will be transferable throughout the State and throughout the region. The principal objective of the project was to identify options for best development and management of the South Platte Basin's limited water supply. Emphasis was placed on potential for use of computer technologies. Team investigators considered urban and industrial water conservation, stream-aquifer modeling, water storage optimization, Denver Basin deep-bedrock groundwater, the quality of surface and groundwaters, economics of water allocation alternatives, legal-institutional aspects of water allocation, and current management practices. The Institute's technology transfer program was fully integrated with its water research and development program. Water user workshops and seminars were conducted while the research project was in progress. A monthly Colorado Water Issues Forum was held in Denver, and authoritative speakers presented programs of current interest to water managers, professionals, and interested citizens. The Institute's technology transfer program also includes: newsletters; three publications series; distribution of a 'Library List' of new water resources research reports and publications; Project AWARE, designed to keep State and Federal agency personnel aware of proposed research; public water policy education (programs, including slide presentations); and workshops, seminars, and small group consultations involving potential users.
W86-02481

RHODE ISLAND WATER RESOURCES CENTER, ANNUAL PROGRAM REPORT, FISCAL YEAR 1983,

Rhode Island Water Resources Center, Kingston.
C. P. C. Poon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214872/AS, Price codes: A04 in paper copy, A01 in microfiche. FY-1983 Annual Program Report, Sept 1984. 44 p. USGS G867-01.

Descriptors: *Rhode Island, *Water resources research, Administration, Research priorities, Planning, Cooperatives.

The State of Rhode Island is very active in water resources development and management activities which include legislation, building of treatment facilities, and instituting pretreatment programs. Current and anticipated state water problems are lack of comprehensive and definitive water policies, contamination of groundwater by toxic chemicals from agricultural, road-salting, septic-tank cleanup, landfill, and gasoline storage practices, lack of a water data information system, the need of a program to improve the management of septic tank leaching field systems, and restructuring a price scheme for water supply and wastewater discharge. Four research projects covering subjects of Resonance Raman Method for Bacteria Detection and Identification; Acid Precipitation; Combined Sewer Overflow Management Modeling; and River Nitrification are completed. A fifth project on Chemical Nitrification Inhibition will be carried over to the FY-1984 Cooperative Program. This center works closely with the R. I. Dept. of Management, Subdistrict Office of USGS in R.I., Narragansett Bay Water Quality Commission, as well as with other New England Water Resources Centers for research projects and program planning.
W86-02490

FINAL PROGRAM REPORT: FISCAL YEAR 1983 MISSISSIPPI WATER RESOURCES RESEARCH INSTITUTE,

Mississippi State Univ., Mississippi State. Water Resources Research Inst.
M. T. Bond.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214898/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report, September, 1984. 10 p. USGS G851-01. 14-08-0001-G-851.

Descriptors: *Mississippi, Conjunctive use, Computer models, Aquifers, Management planning, Institutional aspects, Legal aspects, Organizations, Industrial water use, Water conservation, Information exchange.

This publication is a summary of the Mississippi Water Resources Research Institute Annual Program with U.S. Department of Interior for the Fiscal Year 1983. Synopses of the following activities and research are included: (1) Director's Office; (2) Institutional Framework for Conjunctive Use of Surface and Ground Water; (3) Mathematical Models for Water Reources Policy and Management with Application to the Eutaw-McShan Aquifer; (4) Incentives for Industrial Conversion to Surface Water; and (22) Water Resources Technology/Information Transfer.
W86-02492

1983 WATER RESEARCH INSTITUTE PROGRAM FINAL REPORT, (MAINE),

Maine Univ. at Orono. Land and Water Resources Center.
S. N. Landry, and L. Y. Breece.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214971/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Final Report, Orono, November 1984, 23 p, 2 fig, 5 tab. USGS G846-01.

Descriptors: *Acid Rain, Administration, Chromium, *Clays, Groundwater Pollution, *Maine, Information Exchange, *Macroinvertebrates, Potable Water, *Radioactivity, *Technology Transfer, *Water Resources Institutes.

Four research projects and a technology transfer component were funded with FY-83 monies: Effects of Acidification on Pond and Stream Macroinvertebrates (G846-02): Suitability of Marine Clays as Liners for Hazardous Waste Disposal Sites (G846-03); Radon in Houses Due to Radon in Potable Water (G846-04); A Kinetic Study of the Effects of Acid Rain on Trace Metal Uptake at Surfaces (G846-05); and Technology transfer in Water Resources Management (G846-22). Projects G846-03 and G846-05 were completed under this grant, and the others continue into the next program year. In the 'clay liners' study it was found that the permeability of Maine's marine clays seemed unaffected under tests with solvents within the time frame of the project's permeameter test; longer-duration testing would yield more conclusive determinations regarding the suitability of these clays as liners at hazardous waste disposal sites. The metal uptake study indicated that rates and mechanism of reaction of Cr(III) with iron oxide are similar to those observed for reactions of Cr(III) with anions in solution; comparisons of the rate of reaction of a metal with a simple carboxylic acid in contrast to an iron oxide surface or with a humic acid component should indicate the relative rates of important processes in natural water systems, and how these processes can be affected by changes in pH such as when acid rain is evident. Initial work with selected macroinvertebrates (-02) has indicated that a process similar to encapsulation in fish eggs exposed to low pH may occur in C. triangulifer allowed to develop at pH 4.0; future experiments to determine effects of Al and Ca on hatching of eggs, survival, growth, and molting success of nymphs, and emergence success and fecundity of adults, will be concentrated within that range. In the radon project the researchers have attemped to determine relationships between indoor airborne radon levels and certain weather parameters, domestic water use, and building ventiliation; these parameters are being incorporated into a mathematical model that can be used to predict average radon doses to building occupants, and to evaluate the effectiveness of radon removal equipment. The technology transfer component of the program facilitates the exchange of information on Maine water resources issues between the researchers and the consumers, who range from state policy-makers to homeowners concerned about contaminants in their drinking water. Information is disseminated through workshops, conferences, and publications. Topics covered during this program year were acid deposition, radon in groundwater, hazardous wastes disposal, land use laws, use conflicts on Maine's rivers and streams, and Maine peatlands.
W86-02500

NINETEENTH ANNUAL REPORT PROGRAM ACTIVITIES, OCTOBER 1, 1982 - SEPTEMBER 30, 1984, MARYLAND WATER RESOURCES RESEARCH CENTER,

Maryland Water Resources Research Center, College Park.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-214997/AS, Price codes: A05 in paper copy, A01 in microfiche. Annual Report, (1984), 93 p, 10 tab, 13 fig, 66 ref. USGS G847-01.

Descriptors: *Maryland, *Water resources research, *Groundwater, *Water pollution effects, Nutrients.

This report covers the program activities of the Maryland Water Resources Research Center's four projects for the period October 1, 1982 through September 30, 1984. Two of the projects will be continued during the fiscal year 1984. The projects covered in this report are: (1) Nitrogen and Phosphorus Losses Via Subsurface Ground Water Flow From Conventional and No-till Corn Watersheds, (2) Effects of Disinfection Techniques on Chesapeake Bay Sediments, (3) Accumulation of Toxic Metals in Wetland Areas of Two Eastern Shore Rivers, Implications for Water Quality, and (4) The Impact of Point and Non-point Nutrient Enrichment on the Dynamics of Natural Phytoplankton.
W86-02502

FISCAL YEAR 1983 INSTITUTE FINAL PROGRAM REPORT, WASHINGTON WATER RESEARCH CENTER,

Washington State Water Research Center, Pullman.
W. H. Funk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215069/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, December 1984, 28 p. USGS G876-01.

Descriptors: *Research , *Information transfer, Student training, *Washington, Modeling, Irrigation, Columbia River Basin, Conflicting use, Fisheries, Salmon propagation, Roughfish control, Algae, Algal dominance, Zooplankton grazing, Flood routing, Flood control, Acid rain.

The state of Washington water concerns and problems arre indicative of regional problems in the Columbia and Snake River drainage basins. Eighty percent of the electrical needs of the region are met by hydro-produced power. Although the state appears water-rich, there are increasing conflicts over the use of water resources which include irrigation withdrawal and return flow, erosion, power production, fish propagation and migration, barging transportation, effluent dilution, flood storage, and recreation. In addition, there is high usage and value placed on the smaller rivers and streams of the state as well as lakes. Concern for water resources leads to research of state and national significance in conflict resolution, mitigation of water and fisheries problems due to hydro development, irrigation return flow, excess nutrients, acid rain, eutrophication of lakes and reservoirs, food chain relationships, and water storage.
W86-02509

FISCAL YEAR 1983 PROGRAM REPORT, NEW HAMPSHIRE WATER RESOURCES RESEARCH CENTER,

New Hampshire Univ., Durham. Water Resources Research Center.
G. L. Byers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-215077/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, Sept 1984. 20 p. USGS G856-01.

Descriptors: *Water Research, *New Hampshire, *Acid rain, Water conservation pressures, Aluminum, Stream invertebrates.

The Program of the New Hampshire Water Resource Research Center included three projects which focused on acid rain phenomenon, and one that studied public reaction towards water conservation pressures. This report includes a brief discussion on the release of aluminum in drinking water supplies, the impact of increased acidity on stream invertebrates, and how watershed characteristics may interact with acid precipitation. A brief discussion is included on the acid slug effect of spring runoff (snowmelt). The attitudes of people towards imposed conservation measures and some of the conclusions drawn from the study are discussed. A listing of publications and papers presented is included.
W86-02510

FISCAL YEAR 1983 PROGRAM REPORT, MASSACHUSETTS WATER RESOURCES RESEARCH CENTER,

Massachusetts Univ., Amherst. Water Resources Research Center.
P. J. Godfrey, and E. R. Kaynor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216885/AS, Price codes: A03 in paper copy, A01 in microfiche. Annual Report for Fiscal Year 1983, December 1984. 30 p. USGS G848-01.

Descriptors: *Water Resources Institutes, *Massachusetts, *Water resources research, Training, Education.

This report summarizes the activities of the Water Resources Research Center at the University of Massachusetts for the period October 1983 to September 1984. It contains a Director's Message, summaries of four projects supported by the United States Geological Survey, 19 projects supported by state and private grants, education and training functions of the Center, and a summary of the water resource research needs of the Commonwealth of Massachusetts.
W86-02519

FISCAL YEAR 1983 INSTITUTE PROGRAM REPORT, (VIRGINIA WATER RESOURCES RESEARCH CENTER),

Virginia Water Resources Research Center, Blacksburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-216919/AS, Price codes: A02 in paper copy, A01 in microfiche. Final Program Report, April 1985. 18 p. USGS G874-01.

Descriptors: *Water management, *Water quality, *Land use, *Urban runoff, *Agricultural runoff, *Information retrieval, *Public participation, *Technology transfer, Forest watersheds, Water quality data, Indexing, *Virginia.

This report summarizes the sponsored research, technology transfer/information dissemination, and state and local cooperative efforts of the Virginia Water Resources Research Center during 1983. In all its activities the Center cooperated extensively with state and local officials and agency personnel through a Statewide Advisory Committee and a system of ad-hoc advisory committees for particular projects. Three research projects were sponsored. The first reviewed land use impacts on water resources in Virginia and outlines topics needing additional research. The second project examined issues related to the design of a water quality data clearinghouse for Virginia, and suggested that a clearinghouse should be developed progressively as part of an already existing system, such as NAWDEX or STORET. Project three analyzed the water resource public participation programs of 31 states, compared them with the prescriptions found in the literature, and provided recommendations for expanded public involvement. Information dissemination activities included publication of a monthly newsletter, bulletins, a special report, and an examination of options for change in southeastern states' systems for water management. Center staff also conducted a water/energy conservation education program and developed an interactive unit in wildlife management and a groundwater education program.
W86-02522

FISCAL YEAR 1983 PROGRAM REPORT OF THE WATER RESOURCES RESEARCH INSTITUTE OF NEW YORK STATE,

Cornell Univ., Ithaca, NY. Center for Environmental Research.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217024/AS, Price codes: A02 in paper copy, A01 in microfiche. Final Program Report, Sept 1984. 17 p. USGS G859-01.

Descriptors: Groundwater protection and management, Acid precipitation, *Water resources planning, *New York.

The Institute Water Resources Research Program for FY 1983 focused on three problem areas identified as critical in the Middle Atlantic Region: groundwater protection and management; acid precipitation; and water resources planning. The groundwater protection and management research program addressed problems of quality protection and the technology transfer program focused on related problems of management and information dissemination. The latter program was and is carried out in close coordination with the New York State Department of Environmental Conservation, and included special training sessions for staff of the NYSDEC. The Institute participated in the development of State policy in the groundwater area, as well as in the development of the scientific base for that policy. The acid precipitation research projects focused on the effects of the phenomenon: on tree pollen germination and tube growth and use of induced fluorescence measurements to assess aluminum-organic interactions in acidified lakes. The project relating to water resources planning developed a methodology for estimating the frequency, severity and duration of water supply shortages in existing water supply systems which rely on both surface and ground water. The methods were applied to an area troubled by water shortages due to both episodic and chronic contamination of the water supply sources.
W86-02533

FY 1983 DELAWARE WATER RESEARCH INSTITUTE, PROGRAM FINAL REPORT,

Delaware Univ., Newark. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217693/AS, Price codes: A02 in paper copy, A01 in microfiche. 1984. 10 p. USGS G-833/01.

Descriptors: *Delaware, *Water resources research, Storm runoff, Management planning, Groundwater pollution, Sanitary landfills, Aerobic digestion, Biological oxidation, Activated carbon, Adsorption, Hydrologic budget, Water shortage, Groundwater, Nitrates, Nitrification, Kinetics, Technology transfer.

The FY 1983 Delaware Water Research Institute Program was responsive to the water problems of Delaware and the surrounding region. Groundwater management and contamination have been identified as high priority research needs, and three of our 1983 research projects focused on groundwater contamination. A second area cited as a high priority regional and Delaware water problem is wastewater treatment, and two of the projects included in our FY 1983 program involved research into improved treatment methods. The need for improved water resources planning has continued to appear as a problem area over the years, and one of the research projects in our FY 1983 program addressed this issue. The final component of our 1983 program consisted of two technology transfer projects; one resulted in a newsletter, the other in a computer-based program for the selection of techniques to mitigate the impacts of urban stormwater. The FY 1983 Program Final Report contains an informative abstract outlining these projects, as well as a synopsis of each including the purpose and objectives, the methods and procedures, principal findings, conclusions, and publications produced.
W86-02534

FY 1983 INSTITUTE FINAL PROGRAM REPORT (TENNESSEE WATER RESOURCES RESEARCH CENTER),

Tennessee Water Resources Research Center, Knoxville.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-217768/AS, Price codes: A03 in paper copy, A01 in microfiche. Tennessee University, Knoxville, Water Resources Research Center. Final Program Report, September 1984. 19 p. USGS G870-01.

Descriptors: Water Resources Research Institute, *Tennessee, Water pollution control, Erosion control, Information transfer, Acid rain.

This report details FY 83 research work accomplished by the Tennessee Water Resources Research Center under the Department of Interior's Annual Cooperative Program. Foremost was the desire of the Tennessee Water Resources Research Center to direct its funded research efforts towards environmental and growth related issues identified by Governor Alexander's Safe Growth Action Team. Specifically, these issues revolved in and around aspects of water and hazardous wastes; (1) a comprehensive evaluation of water law and policy for the State, leading to resolution of legal and institutional restraints on water resources planning and management; (2) a variety of economic, social and political studies relating to problems of government in coping with water resources needs and responsibilities and (3) technical research projects in engineering and in the physical and life sciences designed to assist in resolving such problems as erosion, impact of strip-mining, groundwater pollution and eutrophication. This report provides an overview of five (5) research projects/activities: (1) Biological Detoxification of Hazrdous Wastes; (2) Effects of Acid Precipitation on Composition, Electrokinetic Behavior, Cation Adsorption and Ion Exchange Capacity in Various Soil Systems; (3) Prevention of Gully Formation and Associated Water Degradation; (4) Evaluation of Tennessee Sites for the Disposal of Hazardous Wastes--Social, Economic and Technical Considerations and (5) Information Dissemination/Technology Transfer Program.
W86-02541

LOUISIANA WATER RESOURCES RESEARCH INSTITUTE, FY 1983 PROGRAM REPORT.

Louisiana Water Resources Research Inst., Baton Rouge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-218998/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Completion Report, 1984, 57 p. USGS G845-01.

Descriptors: *Louisiana, *Technology transfer, Water resources, Water pollution control, Coal wastes, Nutrient assimilation, Lakes.

Five projects were supported by the Louisiana Water Resources Research Institute during the year 1983-84. One project related to technology transfer, and the remaining four were research projects. The technology transfer project reaffirmed the need for continued water resources research and subsequent transfer of research results to the user-community. The research projects covered a broad spectrum of environmental and water resources area. One project dealt with mathematical modeling of streamflow. The other project dealt with development of techniques for sediment analysis to isolate, concentrate and detect chlorinated hydrocarbons. Another project concentrated on treatment of coal pile runoff in Louisiana and suggested ways for treating this wastewater most effectively. The last project dealt with nutrient assimilation capacity in two shallow coastal lakes. It was found that total nitrogen concentrations in

water draining into the lakes generally exceeded concentrations already in the existing lake.
W86-02546

INFORMATION DISSEMINATION FOR A BETTER UNDERSTANDING OF LOUISIANA'S WATER RESOURCES,

Louisiana State Univ., Baton Rouge. Hazardous Waste Research Center.
B. Worm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-219079/AS, Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, Louisiana Water Resources Research Institute, Baton Rouge, September 1984. 31 p. 3 tab, 2 ref, 4 app. USGS G845-22.

Descriptors: Education, Research priorities, *Coastal zone management *Louisiana, *Information transfer.

This project involved the assessment of Louisiana citizen's needs for water resources information, and the identification, preparation, and dissemination of the information available through the Louisiana Water Resources Research Institute to meet these needs. During the needs assessment phase, it was found that a need for information on most aspects of water resources exists in Louisiana. One topic of major concern for the State, coastal zone water problems, has been addressed by Institute-supported research, and the results of this research was used to develop educational materials for the public on these problems. A brochure was prepared to explain the complex, interrelated nature of coastal water and water-related problems. This material was prepared for distribution to the libraries and local governments of the communities affected by the problems addressed as well as to appropriate state government offices. This project, through the evaluation of the Institute's ability to satisfy the State's needs for water information through existing Institute information, revealed gaps between needs for information and existing information. An updating of the Institute's research priorities was, therefore, proposed as a means of helping fill the gap between information needs for the State and information available through the institute. Those topics not previously addressed by the Institute were recommended for incorporation into the Institute's water research priorities listing.
W86-02554

FISCAL YEAR 1983 PROGRAM REPORT INDIANA WATER RESOURCES RESEARCH CENTER,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. H. Cushman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225829/AS, Price codes: A03 in paper copy, A01 in microfiche. December, 1984. 90 p. USGS G841-01.

Descriptors: *Water resources research, *Indiana, Path of pollutants, Overland flow, Water pollution control, Shellfish, Water management.

A compilation of project summaries for the Fiscal Year 1983. These projects include studies of groundwater pollutant transport, overland flow, control of non-point pollution control, growth of mussels, simulation of drought management, and technology transfer.
W86-02558

1983 CALIFORNIA WATER RESOURCES INSTITUTE PROGRAM FINAL REPORT,

California Univ., Davis. Water Resources Center.
J. H. Synder, J. DeVries, and R. J. Woods.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-225837/AS, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, (Sept. 1984.) 17 p. USGS G828-01.

Descriptors: *Water Resources Institutes, *Administrative agencies, *Chaparral, *Wetlands, *Economic aspects, *Irrigation practices, *Fish, *Groundwater recharge, Watershed management, Channels, Irrigation, Drip irrigation, Streamflow, Wells, *California.

This report is a synopsis of the results of research projects sponsored under Grant Program G-830, the 1983 Water Research Institute Program (WRIP) for the University of California's Water Resources Center. The California WRIP package is a subset of the Center's overall research program effort and contains six one-year projects investigating the following areas: Clarification of Surface Waters for Recharge Through Wells, Temperature Requirements of Pacific Coastal Stream Fishes, The Implications for Total Water Demand from the Adoption of Drip Irrigation in Western Agriculture, An Economic Approach to the Estimation of a Dynamic Production Function for an Irrigated Crop, Channel and Flow Relationships in Tidal Salt March Wetlands, and Chaparral Management Effects on Water and the Environment.
W86-02559

DISTRICT OF COLUMBIA WATER RESOURCES RESEARCH CENTER, FY 83 INSTITUTE FINAL PROGRAM REPORT,

District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-226009/AS, Price codes: A03 in paper copy, A01 in microfiche. Report No. 60, September 1984. 45 p. USGS G834-01.

Descriptors: *Groundwater, *Urban hydrology, *Unit-day-values, *Urbanization, *Non-point sources, Dewatering, Statistical methods, Water quality, Run-off, Microcomputers, Recreation, Seminars, Mathematical models, Water pollution sources.

This FY 83 Institute Final Program Report presents the completed and continuing projects that the D.C. Water Resources Research Center conducted between August 1, 1983 and September 30, 1984. These projects are: 1) evaluation of the impact of urbanization on the hydrogeological conditions of the Fall-Line Cities; 2) Development of frequency functions for urban non-point risk evaluation; 3) Derivation of unit-day-values for recreation benefit valuation in water resource planning based on a comprehensive theoretical framework; 4) Identification and prioritization of the water resources problems and research needs in the District of Columbia; 5) Development of an improved test for the determination of biochemical oxygen daemand; 6) Model of flow and non-point source pollution in the tidal portion of the Potomac River; and 7) Assessment of the impact of non-point source pollutants on an urban river. Also, the activities of the Center included seminars which are described in the report.
W86-02576

FISCAL YEAR 1983 ANNUAL REPORT OF THE WYOMING WATER RESEARCH CENTER,

Wyoming Water Research Center, Laramie.
R. W. Brocksen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-226348/AS, Price codes: A03 in paper copy, A01 in microfiche. Final program report, September 1984. 68 p, 2 fig, 2 tab, append. USGS G879-01.

Descriptors: *Wyoming, *Water resources research, Universities, Colorado River Basin, Water resources development.

The State of Wyoming is considered to be a water producing state to the Colorado River Basin, the Snake River Basin, and the Missouri River Basin. Approximately 15.5 million acre feet of water is produced in Wyoming annually, with approximately 12 million acre feet obligated for downstream use through compacts and treaties. Wyoming has embarked on a large-scale water development program with the intended purpose of capturing for its use as much of the excess water produced as possible. The problems associated with the capture, diversion, dispersal, and re-use of these water resources are encompassing. In addition, being better able to forecast quantity and quality of water availability to downstream users is extremely important. To address the problems and generate needed information associated with water conservation, development, and re-use, a truly interdisciplinary effort, well-managed and coordinated, is essential. The Wyoming Water Research Center is organized in such a manner and can call on the diverse set of disciplinary expertise necessary to address key issues for the state and the region.
W86-02581

FY1983 FINAL PROGRAM REPORT FOR THE WATER RESOURCES RESEARCH CENTER, THE UNIVERSITY OF ARIZONA, TUCSON, ARIZONA,

Arizona Water Resources Research Center, Tucson.
L. G. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227213/AS, Price codes: A03 in paper copy, A01 in microfiche. FY83 Final Program Report, Sept. 1984, 42 p. USGS G828-01.

Descriptors: *Arizona, *Water resources research, Grants, Water use, Water conservation, Groundwater, Irrigation, Water reuse, Water quality, Flood forecasting.

Projects supported by the FY83 program related to the following four priority issues of state and regional importance: Water conservation, water utilization, water control and ground-water quality. The water conservation projects dealt with irrigation scheduling and household reuse and conservation. Among the water utilization projects was a project dealing with the economics of water importation into a southwestern community and a project examining the effect of the Southern Arizona Water Rights Act of 1981 on the political influence of the Papago nation. Four projects related to water control. One project was aimed at developing an automated flood warning system for the Southwest. A second project examined the role of paleoflood hydrology in forecasting extreme flood events. A third project examined rainfall-runoff models in a southwestern city. A fourth project evaluated models for predicting water retention and spillage in small stockponds in Southern Arizona. Two projects dealt with groundwater pollution by volatile organic compounds (VOC's) in the Southwest. One project is characterizing seasonal and diurnal fluctations of VOC's in the vadose zone overlying a pollution plume. The second project comprised writing a primer for sampling VOC's in ground water. The information dissemination activities of the Center included preparing a newsbulletin and project bulletins.
W86-02586

NEBRASKA WATER RESOURCES CENTER PROGRAM, FY 1983 REPORT,

Nebraska Water Resources Center, Lincoln.
W. L. Powers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227304/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Completion Report (1984). 11 p. USGS G854-01. 14-08-0001-G854.

Descriptors: *Nebraska, *Water management, Groundwater, Surface waters, Lakes, Eutrophication, Grants.

This program report discussed eight projects in the Nebraska Water Resources Center research program for FY 1983. Projects are divided into two broad categories of Water Quantity and Management, and Water Quality. Under Water Quantity and Management, four projects deal with the major water problems in Nebraska. Declining groundwater tables are a problem in many Great Plains states. Project 854-02 provides a mechanism for comparing management alternatives necessary to effective groundwater management. The other three projects in this area relate to conservation of water supplies. Project G854-08 compares two

methods for measuring evaporation and transpiration for corn, sorghum and soybeans. G854-07 and G854-09 examine techniques for maximizing the effectiveness of limited amounts of water. There are four projects under Water Quality. Project G854-03 related to the problem of eutrophication of area lakes. G854-04 examines the problem of surface runoff as a potential vehicle for transmitting pseudorabies virus from swine facilities. G854-05 relates to the problem of irrigation on sandy soils and involved an effort to improve the estimates of nitrate movement in sandy soils. Project G854-06 studied the mixing and movement of nitrate-nitrogen within an aquifer. Snyopses of these projects are included in this program report.
W86-02595

FLORIDA WATER RESOURCES RESEARCH CENTER, ANNUAL INSTITUTE PROGRAM REPORT, 1983,

Florida Water Resources Research Center, Gainesville.
J. P. Heaney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-227312/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Report, December 1984, 20 p. USGS G835-01.

Descriptors: *Florida, Water resources, Groundwater, Pesticides, Citrus, Models, Biological waste treatment.

The 1983 Annual Institute Report for Florida contains synopses of the following four studies which were supported by this program: 1. Aldicarb Studies in Groundwaters from Citrus Groves in Indian River County, Florida by Forrest E. Dierberg of Florida Institute of Technology; 2. Extension of Simplified Models Developed for Groundwater Quality Simulation, by Barry A. Benedict, University of Florida; 3. Biological Flocculation in Waste-grown Algal Cultures, by Ben Koopman and Edward P. Lincoln of the University of Florida; and 4. Dissemination of Water Related Information Within the State of Florida, by James P. Heaney of the University of Florida. Ten reports were published in 1983 including a comprehensive study of Florida's lakes. Runoff, the quarterly newsletter, was sent to over 1100 readers including 130 faculty. A major research study on hazardous wastes was initiated with support from the U.S. Air Force.
W86-02596

FY 1983 INSTITUTE FINAL PROGRAM REPORT - NEW MEXICO,

New Mexico Water Resources Research Inst., Las Cruces.
T. G. Bahr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229813/AS, Price codes: A02 in paper copy, A01 in microfiche. Final Program Report, September 1984. 17 p. USGS G-858-01.

Descriptors: *New Mexico, *Water resources research, Personnel, Water management, Water rights, Water resources development, Hydrology institutional constraints.

The Fy 1983 research program funded cooperatively by the U.S. Geological Survey and the New Mexico Water Resources Research Institute supported four research projects and one technology transfer project. These projects addressed questions in three of New Mexico's five major water problem areas. Water quality problems associated with increasing industrial demand were the topic of two of the projects, while one project each investigated groundwater recharge and water demand projection. One of the water quality projects has developed a methodology for monitoring heavy metal concentrations in natural waters on a real-tie basis. The technique is based on anodic stripping voltammetry. The second water quality project looked at Gas Chromatographic/Mass Spectrometric techniques for identifying toxic organic compounds in natural gas pipeline hydrostatic test water. The project will continue in FY 1984 with a shift in emphasis to looking at water generated as a result of drilling and production operations. Groundwater recharge is a critical issue in New Mexico. New ways are needed to estimate current and historic levels of recharge. This study used radio and stable isotope techniques to age groundwaters associated with coal bearing formations in New Mexico an estimate prehistoric climates and recharge rates. The final research project in the joint federal-state program looked at the techniques needed for projecting future water demand from economic and demographic data. The project used the Arkansas, Red, White River basin area of New Mexico as its case study location.
W86-02610

WISCONSIN WATER RESOURCES CENTER, FINAL PROGRAM REPORT FY 1983.

Wisconsin Univ.-Madison. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230050/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, Sept 1984. 40 p, 2 fig, 30 ref. USGS G878-01. 14-08-0001-G878.

Descriptors: *Path of pollutants, *Wisconsin, Education, Groundwater, Organizations, Technology transfer, Training, Water Resources Institutes.

The issue of primary concern addressed by the FY 1983 Wisconsin Water Resources Research Institute Program was the transport of contaminants to and through the groundwater system. Of particular concern were (1) pesticide movement to groundwater from agricultural uses in irrigated sandy soils and its vertical and horizontal dispersion in the groundwater; (2) the impact of dewatering a lead mine on the movement of lead, arsenic, magnesium and sulfate to groundwater; and (3) the importance of adsorption/desorption reactions in the root and vadose zones of soil in transport of contaminants to groundwater. This research has allowed us to begin to determine the minimum amount of information to predict whether a particular location is sensitive to transport of materials through soils to groundwater; the physical and chemical properties of organic and inorganic compounds related to the ease of their transport to groundwater; the dispersion of contaminants in flowing groundwater; and the time required for contaminants to reach non-threatening concentrations in the groundwater. The sites chosen for investigation include areas where there are important contaminant threats to groundwater in Wisconsin and the region. Three Ph.D. students (Environmental Toxicology, Geology and Geophysics, and Water Chemistry) were supported by the FY 1983 Wisconsin WRC program. In addition hourly help students have been provided with 1200 hours of training in scientific field work, library references services, and computer cataloging.
W86-02613

FY 1983 FINAL REPORT--STATE WATER RESOURCES RESEARCH INSTITUTE PROGRAM, UNIVERSITY OF GUAM.

Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230076/AS, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report (1984), 17 p. USGS G837-01.

Descriptors: *Guam, *Research institutions, *Technology transfer, *Information exchange.

An overview of the organizational structure and mission of the University of Guam Water and Energy Research Institute is given. Synopses of research projects undertaken in FY 1983 are also given. Four were completed; one was terminated; and one is continuing into the next fiscal year. The titles of these projects are: Completed--(1) Technology Transfer; (2) A Hydrogeologic Investigation of Atoll Islands, Ponape State, Eastern Caroline Islands; (3) A Comparison of Fresh Water Use Customs on Ulithi Atoll with those of Selected other Micronesians Atolls; (4) A Comparative Study of Sewage Treatment by a Capillary Siphon Trench System versus a Conventional Leaching Trench System; Terminated--(1) Feasibility Study of Tracer Utilization to Determine Hydrodynamic Properties of Limestone Units in Northern Guam; Continuing--(1) Solar Pumping of Groundwater as a Source of Irrigation Water for Remote Areas of Southern Guam.
W86-02615

F.Y. 1983 INSTITUTE FINAL PROGRAM REPORT, (MISSOURI WATER RESOURCES RESEARCH CENTER),

Missouri Water Resources Research Center, Columbia.
T. E. Clevenger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230084/AS, Price codes: A03 in paper copy, A01 in microfiche. Institute Report, Sept. 1984. 24 p. USGS G-852-01. 14-08-0001-G-852.

Descriptors: Computer modeling, Water management, Soil absorption capacity, Groundwater pollution, Waste water treatment, Land disposal, *Missouri, *Water resources research.

Research areas covered under the 1983 Fiscal Year for the Missouri Water Resources Research Center are: a) Aspects of Water Quantity, b) Water Policy, Planning and Adjudication, and c) Quality of Surface and Groundwaters. Four proposals were funded during this period with two in Water Quality, one each in Water Quantity and Water Policy. Water Quality: 1) Organic Groundwater Contamination Evlauation and Prediction, and 2) Decreasing Hydraulic Conductivity of Hazardous Waste Clay Barriers by Internal Chemical Reactions - Phase One of Two Phases. Water Quantity: 1) Quantitative Aspects of Water Resources Management for the State of Missouri. Water Policy: 1) Land Application of Sewage Effluent for Missouri Water Resources Conservation and Pollution Control.
W86-02616

FISCAL YEAR 1983, PROGRAM REPORT, MONTANA WATER RESOURCES RESEARCH CENTER,

Montana Water Resources Research Center, Bozeman.
H. S. Peavy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230126/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, February 1985. 48 p. USGS G-853-01. 14-08-0001-G853.

Descriptors: Administration, Grants, *Research projects, *Information transfer, *Water resources research, *Montana.

The organization and operation of the Montana Water Resources Research Center programs for the period of October 1, 1982 to September 30, 1984 is described. Included are statements regarding the authorization, funding, role and organizational structure of the Center. The Water Center is outlined and synopsis of the 1983 research and information transfer projects are included. Several projects funded under other fiscal year programs were either completed or begun during FY 1983. A list of the publications resulting from projects reported in this document, along with a list of student trainees, is also included.
W86-02620

FINAL PROGRAM REPORT FOR THE FY1983 NEVADA WATER RESEARCH INSTITUTE PROGRAM,

Nevada Univ. System, Reno. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232775/AS, Price codes: A02 in paper copy, A01 in microfiche. Sept., 1984. 5 p. USGS G855-01. 14-08-0001-G-855.

Descriptors: *Nevada, Water Research Institute Program, *Recharge, Irrigation, Reservoir models, *Water resources research.

The Nevada research program for FY1983, funded in part by the U.S. Department of the Interior as authorized by the Water Research and Development Act of 1978 (P.L. 95-467), is described. Three research projects were undertaken, namely: Water Harvest and Artificial Recharge; Analysis of the Economics of Irrigation Pumping, and Distribution Efficiences; and Uncertainty in Modern Impoundment Models/Effects and Methods of Analysis. Abstracts of these research projects are provided.
W86-02622

FY 1983 (SOUTH DAKOTA WATER RESOURCES RESEARCH INSTITUTE) FINAL PROGRAM REPORT,
South Dakota State Univ., Brookings. Water Resources Research Inst.
A. R. Bender.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232833/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, March 1985. 28p. USGS G869-01. 14-08-0001-G-869.

Descriptors: *South Dakota, *Water research, *Irrigation, *Drainage, *Groundwater, *Radiochemical analysis, *Glacial soils.

The FY 1983 South Dakota Water Research Institute program consisted of five research projects in three general areas: (1) water use and management, (2) groundwater quality, (3) dynamics of groundwater systems. These projects develop information necessary to improve the economic and personal well-being of the citizens of the state and region. The report contains a synopsis of each of the following projects: G-869-02, Conservation tillage and irrigation management practices for optimum crop production; G-869-03, Effective use of soil amendments on prevention and reclamation of irrigation-induced sodic soils; G-869-04, Monitoring leachate treatment provided by a groundwater interception trench at a solid waste landfill; G-869-05, Radium -226 and -228 in the groundwater of southeastern South Dakota; and G-869-06, Characterizing water movement in the weathered zone of glacial tills under continuous irrigation.
W86-02628

1983 INSTITUTE PROGRAM REPORT, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
A. W. McIntosh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232882/AS, Price codes: A02 in paper copy, A01 in microfiche. Final Program Report, March, 1985. 14 p. USGS G857-01. 14-08-0001-G-857.

Descriptors: *Acid rain, Organic compounds, Groundwater pollution.

The 1983 program focused on two key issues within New Jersey: (1) toxic substances in the ground water, and (2) acidic deposition. Two projects ('Toxic Chemical Transport and Fate in Groundwater Systems' by Drs. R. Ferrara and W. G. Gray, and 'Buffer Capacities of Freshwater Lakes Sensitive to Acidic Rain and Leaching of Toxic Metals from their Sediments' by Dr. S. Faust) have been completed, while three other projects in these categories are continuing during the fiscal year 1984 program.
W86-02633

HAWAII WATER RESOURCES INSTITUTE PROGRAM: FISCAL YEAR 1983,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
L. S. Lau.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232916/AS, Price codes: A02 in paper copy, A01 in microfiche. Final Program Report, 1984. 17 p. USGS G838-01. 14-08-0001-G838.

Descriptors: *Water Resources Institutes, *Long-term planning, *Hawaii, *Water programs, Policy formulation.

A synopsis of the results of research projects sponsored under Grant Program G-838, the 1983 Water Research Institute Program (WRIP), is reported for the University of Hawaii at Manoa's Water Resources Research Center. The Hawaii WRIP projects are a portion of the Center's total research program and include seven projects: Development of Methods to Recover and Culture Infectious Human Rotavirus from Sewage and Natural Waters; Chemical Constituents of Rainfall at Different Locations in Hawaii; An Evaluation of the Economic Efficiency of the Property Rules Resulting from the Reppun Decision; Habitat Preferences of Hawaiian Stream Fishes; Estimation of Water Use Coefficients and Multipliers for Oahu; Dynamic Response of the Lower Boundary of a Basal Aquifer to Surface Disturbances; and Journal Reprints and Unpublished Papers Relevant to Water Resources in Hawaii: Information Transfer.
W86-02636

FISCAL YEAR 1983 PROGRAM REPORT, WATER RESOURCES RESEARCH CENTER (MINNESOTA),
Minnesota Univ., St. Paul. Water Resources Research Center.
G. R. Blake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232924/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, St. Paul, Oct. 1984. 25 p. USGS G850-01. 14-08-0001-G-850.

Descriptors: *Coordination, Administration, Policy, State agencies, Objectives, *Research and development, *Grants, *Minnesota, *Water Resources Research.

The Fiscal Year 1983 Program Report of the University of Minnesota Water Resources Center presents a summary of activities for fiscal year 1983. It covers the period October 1, 1982 through September 30, 1984. The report describes the research activities of the Center, its involvement in training water scientists and its efforts in transferring technologic information to potential users. Research progress reports of six sponsored projects are included in the report. A summary of students employed and given water sciences training through the Water Resources Center are presented.
W86-02637

POLICY AND ORGANIZATIONAL CONSIDERATIONS FOR IMPROVING TRANSFER OF UNIVERSITY RESEARCH INFORMATION AND EFFECTING AVAILABILITY OF EXPERTISE TO STATE AGENCIES,
Minnesota Univ., St. Paul. Water Resources Research Center.
G. R. Blake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232932/AS, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, St. Paul, July, 1984. 36 p. USGS G850-22. 14-08-0001--G-850.

Descriptors: Coordination, Administration, Policy, *State agencies, Procedures, *Minnesota, *Water Resources Research.

The troubled state of financing of the Water Resources Research Center (WRRC) precipitated a review of the WRRC, its role, its relation to other water resources units or programs in the University, its administrative structure and its financing. An ad hoc committee appointed by the University Vice President reported back with its recommendations on the role of WRRRC, in research, in coordination, and in communication and outreach. The ad hoc report was supportive of the need for strengthening and financially supporting an expanded role for WRRC. The University administration sensing a need for developing a coordinated mission for Natural Resources on its various colleges and campuses took action to set up a structure for that purpose. This consisted of appointing an Executive Council, a technical advisory committee and four resources sub-committees of which the Water Resources Subcommittee was one. The Water Resources Subcommittee if activated will probably set the goals and define the future role and authority of not only WRRC but also of other water Center in the University.
W86-02638

FY 1983 FINAL PROGRAM REPORT (TEXAS WATER RESOURCES INSTITUTE),
Texas Water Resources Inst., College Station.
W. G. Jordan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232965/AS, Price codes: A03 in paper copy, A01 in microfiche. Final Program Report, FY 1983, 1984. 32 p. USGS G-871-01. 14-08-0001-G-871.

Descriptors: *Texas, *Water management, Reservoir management, Conservation, Flood control, Secondary recovery, Ogallala aquifer, Unsaturated zone, Surface irrigation, Surge flow, Irrigation efficiency, Technology transfer methods, Effectiveness, New irrigation design.

The Institute's 1983 annual cooperative program consisted of four research projects that dealt in general with the efficient use of the state's surface and ground water resources. Current methods of reservoir operation were examined to determine if current policies provided for an optimum balance between flood control and conservation purposes. Redistribution of storage capacity between flood control and conservation has significant potential to improve the overall effectiveness of a reservoir system. This project will continue in 1984 with an intensive analysis of selected reservoirs. The remaining three projects dealt with enhanced recovery of ground water and its efficient use in irrigation. Enhanced recovery technologies have been applied to the Ogallala Aquifer with encouraging results. Air injection appears to force additional water from the unsaturated portion of the formation into the saturated zone. A large physical model has been designed to provide an experimental vehicle to verify and extend field results. Research on surge irrigation has produced a simple model to predict the impact of operational procedures on soil infiltration rates. This model permits prediction of the effectiveness of surge irrigation in improving water application efficiency for soils with different infiltration rates. Factors determining the rate of irrigation technology transfer were also studied with the conclusion that research agencies and farm pubications were the most important initial sources of information, but irrigation equipment dealers and company representatives were most instrumental in adoption of new technology. Adoption of the LEPA (Low Energy Precision Application) technology was the case under study.
W86-02641

INSTITUTE PROGRAM REPORT, FISCAL YEAR 1983, SOUTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE.
Clemson Univ., SC. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-232999/AS, Price codes: A03 in paper copy, A01 in microfiche. Annual Report, September 1984. 76 p, 10 fig, 5 tab. Paul B. Zielinski, editor. USGS G-868-01. 14-08-0001-G-868.

Descriptors: *Water Resources Institutes, *South Carolina, *Water resources research, Universities, Education.

This report contains the summary statement of activities for the fiscal year 1983. Descriptions of eight (8) funded projects. Three (3) of these were funded with state funds only. Summaries of research funded through federal funds, five (5) proposals and synopsis of (5) federal funded research projects. Also, a description of the proposal development is included.
W86-02644

FINAL PROGRAM REPORT, FISCAL 1983, KANSAS WATER RESOURCES RESEARCH INSTITUTE,

Kansas Water Resources Research Inst., Manhattan.
F. W. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233021/AS, Price codes: A02 in paper copy, A01 in microfiche. January, 1985. 19 p. USGS G843-01.

Descriptors: *Kansas, *Water Resources Research, Water yield, Stream flow, Water conservation, Agricultural runoff, Simulation analysis, Water use efficiency, Interstitial soil pore water, Water shortage risk, Water rights.

More effective water use where it falls is a desirable goal for agriculture, but fuller utilization upstream means potentially less water available for downsteam users. New agricultural technology on nonirrigated areas is estimated to be reducing potential stream flow by 18 percent at present and projected to reduce it by 25 percent by year 2024. A study of irrigators in central Kansas indicated that improvements are needed in the form of more tailwater pits and reuse of the tailwater could be increased. This same study yielded information that is needed in order to establish a baseline study which is essential for adequate determination of management and control data. A diffusion model was formulated and used to describe mass transfer across the soil surface. The object of the research was to study the important component of pesticide transport process. Another study was concerned with providing an evaluation before making a decision on the future policy for operating a reservoir. As pertains to Kansas state water resources planning, it seems clear the state can and probably does indirectly tax water rights as a property right at least in some portions of the state.
W86-02647

FINAL PROGRAM REPORT FOR FISCAL YEAR 1983, (VIRGIN ISLANDS WATER RESOURCES RESEARCH CENTER),

Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233732/AS, Price codes: A02 in paper copy, A01 in microfiche. Annual Report, Sept 1984. 12 p. USGS G875-01. 14-08-0001-G-875.

Descriptors: *Virgin Islands, *Water Resources Institute, Program report, *Water resources research, Education, Universities.

The FY 1983 research program of the Virgin Islands Water Resources Research Center concentrated on assessment of water resources and present and future needs for the limited water resources in the Virgin Islands. Projects investigated the demand for water and quality of groundwater in St. Thomas, as well as the rainfall-runoff characteristics of basins in St. John. A method was developed to optimally size rain water cisterns and an international conference was held to discuss the water resources problems of islands of the eastern Caribbean.
W86-02651

FISCAL YEAR 1983 FINAL PROGRAM REPORT PENNSYLVANIA WATER RESEARCH INSTITUTE PROGRAM.

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233740/AS, Price codes: A03 in paper copy, A01 in microfiche. Report LW8406, Sept. 1984. 23 p. USGS G865-01. 14-08-001-G-865.

Descriptors: Streams, Aquatic productivity, *Technology transfer, Atmospheric deposition, Water conservation, Reservoir operation, Eutrophication, Nutrients, Forest soils leachate, Water allocation, *Pennsylvania, *Water Resources Institute, Education, Universities.

Program objectives pursued in the Fiscal Year 1983 Annual Cooperative Program included: evaluating the rate and extent of recovery of a stream, dominated by the growth of aquatic vascular plants, following a program of phosphorus removal; determining if the chemistry of soil and soil leachate in Appalachian forests varies with the amount of acidic atmospheric deposition; developing a flow management model to explore alternative approaches to future drought protection for the Monongahela River Basin, and examine possible impacts of modifications in reservoir operating policies and low flow consumptive use restrictions. In addition a program of technology transfer was directed to: improving the general public's understanding about atmospheric deposition in Pennsylvania; increasing the knowledge of local sewage enforcement officers and water managers about maximum level water conservation devices; and educating local government officials to the potential benefits of hydraulic load reduction through water conservation for malfunctioning on-lot sewage systems.
W86-02652

NORTH DAKOTA WATER RESOURCES RESEARCH INSTITUTE, ANNUAL COOPERATIVE PROGRAM FOR FY83,

North Dakota State Univ., Fargo. Dept. of Chemistry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233757/AS, Price codes: A02 in paper copy, A01 in microfiche. FY83 Final Program Report, (1984). 9 p. USGS G861. 14-08-0001-G861.

Descriptors: *North Dakota, *Water Resources Institute, Brine disposal, Evaporation, Terrain analysis, Oil industry, Seepage, Water pollution, Water resources research, Education, Universities.

In the fiscal year of 1983 the North Dakota Water Resources Research Institute carried out a program of research development, information dissemination and research action dealing with water problems important to North Dakota and relevant to other parts of the nation with similar water related problems. The research focus for FY83 was water contamination and water borne soil contamination resulting from oil drilling activities. Special emphasis was given to movement of water and water borne materials through the vadose zone of soil materials. A survey was taken of the extent of externally visible damage. A few test sites were chosen for specific examination of extent of salt migration from abandoned brine disposal ponds. Both lateral and vertical migration were explored and area mineralogy was characterized. The study is relevant to current as well as past practices since the injection well technology for brine disposal is apparently imperfect. Significant brine infiltration has been discovered near injection wells in addition to that found near abandoned brine disposal ponds.
W86-02653

OHIO WATER RESEARCH INSTITUTE PROGRAM FINAL PROGRAM REPORT, FISCAL YEAR 1983.

Ohio State Univ., Columbus. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-233773/AS, Price codes: A03 in paper copy, A01 in microfiche. Annual Report, Sept 1984. 44 p, 3 fig, 7 tab, 31 ref. USGS G862-01. 14-08-0001-G-862.

Descriptors: *Ohio, *Water resources research, Lake Erie, Fluidized bed process, Biological wastewater treatment, Phenols, Fish larvae, Habitat structure, Wetlands, Aquatic vegetation, Phosphorus, Eutrophication, Nutrient loading, Atrizine, Chloroacetamide, Pesticide residues, Algae, Artificial streams, Water quality, Non-point source pollution, Great Lakes.

This report summarizes the activities of the FY 1983 Ohio Water Research Program and includes progress reports for each of the research and technology transfer projects conducted using funds provided by the Geological Survey, U.S. Department of the Interior under provisions of P.L. 95-467. Much of the research program is directed at phosphorus from land surfaces to Lake Erie. One project is testing the hypothesis that the herbicide, atrazine, inhibits the productivity of a stream's algal communities and thus limits the amount of phosphorus that can be processed by that stream. Another project is developing a technique to estimate the amount of dissolved phosphorus being transported in the runoff from agricultural lands, while a third project is investigating the relationships that exist between the quantities of biologically available and non-available phosphorus in the Lake. Other projects being conducted in this program are exploring mechanisms to improve the Lake Erie fishery by manipulating the habitat for the larval fishes in the controlled wetlands of the region and are developing processes for removing phenol from the wastewater at coal processing operations.
W86-02655

UNIVERSITY OF CONNECTICUT INSTITUTE OF WATER RESOURCES FINAL REPORT FOR GRANT NO. 14-08-0001-G832, FY 83-84,

Connecticut Univ., Storrs. Inst. of Water Resources.
C. N. Burke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-242899/AS, Price codes: A03 in paper copy, A01 in microfiche. FY 83 Annual Report, (1984). 34 p. USGS G832-01. 14-08-0001-832.

Descriptors: *Water Resources Institute, Education, Water resources projects, Research projects, Universities, Electroplating, Water pollution treatment, Landfills, Reservoirs, Hydrocarbons.

A synopsis is presented of the results of sponsored research projects from the Water Research Institute Program (WRIP) for the University of Connecticut's Water Resources Institute which acts on behalf of the State of Connecticut in administering this program on the basis of open competition for support of applications from any university or college within the state. This report contains the research synopses of the following one-year projects: 'The destruction of hazardous wastes by ultraviolet catalyzed oxidation.' 'The economic impact of limiting electroplating discharges to achieve specified water quality standards.' 'The detection and effects of aperiodic leachate discharges from landfills.' 'The development of a chlorophyll monitoring program for reservoirs using in vitro fluorimetry.' 'A study of the mechanisms controlling gasoline hydrocarbon partitioning and transport in groundwater systems.'
W86-02658

FISCAL YEAR 1983 PROGRAM REPORT FOR THE OREGON WATER RESOURCES RESEARCH INSTITUTE,

Oregon State Univ., Corvallis. Water Resources Research Inst.
P. C. Klingeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246726/AS, Price codes: A03 in paper copy, A01 in microfiche. Annual report, September 1984. 34 p, 3 tab. USGS G864-01. 14-08-0001-G-864.

Descriptors: *Water resources institutes, *Research, *Research projects, *Research programs, Technology transfer, Information dissemination, *Oregon, Acid rain, Water quality, Fisheries, Sedimentology, Water management.

Program and activities of the Oregon Water Resources Research Institute, supported with FY 1983 funds provided by the Water Research and Development Act of 1978 (P.L. 95-467), are described. Eight research projects and the technology/information transfer projects were supported under the Federal State Water Research Institute program. Other research of the Institute during FY 1983 is also summarized.
W86-02666

DIRECTOR'S TECHNOLOGY/INFORMATION TRANSFER PROGRAM 1983-1984,

Oregon State Univ., Corvallis. Water Resources Research Inst.
P. C. Klingeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-246759/AS, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute, Corvallis, September 1984. 55 p, 10 append. USGS G864-23. 14-08-0001-G-864.

Descriptors: *Technology transfer, *Information dissemination, *Information exchange, *Water Resources Institutes, Publications, Workshops, *Oregon.

The Oregon Water Resources Research Institue is the focal point for a wide range of inquiries and requests for assistance. The Institute has responded by carrying out a program of technology/information transfer. This has been accomplished by means of seminars, workshops, technical reports, news releases, field site visits, office visits, telephone calls, mail, and committee work. In particular, special efforts have been made to provide public seminars on water policy and management issues, to conduct two interuniversity faculty workshops on university capabilities in water planning and water policy issues, and to assist state agenies in their response to legislative activities involving hydropower site assessments and strategic water planning.
W86-02669

ANNUAL REPORT FY 1985 WATER RESOURCES RESEARCH INSTITUTE OF THE UNIVERSITY OF PUERTO RICO,

Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-248003/AS, Price codes: A02 in paper copy, A01 in microfiche. Annual report, September 1983. 11 p. USGS G866-01. 14-08-0001-G866.

Descriptors: *Puerto Rico, *Water Resources Institutes, Grants, Research priorities, Planning, Rainfall-runoff relationships, Water quality.

The research activity at the Puerto Rico Water Resources Research Institute during FY 1983 included three research projects and three technology transfer activities. The technology transfer projects completed were a two-day conference on water resources problems in the Caribbean region, the publication of a report on the public water supplies of Puerto Rico, and the updating of the Institute's five-year research plan. The research projects completed were a statistical analysis of spatial and temporal storm rainfall characteristics in Puerto Rico, a study on the fate of priority pollutants in regional wastewater treatment plants in Puerto Rico, and a final one on the digestion of rum distillery slops in a sea water medium.
W86-02680

ILLINOIS WATER RESOURCES CENTER PROGRAM FOR 1983,

Illinois Univ. at Urbana-Champaign. Water Resources Center.
E. Stout
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249043/AS, Price codes: A03 in paper copy, A01 in microfiche. Annual Report No. 19, September 1984. 26 p. USGS G840-01. 14-08-0001-G840.

Descriptors: Water resources, *Illinois, Streamflow, Irrigation, Water quality, Water law, *Water resources research.

The University of Illinois Water Resources Center was established in 1963 to encourage and coordinate university-wide planning and implementation of interdisciplinary programs for research and graduate education in water resources. Since designation by the Department of the Interior as the 'institute' for Illinois, the center's activities have become statewide. This report describes research accomplishments and other activities of the center during fiscal year 1983. The center's fiscal year 1983 research program included a total of six projects. A summary of each research project is presented.
W86-02683

IDAHO WATER RESOURCES RESEARCH INSTITUTE PROGRAM FOR 1983,

Idaho Water Resources Research Inst., Moscow.
G. L. Bloomsburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-249134/AS, Price codes: A02 in paper copy, A01 in microfiche. Annual Report, December, 1984, 14 p. USGS G839-01. 14-08-0001-G839.

Descriptors: *Idaho, *Water resources research, Suspended load, Administration, Water Resources Institutes, Information exhange, Water quality, Groundwater, Fisheries, Water reuse.

A synopsis is presented of the results of research projects sponsored under Grant Program G839, the 1983 Water Research Institute Program (WRIP) for the University of Idaho Water Resources Institute. The Idaho WRIP package is a sub-set of the Institute's overall research program effort and contains 8 one year projects investigating the following areas: Effects of Suspended Sediments on Stream Invertebrate Detrital Processing and Bioenergetics, Impacts of Individual On Site Sewage Disposal Facilities on Mountain Valleys - Phase II, Abundance Upstream from Dworshak Dam following Exclusion of Steelhead Trout, Hydrologic and Legal Assessment of Ground Water Management Alternatives for Idaho, Calibration of the Snake Plain Aquifer Ground Water Flow Model, Development of a Methodology to Evaluate the Success and Consequences of Establishing Exotic Fishes in Idaho, Enhancement of Duration Curve Prediction Using Short Time Low Flow Measurements, Aquaculture Utilization of Geothermal Wastewater, and Information Dissemination.
W86-02692

OKLAHOMA WATER RESOURCES RESEARCH INSTITUTE, FISCAL YEAR 1983 PROGRAM REPORT,

Oklahoma Water Resources Research Inst., Stillwater.
N. N. Durham, and A. E. Redelfs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-100609, Price codes: A02 in paper copy, A01 in microfiche. Annual Report, (1984). 12 p. USGS G-863-01. 14-08-0001-G-863.

Descriptors: *Oklahoma, *Water resources research, Hydrogeology, Water chemistry, Artificial recharge, Groundwater quality.

A diversity of needs for the state and region required a broad base of research projects to study, obtain and analyze data, and provide decision makers with sound information on which to base decisions that will affect the quality and quantity of water in the area for future use. The FY 1983 OWRRI Annual Cooperative Program included five research projects, and all made significant contributions to the data base needed for sound decision-making. Some of the contributions and conclusions included: (1) Data collection and lab analysis on water quality, aquifer use, geomorphology, and mineralogy on the potential contamination of a large and extensively used aquifer in northeast Oklahoma, which will be utilized in the second portion of a two-phase project; (2) Development of a microwave dielectric method to apply to the measurement of fluid flow in soil columns; (3) The determination that artificial recharge of aquifers may be feasible on a local scale; (4) The training of water resource professionals in the use of computer models to predict the flow of potential contaminants in ground water supplies; and (5) increased liaison with state and federal representatives, researchers, water resource professionals, and the public.
W86-02701

WEST VIRGINIA FY 1983 INSTITUTE FINAL PROGRAM REPORT,

West Virginia Univ., Morgantown. Water Research Inst.
C. L. Dodson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101219/AS, Price codes: A02 in paper copy, A01 in microfiche. Final Report, 1984. 7 p. USGS G877-201. 14-08-0001-G-877.

Descriptors: *West Virginia, *Water resources research, Acid mine drainage, Iron, Heavy metals, Water quality standards, Technology transfer, Communication, Information exchange, Reviews. Education, Sediments, Stream pollution, Fish, Aquatic life, Water pollution effects, Ecology, Chemical properties.

The West Virginia State Water Research Institute Program for 1983 was planned, designed, and done in close collaboration and cooperation with state and federal water agencies. The prime objective was to generate usable research results and information for users. The major specific objective was to obtain new knowledge for use in establishing a rational water-quality standard for iron in streams. Another specific objective was to transfer information on research results related to acid mine drainage to those concerned with establishing iron standards. The 1983 Program comprised two research projects and one technology-information transfer project. The larger research project was customed designed to yield information useful in establishing iron standards, and results indicate that the old arbitrary standard of 1 mg/L was unrealistic, and that rational standards specifically designed for individual streams are possible. The other, relatively small, somewhat exploratory, research project investigated a segment of a major river to determine the characteristics and dynamics of sediment bearing iron and other metals originating from acid mine drainage. Results indicate that the sediments adsorb metals from the river water and that agitation by passage of towboats maintain conditions that immobilize the metals. The technology-information project was designed to inform the user of results of the acid-mine-drainage research of the state water-research-institute program. Results indicate that under the time-constraint conditions prevailing, direct personal contact was the preferred method of transfer.
W86-02702

FY 1983 FINAL PROGRAM REPORT, ALABAMA WATER RESOURCES RESEARCH INSTITUTE OF AUBURN UNIVERSITY,

Auburn Univ., AL. Water Resources Research Inst.
J. C. Warman, and D. H. Block.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101235/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Executive Summary, revised May, 1985. 12 p. USGS G889-01. 14-08-0001-G880.

Descriptors: *Activated sludge, *Groundwater pollution, *Irrigation efficiency, *Erosion, *Aquifer, *Aquitard, *Computer modeling, *Technology transfer.

Alabama's Water Resources Research Institute began expenditure of FY 1983 funds under Grant No. 14-08-0001-G880 about June 1, 1983, supporting six research projects. One project performed a sensitivity analysis of a biological toxicity model of an activated sludge process. The analysis indicated that the single most important factor in determining model output (based on the effluent organics concentration) is the retention time in the reactor and the second most important factor is the floc radius. Other projects addresses biodegredation of potential ground water pollutants by microorganisms in subsurface soil horizons; optimization of irrigation techniques to reduce water needs for fields with irregular boundaries; the effect of saltwater intrusion on soil erodibility of marshland; the mechanics of ground water aquifer/aquitard expansion caused by heating; and permeability changes in clay and chalk flow barriers caused by hazardous wastes. In addition to the development and management of this cooperative program with the Geological Survey and continuing efforts in

information transfer, the Institute remains active in the development of support for water resources research from other sources.
W86-02704

FISCAL YEAR 1983 WATER INSTITUTE PROGRAM REPORT,

Iowa State Water Resources Research Inst., Ames.
T. A. Austin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101250/AS, Price codes: A04 in paper copy, A01 in microfiche. Annual Report, 1985. 52 p, 12 ref. USGS G842-01. 14-08-0001-G-842.

Descriptors: *Iowa, *Water resources research, Groundwater, Safe yield, Surface water/groundwater interaction, Bank erosion.

This report summarizes the accomplishments from the FY 1983 Water Institute Grant program of the Iowa State Water Resources Research Institute. Two projects deal with groundwater management with emphasis on surface water/groundwater interactions (G-842-03) and estimating aquifer safe yields (G-842-02). Two projects deal with erosion with emphasis on stream bank erosion (G-842-04 and G-842-06). Project G-842-04, 'Bank Erosion Contribution to Stream Sediment Load' was completed. The remaining projects are continuing in FY 1984.
W86-02706

COLORADO WATER RESOURCES RESEARCH INSTITUTE, ACTIVITIES REPORT, FY1981-1984,

Colorado Water Resources Research Inst., Fort Collins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-101367/AS, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute Final Program Report, Fort Collins, June, 1985. 23 p. USGS G895-01. 14-08-0001-G895.

Descriptors: *Research, *Information transfer, *Training, *Colorado, *Water Resources Institutes, River Basin Development, Water management, Computer models, Water conservation, Water quality control, Urban drainage, Drought resistance.

An overview is provided of activities of the Colorado Water Resources Research Institute during FY1981-1984. Research projects, public service and educational activities described in the report illustrate the practical problem-solving mission of the Institute. It has conducted water research for 20 years with partial support under P.L. 88-379 (as amended), the Water Research Act of 1964. The report provides a summary of Institute programs for FY1981-84, including sources of funding, number of research projects conducted, number of faculty members involved, number of graduate research assistants and similar statistics. The Institute's organization and mode of operation are described including functions of advisory committees, analysis of research needs, identification of research priorities and formulation of the Institute's research program. Services provided to the executive department of state government, the Colorado General Assembly, municipalities, industry and the general public are also described. Selected examples of completed research include: integrated basinwide water management; surface and groundwater management; groundwater recharge; urban drainage; computer-assisted water resources planning; urban water conservation; development of drought-tolerant crops; and water quality management for metal mining operations.
W86-02717

FISCAL YEAR 1984 PROGRAM REPORT (MISSISSIPPI WATER RESOURCES RESEARCH INSTITUTE),

Mississippi State Univ., Mississippi State. Water Resources Research Inst.
M. T. Bond.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126125/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report No G-915-01, September 1985. 20 p, 2 tab. USGS G915-01. 14-08-0001-G915.

Descriptors: *Research, *Information transfer, *Training, *Mississippi, Ground water management, Economic aspects, Political aspects, Water policy, Water use, Water law, Water allocation, Management planning, Irrigation practices, Water reuse, Surface-ground water relations, Mathematical models, Sedimentation.

During the 1984 Program Year the Mississippi Institute's involvement in statewide planning activities and its research program addressed major issues in Mississippi, which include but are not limited to water management needs, surface water quality, erosion and sedimentation and flood plain management. Project Number G915-02 was designed to provide an economic and institutional assessment of alternative strategies to deal with the types of ground water mining problems encountered in Mississippi and to determine how solutions can best be implemented and administered through a functional framework. Project Number G915-03 evaluated existing water management plans from 31 states, analyzed responses to a survey of community water managers in Mississippi, and delineated criteria for a water management plan in a water surplus state. Project Number G915-04 studied options for using surface supplies in place of ground water for irrigation by evaluating equipment and making cost comparisons of three configurations of a center pivot system. Project Number G915-05 developed a mathematical model for investigating the effect of sedimentation processes on water resources systems. (First year of two-year project). Project Number G915-22 supported the Institute program through publication and dissemination of research results and promotional and information materials, response to requests for information and programs, and coordination of the Mississippi Water Resources Conference and publication of its proceedings.
W86-02722

FISCAL YEAR 1984 PROGRAM REPORT (TEXAS WATER RESOURCES INSTITUTE),

Texas Water Resources Inst., College Station.
W. R. Jordan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-126190/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-935-01, September 1985, 28 p. USGS G935-01. 14-08-0001-G935.

Descriptors: *Research, *Information transfer, *Training, *Texas, Reservoir operation, Flood control, Hydroelectric power, Aquifer recharge, Artificial recharge, Playa lakes, Water conservation pricing, Infiltration, Furrow infiltrometer, Surface irrigation, Surge flow irrigation, Hydraulic modeling, Stormwater, Drainage, Flood forecasting, Detention basin, Flood plain.

The Institute's 1984 annual cooperative program concentrated on topics related to conservation of the state's water resources. A management strategy for dynamic reallocation of storage capacity between flood control and conservation purposes were shown to enhance total water resource benefits. The reservoir evaluation methodology is expected to be generally applicable to multiple use reservoirs. Surface waters captured in playa lakes could also be conserved if appropriate methods could be developed for artificial groundwater recharge. Rapid, natural infiltration does occur if sufficient runoff occurs to fill the playas beyond the limits of the clay covered bottom, but the water volume retained by the clay bottom is usually lost to evaporation. Detailed analysis of playa flooding suggests that from 27 to 43% of the total runoff recharges naturally; the remaining 57 to 73% is available for artificial recharge. User charges may be used as a form of water demand management to encourage conservation. A case study of the Austin-San Antonio corridor was undertaken to examine pricing and taxation as means to encourage conservation. Results will be included in the FY85 report. Surge irrigation is a potentially important advance in technology that allows even distribution of water along furrows thus reducing deep percolation and tailwater waste. A simulation model was developed to account for dynamic changes in infiltration rates in order to optimize surge operation procedures. A watershed model was prepared for use on a microcomputer and used as part of a Flood and Flood Plain Analysis short course to be offered annually. The users manual and diskettes are available for purchase and are currently in use by 10 cities and 20 consulting firms.
W86-02729

FISCAL YEAR 1984 PROGRAM REPORT (MISSOURI WATER RESOURCES RESEARCH CENTER).

Missouri Water Resources Research Center, Rolla.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132313/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Report G-916-01, September 1985. 19 p. USGS G916-01. 14-08-0001-G916.

Descriptors: *Research, *Information transfer, Training, *Missouri, Tetrachloro-p-dioxins, Vapor-phase migration, Effects of co-pollutants, Soil contamination, Soil detachment, Fall-cone shear strength, Rainfall erosion, Clay, Permeability, Hazardous waste, Unsaturated flow, Drinking water, Microbiology, Turbidity.

The Missouri Water Resources Research center's goals are: (1) sponsor, coordinate and administer research projects on Missouri's water problems, (2) provide training opportunities in research for men and women interested in careers in water resources and related fields, and (3) conduct an active technology transfer which includes conferences, workshops, newsletters, and water center research reports. Each of the four research projects funded under this grant produced valuable information to Missouri problems, and student involvement was encouraged on all projects. Research covered (a) study of cropping effects on soil properties related to water infiltration, runoff and soil loss using simple laboratory methods; (b) influence of permeant and clay chemistry on the hydraulic conductivity of compacted clays used as liners for hazardous waste disposal landfills, Phase II; (c) disposition of polychlorinated dibenzo-p-dioxins, vapor-phase migration, effect of co-pollutants, soil contamination; and (d) microbiological and chemical changes in drinking water systems caused by increased temperature during the summer months.
W86-02731

FISCAL YEAR 1984 PROGRAM REPORT (VIRGINIA WATER RESOURCES RESEARCH CENTER).

Virginia Water Resources Research Center, Blacksburg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132339/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-938-01, September 1985. 26 p. USGS G938-01. 14-08-0001-G-938.

Descriptors: *Research, *Information transfer, *Training, *Virginia, Fish, Instream flow, Habitats, Groundwater, Contamination, Underground storage, Data storage and retrieval, Water quality data.

This report summarizes the Virginia Water Center's efforts to contribute to the solution of Virginia's high priority water resource problems. Program focus during federal FY 84 was on decreasing barriers to development of a water resource planning process and assessing the impact of land use practices on water resources. Three research projects were supported with institute program funds. Project 02 provides an approach to recommending instream flows based on hydrologic statistics for streams in the upper James River basin. Project 03 offers three alternative options for managing underground petroleum storage tanks for Virginia. Project 04 completed a two-year project on evaluating alternatives for a water quality data clearinghouse for Virginia. Publications were the primary vehicle utilized to promote the application

and dissemination of research results. Water News continued to highlight important water resource problems, research findings, conference and seminar schedules, and new publications. Also published were bulletins on the agricultural use of sewage sludge, effects of land use practices on water resources in Virginia, new procedures for resolving conflicts over interjurisdictional water transfers, the economic feasibility of expanded irrigation in Virginia, methods of analyzing instream flows, and public participation. Three special reports improved the information available in Virginia concerning interjuridictional transfers and acid rain. The education program produced homeowners' guides to wells and septic systems, two exhibits, a slide-tape program and a booklet presenting an overview of the state's surface and ground waters.
W86-02733

FISCAL YEAR 1984 PROGRAM REPORT(OREGON WATER RESOURCES RESEARCH INSTITUTE),

Oregon State Univ., Corvallis. Water Resources Research Inst.
P. C. Klingeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132347/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-928-01, September 1985. 44 p, 2 tab. USGS G928-01. 14-08-0001-G928.

Descriptors: *Research, *Information transfer, *Training, Oregon, Transpiration, Juniper trees, Culverts, Roads, Estuaries, Algae, Nutrients, Yaquina Bay, Salmon, Minimum flow, Aquatic habitats, John Day River, Regulated flow, Invertebrates, Wild rivers, White water, Recreation, Rogue River, Water management, Microcomputers, Forecasting, Groundwater, Conjunctive use, Goose Lake Basin, Water law.

The FY 1984 Oregon Water Resources Research Institute program included 10 projects concerned with water management of forest, range, agricultural and estuarine zones, including the associated biological resources, problem areas of Oregon water law, and technology/information transfer activities for state water management. Brief summaries of research findings are presented for each project: 02, Water Budget Model of Western Juniper; 03, Assessing Culvert Effectiveness in Mountainous Terrain; 04, Impact of Estuarine Benthic Algal Production on Dissolved Nutrients and Water Quality in the Yaquina River Estuary; 05, Minimum Flow Needs for Juvenile Salmonids in Central Oregon Streams; 06, Effects of Long-Term Regulated Flow on Community Composition of Stream Invertebrates; 07, Valuation of the Rogue River for Whitewater Recreation; 08, Real-Time Data Acquisition and Forecasting for Local Water Management; 09, Alternative Approaches to Management of Water Resources of Goose Lake Basin, Oregon-California; 10, Oregon Water Law and Water Resource Management; 22, Technology and Information Transfer for Oregon's Water Resources Management.
W86-02734

FISCAL YEAR 1984 PROGRAM REPORT (NEW MEXICO WATER RESOURCES RESEARCH INSTITUTE),

New Mexico Water Resources Research Inst., Las Cruces.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132354/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-922-01, September 1985. 21 p. USGS G922-01. 14-08-0001-G922.

Descriptors: *Research, *Information transfer, *Training, *New Mexico, Recharge, Groundwater, Infiltration, Isotopic tracers, Monte Carlo simulation, Computer model, Ion exchange, Adsorbants, Biological filters, Heavy metals, Alfalfa, Plant physiology, Selective media.

The New Mexico Water Resources Research Institute's (WRRI) goal is to maintain a well balanced program of research to address critical state, regional and national water problems. The institute has targeted four areas as high priority for institute funding. They are: (1) Water Conservation, particularly in agriculture. (2) Water Quality Research. (3) Saline water Research and, (4) Surface-Ground Water Relationships. The institute's USGS program attacked three of these four areas. 'Improving water use efficiency in alfalfa by genetic engineering' compares a water use efficient alfalfa produced in earlier research and the unimproved parent stock to see which differences in biochemical or genetic parameters would be useful in cell selection. 'Biosorption of heavy metal ions in water' investigated the use of algae to extract toxic material from industrial amd mining wastewaters. The project has shown that algae can effectively biosorb most heavy metal cations and many oxyanions such as selanide. Most of the sorbed metals can be released and recovered by appropriate pH manipulation. 'Groundwater basin parameter estimation and simulation under uncertainty' and 'Quantification of groundwater recharge rates in New Mexico using bomb 36C1 as a soil-water tracer' both examined surface-groundwater relationships. The first of these projects has been studying the sources and magnitudes of uncertainties in predictive hydrologic models. The second project uses the pulse of radioactive chlorine and tritium released during atmospheric nuclear testing to measure soil-water and soil-water vapor movement in arid soils. Preliminary results indicate that the 36C1 has infiltrated to a depth of 1m in the 22 years since testing ended.
W86-02735

FISCAL YEAR 1984 PROGRAM REPORT (ALABAMA WATER RESOURCES RESEARCH INSTITUTE),

Auburn Univ., AL. Water Resources Research Inst.
J. C. Warman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132362/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-890-01, September 1985. 20 p. USGS G890-01. 14-08-0001-G890.

Descriptors: *Research, *Information transfer, *Training, *Alabama, Activated sludge, Toxins, Microbial degradation, Organic compounds, Biological wastewater treatment, Acidic water, Benthic fauna, Tidal hydraulics, Environmental effects, Lagoons, Organic wastes, Clay permeability, Water conservation.

Under grant No. 14-08-0001-G890 the Auburn, Alabama Water Resources Research Institute provided support for eight research projects. One project developed a unique mathematical model for the activated sludge process. The model takes into account the flow pattern in the reactor, intraparticle mass transport of nutrients, biochemical reactions by individual cells embedded in the floc and inhibition and toxicity effects on cellular reactions. Other projects addressed biodegradation of potential groundwater pollutants by microorganisms in subsurface soil horizons; domestic wastewater treatment and effluent mutagenicity relationships; simulated acidification effects on benthos of southern fishponds; tidal inlet hydraulics and selected environmental parameters associated with small lagoons in developing areas; use of consolidation tests for assessing effects of certain organic fluids on clay permeability; eliminating the use of water in preparation of textile yarn for weaving and fabric desizing; permeability changes in clay and chalk flow barriers caused by hazardous wastes. In addition to the development and management of this cooperative program with the Geological Survey and our continuing efforts in information transfer, the Institute remains active in the development of support for water resources research from other sources.
W86-02736

FISCAL YEAR 1984 PROGRAM REPORT (ARIZONA WATER RESOURCES RESEARCH CENTER),

Arizona Water Resources Research Center, Tucson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132370/AS, Price codes: A04 in paper copy, A01 in microfiche. Program Report G-892-01, September 1985. 52 p, 8 ref, 6 tab. USGS G892-01. 14-08-0001-G892.

Descriptors: *Research, *Information transfer, *Training, *Arizona, Volatile organics, Trihalomethanes, Viruses, Septic tanks, Geochemistry, Ground-water recharge, Conjunctive conservation, Paleohydrology.

The research projects of the Arizona Water Resources Research Center (1984) addressed the following critical water issues: water quality, conjunctive management, water conservation, and water management. Project O2 dealt with the seasonal, diurnal, and storm-related changes in volatile organics in alluvial vadose zones. Projects 03 and 04 examined the fate of trihalomethanes and viruses, respectively, in ground water. During Project 05 a modified septic tank design was examined for areas with failing leachfields. Project 06 dealt with geochemical factors modifying imported water during ground-water recharge. The technical and legal-institutional elements of a conjunctive management program using Central Arizona Project water in Butler Valley were examined during Project 07. During Project 09 a domestic residence was retrofitted to conserve water by water harvesting and grey-water reuse. The focus of Project 08 was on predicting extreme flood events in the southwest using methods of paleohydrology. The information transfer element of the Program comprised the publication of a news bulletin and project bulletins and disseminating program-related publications.
W86-02737

FISCAL YEAR 1984 PROGRAM REPORT (NEW HAMPSHIRE WATER RESOURCES RESEARCH CENTER),

New Hampshire Univ., Durham. Water Resources Research Center.
G. L. Byers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132412/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-920-01, September 1985. 22p. USGS G920-01. 14-08-0001-G920.

Descriptors: *Research, *Information transfer, *Training, *New Hampshire, Water pollution, Contamination, Toxicity, Aluminum, Environmental isotopes, Groundwater, Eutrophication, Lakes, Hydrologic regimes, Streamflow, Air pollution, Acid rain.

This report covers the activities of the New Hampshire Water Resource Research Center for the period July 1984 to September 30, 1985. The results of four research projects are briefly discussed. Two of the projects relate to the acid precipitation problem, one relates to radon levels in groundwater and one describes the social aspects of hazardous waste disposal. A listing of publications and papers presented is included.
W86-02741

FISCAL YEAR 1984 PROGRAM REPORT (NEW YORK WATER RESOURCES RESEARCH INSTITUTE),

Cornell Univ., Ithaca, NY. Center for Environmental Research.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-1324[illegible]0/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-923-01, September 1985. 21 p. USGS G923-01. 14-08-0001-G-923.

Descriptors: *Groundwater, *Groundwater quality, *Models, *Pesticide residues, Chemical pollution, Toxicants, Soils, Land use, Remote sensing, Satellite technology, *Research, *Information transfer, *Training, *New York.

The Institute's 1985 program aimed to achieve its goals to develop better fundamental understanding about causes and effects of sources or forces which could impair the use of groundwater for water supplies and techniques to assist communities and

agencies in the efficient and cost-effective acquisition and application of data for dealing with groundwater problems. A prototype computer software package was developed in Porter's project that will assist communities and agencies to make preliminary diagnoses of groundwater problems. Loucks and Liu have improved methods by which probabilities of contaminant concentration at wells can be assessed and the cost-risk relation of various options can be estimated. Lemley and Wagenet designed an inexpensive laboratory technique that gives a quick method of screening chemicals with regard to their mobility in soil. Steenhuis improved an evaluatory computer model--the Method of Underground Solute Evaluation (MOUSE) to make it user friendly. The model uses color graphics to display water and contaminant budgets in soil and groundwater. Alexander addressed the issues of how rates of biodegradation due to microbial action may change as the concentrations of specific chemicals change. Philipson and Philpot explored the use of image data from Landsat satellite sensor, the 'Thematic mapper' to recognize land use and cover types which impact on hydrologic processes.
W86-02742

FISCAL YEAR 1984 PROGRAM REPORT (INDIANA WATER RESOURCES RESEARCH CENTER),

Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. H. Cushman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132438/AS, Price codes: A03 in paper copy, A01 in microfiche. 20th Annual Report G-905-01 September 1985. 37 p., 1 tab. USGS G-905-01. 14-08-0001-G905.

Descriptors: *Research, *Information transfer, *Training, *Indiana, Nitrogen cycle, Nitrogen remover, Cation exchange, Tracer, Pollutant, Mathematical model, Agricultural runoff, Nuisance algae, Fertilizers, Fishing, Management planning, Recreation, Strip mine lakes, Microbiological studies, Anaerobic bacteria.

In the Indiana Water Resources Research Center program (1984), Dr. Allan Konopka studied sulfate reduction by microbes as a means of neutralizing acid in lakes. His principal finding was that sulfate-reducing bacteria can metabolize at acidic pH at rates comparable to those found in pH-neutral systems. Dr. Lee Somers evaluated the impact of water chemistry on ammonia speciation and volatilization and the effect of cation exchange reactions on controlling the ammonium level in surface waters. Dr. Carole Lembi studied how agricultural practices that result in the greatest reduction in nitrogen input into surface waters affect the growth of certain nuisance filamentous algae. Dr. Darrell Leap built a laboratory sand tank to examine the validity of a multiple-pulse, single-well tracer test for determining aquifer flow velocities. He found that the method gives reasonable estimates of ground water velocity within bounds that can be statistically estimated. Dr. Joseph O'Leary attempted to empirically develop an activity specialization index that classifies different user groups in relation to fishing activities, and evaluate the impact of resource access on activity specialization. The principle information transfer activity of the center was a conference jointly sponsored by the center and the Department of Energy. The conference dealt with the use of, and future use of, supercomputers in subsurface hydrology with emphasis on transport of organics. 'The Analysis of Organic Pollutants in Water By High-Performance Liquid Chromatography with a Swept-Potential Electrochemical Detector,' by Peter E. Sturrock. Analyses at low concentrations of carbamate, triazine and dinitriloaniline compounds were developed and compared with uv detectors to attain high sensitivity for pesticides and herbicides in water. 'Drainage-Subirrigation System Evaluation for Georgia Flatwoods,' by E.D. Threadgill, A. Shirmohammadi, and D.L. Thomas. The effectiveness of subirrigation was compared to center-pivot and traveling-gun irrigation for several crops in loamy sand soil where drainage is needed to support farm equipment, but water is poorly retained by the soil. 'Technology Transfer for Solution of Water Conservation, Reuse and Water Treatment Problems of Major Generic Industries in Georgia,' by Frederick G. Pohland. Research needs of Georgia industries for providing adequate water supply and wastewater treatment were surveyed to provide appropriate information transfer.
W86-02743

FISCAL YEAR 1984 PROGRAM REPORT (VIRGIN ISLANDS WATER RESOURCE RESEARCH CENTER).

Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132446/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Report G-939-01, September 1985. 13 p. USGS G939-01. 14-08-0001-G-939.

Descriptors: *Research, *Information transfer, *Virgin Islands, Cisterns, Rain water, Water harvesting, Pathogenic bacteria.

The Fiscal Year 1984 program of the Virgin Islands Water Resources Research Center was oriented mainly towards dissemination of information to the public on research that was done in the past by the Center. Several formal presentations were made on previous research activities and plans for the future. A long-needed brochure describing the Center was also prepared. Research was conducted on the presence of pathogens in drinking water supplies in the Virgin Islands and the validity of various methods for their detection. Results indicated that pathogen levels are high and that current indicators used for detecting contaminated water were useless in many instances.
W86-02744

FISCAL YEAR 1984 INSTITUTE PROGRAM REPORT (ARKANSAS WATER RESOURCES RESEARCH CENTER).

Arkansas Water Resources Research Center, Fayetteville.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132453/AS, Price codes: A03 in paper copy, A01 in microfiche. Institute Program Report G893-01, Spetember 1985. 32 p. USGS G892-001. 14-08-0001-G893.

Descriptors: *Research, *Information transfer, *Training, *Arkansas irrigation practices, Scheduling, Computer model, Soil salinity, Rice, Agriculture, Groundwater contamination, Economic Efficiency, User charges, Water management, Simulation, Electronic, Educational, Algae, Habitat, Reservoirs, Chemical analysis, Coal mining, Ground water.

Arkansas' major water problems are floods, droughts, water quality, goundwater mining, institutional arrangements, laws, financing, environmental concerns and public awareness. From this generalized list of probleus, a more specific list was developed by the Technical Advisory Committee to provide goals and priorities for the principal investigators. Specific areas for research include three projects on agricultural water, one on financing water projects and three technology transfer projects. The agricultural projects cover optimal allocation and scheduling of irrigation water, the behavior of soluble salt in clay and trace levels of pesticides in ground water. Institutional arrangements and financing alternatives for state and local water programs are discussed in a timely report. The technology transfer projects include water managment simulator presentations, qualitative and quantitative algal data compilation for macrotrends and the chemistry of water in Arkansas' coal basins. In these research and technology transfer projects, twenty-five graduate and undergraduate students received training.
W86-02745

FISCAL YEAR 1984 PROGRAM REPORT (KENTUCKY WATER RESOURCES RESEARCH INSTITUTE).

Ewald (William R.), Jr., Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132461/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-908-01, September 1985. 33 p, 8 ref. USGS G 908-01. 14-08-0001-G908.

Descriptors: *Research, *Information transfer, *Training, *Kentucky, Suspended solids, Overland flow, Visual resources, Stormwater management facilities, Dechlorination, Karst pollution, Water distribution systems.

The Kentucky Water Resources Research Institute Annual Report for Fiscal Year 1984 describes the problems and issues for the Commonwealth as determined by the State Advisory Council. The program goals and priorities of the Institute describe the areas of research the program addressed. A synopsis of each of the seven research projects is included. The seven projects funded by the Institute in Fiscal Year 1984 are: 02 - Identification of Soil-Water Chemical Parameters for the Prediction and Treatment of Suspended Solids in Surface Water Reservoirs of Coal Mine Lands; 03 - Modeling of Overland Flow by the Diffusion Wave Approach; 04 - A Model for Assessing the Visual Resources of River Basins as an Aid to Making Landuse Planning Decisions; 05 - Development of General Guidelines for the Planning of Stormwater Management Facilities; Application to Urban Watersheds in Kentucky; 06 - Reductive Dechlorination of Toxic Chlorocarbons; 07 - Investigation of Pollution in a Karst Aquifer Utilizing Optical Brightener; and 08 - Hydraulic Design Algorithms for Upgrading and Enhancing Water Distribution Systems. A brief description of the Institute's information transfer activities is provided along with the cooperative arrangements that exist between the Institute and other institutions. The State and University Advisory Councils are listed for 1984. The training accomplishments by fiscal year 1984 research projects is given in terms of category and academic level.
W86-02746

FISCAL YEAR 1984 PROGRAM REPORT (MAINE LAND AND WATER RESOURCES CENTER).

Maine Univ. at Orono. Land and Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132479/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-910-01, September 1985. 24 p, 2 fig, 9 ref. USGS G910-01. 14-08-001-G910.

Descriptors: *Research, *Information transfer, *Training, *Maine, Acidification, Macroinvertebrates, Potable water, Radioactivity effects, Acid rain, Fog, Recreation, Rivers, Landfills, Leachates, Waste treatment.

Five research projects and a technology transfer project were funded under the FY-84 program: 'Effects of Acidification on Pond and Stream Macroinvertebrates' (G910-02); 'Radon in Houses Due to Radon in Potable Water' (G910-03); 'A Comparison of the pH of Coastal fogs with the pH of Interior High-Elevation Fogs' (G910-04); Estimating the Value of River-Related Recreational Activities' (G910-05); 'Treatment of Leachate from Toxic and Hazardous Wastes' (G910-06); and 'Technology Transfer in Water Resources Management' (G910-22). The macroinvertebrate study (02) found that small C. triangulifer nymphs were most susceptible to low acidity. Various naturally occuring concentrations of aluminum do not affect its survival. Other insects were evaluated for sensitivity to pH fluxes at various stages of their development. The radon study (03) found that the average radon in the air in sampled houses due to radon in water varied from .8 to 77 pCi/1. The calculated dose for radon exposure leading to radon daughter dose ranged from 0.02 to 1.6 working level months/month. The study of river recreation values (05) Estimated visitor-day values from $1 to $12 on the West branch of the Penobscot and from $1 to $6 on the Saco. The Contingent value method estimates were significantly influenced by the framing of the questions. Preliminary results of the acid fog study (04) indicate that fog from the

high elevation site is slightly more acidic than average coastal fog (3.14 versus 3.66), but that the pH of fogs from various coastal sites varies significantly (3.08 at Damariscove Island to 4.12 at Mount Desert Rock). The leachate study (06) is evaluating the capacity of peat for treatment of metal ions and organics in landfill leachate. Column studies have determined adsorption isotherms for seven metal ions. Higher peat compaction densities improved metal removal.
W86-02747

FICAL YEAR 1984 PROGRAM REPORT (GEORGIA ENVIRONMENTAL RESOURCES CENTER).
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132859/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-900-01, September 1985. 27 pp. USGS G900-01. 14-08-0001-G900.

Descriptors: *Research, *Information transfer, *Training, *Georgia, Ground water movement, Finite element analysis, Model studies, Simulation analysis, Wastes, Water quality, Coastal marshes, Drainage, Electrochemistry, Chemical analysis, Irrigation, Water table.

The FY 1984 Program included the following seven projects: 'A Simplified Approach to Regional Multilayered Aquifer Analysis,' by M. M. Aral. transfer among aquifers due to seepage and pumping is treated with differential equations and the finite element Galerkin Matrix procedure. 'Estimating the Surface Water Resources of the Georgia Coastal Plain and Predicting the Effects of Changing Land-Use Patterns,' by George A. Brook. A hydrologic simulation model was developed for stream flow in the coastal region, where inflow results from groundwater discharge into the stream bed. 'Heavy Metal Composition of Treated Municipal Wastewater and Sludge Residues, by Gian S. Ghuman. The transfer of manganese, zinc, cadmium, copper, nickel and chromium from wastewater to liquid effluent and sludge was observed, as well as the leachability of these metals from ashed sludge. 'Analysis of Wetland Trends and Management Alternatives for Georgia,' by James E. Kundell. Information is presented on the types, location, and extent of wetlands in the state, and current as well as potential laws and regulations governing the use of the lands.
W86-02748

FISCAL YEAR 1984 PROGRAM REPORT (NEBRASKA WATER RESOURCES CENTER).
Nebraska Water Resources Center, Lincoln.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132867/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G918-01, September 1985. 30 p. USGS G918-01. 14-08-0001-G918.

Descriptors: *Research, *Information transfer, *Training, *Nebraska, Soil fungi, Soil erosion, Nitrates, Denitrification, Water treatment, Conjunctive use, Alluvial aquifers, Consumptive use, Evaporation, Transpiration, Gully erosion, Urbanization, Vegetation effects, Channel morphology, Remote sensing, Groundwater.

Water problems in Nebraska addressed by 1984 research program projects included: nitrate contamination of groundwater; declining groundwater levels; effects or irrigation on the Sandhills; impact of irrigation diversions on wildlife habitat; and stream channel erosion in urban areas. Project 02 studied whether disturbed sandy soils are deficient or lacking in vesicular-arbuscular mycorrhizae and if the reintroduction of mycorrhizal fungi into these soils in the revegetation process improves the survivorship, growth and reproduction of plants. Project No. 03 examined the possibility of using a biological treatment for drinking water. Project No. 04 developed a finite-difference computer model to manage a river system and groundwater conjunctively. Project No. 05 developed a field method for separately measuring soil water evaporation and plant water transpiration using minilysimeters. Project No. 06 found that increased runoff caused by urbanization can cause rapid channel degradation by integrating the factors of rate of transition to urban use, stream velocity needed for tractive sediment removal, and slope stability of the channel. Project No. 07 studied encroachment of vegetation and flow relationships in a river using remote sensing techniques, documenting the rate of encroachment from survey maps and aerial photographs. Project No. 08 tested remote sensing using thermal imagery as a means of measuring subsurface water levels in sandy soils.
W86-02749

FISCAL YEAR 1984 PROGRAM REPORT (NEW JERSEY DIVISION OF WATER RESOURCES).
Rutgers - The State Univ., New Brunswick, NJ. Div. of Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132875/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-921-01, September 1985. 22 p. USGS G921-01. 14-08-0001-G921.

Descriptors: *Research, *Information transfer, *Training, *New Jersey, Water pollution, Fish, Chlorinated hydrocarbons, Lead, Acidity, Trace elements, Bioindicators, Acid rain, Tidal marshes.

The 1984 New Jersey Water Institute Program focuses on the most critical water issue currently facing the state the fate and effects of organic and inorganic trace contaminants in surface and ground waters. Five of the projects funded by the Program are directed toward surface waters. Four of these grants address the physical, chemical and biological factors controlling the cycling of various trace elements, particularly lead, in a variety of ecosystems, including a marsh, a swamp, several rivers and a series of acid lakes. The fifth study is determining the effects of combinations of various volatile organic contaminants on a fish species. The final project is identifying factors which influence the behavior of organic contaminants in groundwater systems.
W86-02750

FISCAL YEAR 1984 PROGRAM REPORT (UTAH CENTER FOR WATER RESOURCES RESEARCH).
Utah Center for Water Resources Research, Logan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132883/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-936-01, September 985. 25 p., 3 fig, 2 tab, 15 ref. USGS G936-01. 14-08-0001-G936.

Descriptors: *Research, *Training, *Utah, Heavy metals, Groundwater pollution, Leaching, Waste treatment, Land disposal, Soil amendment, Groundwater, Salinity, Irrigation, Soil physics, Remote control, Communications, Data retrieval, Hydrometeorology, Cloud seeding, Utilities, Domestic water, Water management, Water supply systems, Institutions, Marine sediments, Geochemistry, Mixing.

Utah water resources problems and issues are presented as background for developing a water research program incorporating studies in four areas: A field-scale application of geochemical and solute transport models to water flowing in soil overlying salt bearing strata showed the importance of mapping flow paths and showed that the predominant leaching to be slow upward diffusion of sulfate salts from the bedrock. Farm water management or canal lining reduce short term salt loading but achieve little long run benefit. Field data were also collected on salt movement through the soil profile and showed soil salts to rise during the winter but problem concentrations to be leached below the root zone once irrigation starts. Soil-waste interactions were examined in the laboratory to determine how the metals in industrial wastes can be immobilized in land disposal and land spill sites. Amendments that modify leachate pH and promote sorption are the most effective. The latest remote control technology was reviewed for information on available equipment and its performance, cost, range, power requirements, and other relevant factors. Combined radio telemetry and telephone are the least expensive systems and their use would be enhanced by modernization of FCC Rules and Regulations. Small privately owned domestic water utilities have a particular problem in maintaining dependable service. The situation can be improved by eliminating unjustified discriminatory regulations and by requiring developers to provide satisfactory plans for perpetual service.
W86-02751

FISCAL YEAR 1984 PROGRAM REPORT (TENNESSEE WATER RESOURCES RESEARCH CENTER),
Tennessee Water Resources Research Center, Knoxville.
W. F. Brandes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132891/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-934-01, September 1985, 20 p. USGS G934-01. 14-09-0001-G-934.

Descriptors: *Research, *Information transfer, *Training, *Tennessee, Hazardous wastes, Waste management, Groundwater contamination, Leachate, Soil permeability, Environmental policy, Administrative regulations, Water laws.

This report details FY 84 research work accomplished by the Tennessee Water Resources Research Center under the Department of Interior's Annual Cooperative Program. Foremost was the desire of the Tennessee Water Resources Research Center to direct its funded research efforts towards environmental and growth related issues identified by Governor Alexander's Safe Growth Action Team. Specifically, these issues revolved in and around aspects of water and hazardous wastes; 1) a comprehensive evaluation of environmental protection programs for the State, leading to resolution of legal and institutional restraints on water resources planning and management; 2) a variety of economic, social and political studies relating to problems of government in coping with water resources needs and responsibilities and 3) technical research projects in engineering and in the physical and life sciences designed to assist in resolving such problems as erosion and sedimentation, floodplain management, and groundwater pollution. This report provides an overview of water problems and issues in Tennessee and highlights of four research project/activities: 1) A Method for the Evaluation of the Need for Hazardous Wastes Treatment/Disposal Facilities: 2) Evaluation of the Impact of a Clay Cap on the Migration of Hazardous Materials; 3) Investigation of Conflicts, Overlaps and Gaps in Tennessee's Environmental Protection Programs and 4) Information Transfer Program.
W86-02752

FISCAL YEAR 1984 PROGRAM REPORT (COLORADO WATER RESOURCES RESEARCH INSTITUTE).
Colorado Water Resources Research Inst., Fort Collins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132909/AS, Price codes: A06 in paper copy, A01 in microfiche. Program Report G-895-01, September 1985. 60 p., 3 tab. USGS G89501. 14-08-0001-G895.

Descriptors: *Colorado, Phreatophytes, Evapotranspiration, Consumptive use, *Water quality management, *Effluent standards, Low flow, Water permits, *Water quality standards, Quality control, *Research and development, *Water resources development, Administration, *Technology transfer, Wildlife habitats, Legal aspects, Institutional constraints, *Conjunctive use, *Surface-groundwater relations, Computer models, *Groundwater, Aquifers, Reservoir release.

The Colorado Water Resources Research Institute is the designated management center in Colorado for the Federal Water Research Program. The Institute's Federal FY1984 Program consisted of

six research projects focused on the following Colorado problems: (1) The Endangered Species Act and Water Development within the South Platte Basin; (2) Maintenance of Crane Habitat by Controlled Reservoir Releases--South Platte River; (3) Water Delivery Strategies--South Platte Mainstream Reservoir; (4) Evaluation of Low-Criteria for Effluent Discharge Permits in Colorado; (5) Evapotranspiration of Natural Vegetation in the San Luis Valley, Colorado; and (6) Voluntary, Basinwide Water Resources Management: South Platte Basin, Phase II. In addition, the Institute received state funding for the first time in 1984-85 when the Colorado General Assembly provided $67,000 for water research. Five research projects were supported by this appropriation--three projects at Colorado State University, one at the Colorado School of Mines, and one at the University of Colorado, Boulder: (1) Geochemistry of Aquifer Recharge in the Denver Basin; (2) Guidelines for Developing Basin-of-Origin Compensation; (3) South Platte Basin Simulation Model (SAMSON); (4) Low-Flow Criteria for Discharge Permits (complements Federal program project); and (5) Voluntary, Basinwide Water Resources Management: South Platte River, Phase II (complements Federal program project). The Institute's technology transfer program was fully integrated with its water research and development program. It includes: newsletters; three publications series; distribution of a 'library list' of new water resources research reports and publications; Project AWARE, designed to keep State and Federal agency personnel aware of proposed research; public water policy education (programs including slide presentations); and workshops, seminars, and small groups consultations involving potential users.
W86-02753

FISCAL YEAR 1984 PROGRAM REPORT (DELAWARE WATER RESOURCES CENTER),

Delaware Univ., Newark. Water Resources Center.
R. D. Varrin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-132917/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-897-01, September 1985. 26 p. USGS G897-01. 14-08-0001-G897.

Descriptors: *Research, *Training, *Information transfer, *Delaware, Activated carbon, Activated sludge, Adsorption, Aerobic digestion, Bacterial analysis, Channel erosion, Contamination, Corn, Domestic water, Groundwater, Groundwater pollution, Heavy metals, Industrial water, Irrigation, Municipal water, Nitrogen, Organic compounds, Petroleum products, Regional planning, Sludge, Biodegradation, Storm runoff, Toxins, Water analysis.

Synopses of 6 research projects of the Delaware Water Resources Center are presented. Project 02, 'A Predictive Study for Groundwater Contamination by Petroleum Products,' formulated a model to predict the movement of gasoline in the soil; the work will advance recovery and cleanup of these substances. Project 03, 'Fundamental Concepts of Autodigestion of Biomass,' focused on determining the extent of biodegradability of the products of autodigestion. This information is critical to design better treatment facilities and to regulate sludge and effluent disposal. Project 04, 'The Removal of Toxic Chemicals by Activated Carbon Process from Contaminated Groundwater,' focused on removing concurrently heavy metals and organic compounds from ground water. The results indicate that activated carbon is effective. Project 05 developed a method for 'Rapid, Accurate Identification of Bacterial Pollutants in Domestic, Institutional, and Industrial Water Supplies.' Fatty acid profiles were developed for bacterial pollutants and linked with a computer for identification. Project 06 investigated 'Thresholds of River Channel Erosion in Urbanized Piedmont Watersheds.' The results indicate that erosion is affected by frequency, rather than intensity,of stress. Project (07), 'The Influence of Nitrogen Management and Irrigation on Ground-Water Quality,' investigated the effect of intensive irrigaton and fertilizer application on ground-water pollution. The results indicate that greater leaching occurs with increased irrigation but that different fertilizer application treatments have little effect on soil nitrogen. This report also includes a summary of the Delaware WRC's information transfer effort, a newsletter published 3 times a year to summarize research.
W86-02754

FISCAL YEAR 1984 PROGRAM REPORT (PENNSYLVANIA INSTITUTE FOR RESEARCH ON LAND AND WATER RESOURCES).

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-133220/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-929-01, September 1985, 31 p. USGS G929-01. 14-08-0001-G-929.

Descriptors: *Research, *Information transfer, *Training, *Pennsylvania, Deposition, Acidic soils, Deciduous forest, Streams, Eutrophication, Aquatic productivity, Nutrients, Hydrological model, Drought, Monongahela River, Reservoir operation, Consumptive use, Precipitation, Air pollution, Drought resistance, Water conservation, Forest soils, Leachate, Water allocation.

Three Fiscal Year 1983 programs continued in Fiscal Year 1984. One program evaluated the rate and extent of recovery of a stream, dominated by the growth of aquatic vascular plants, following a program of phosphorus removal. Another attempted to determine if the chemistry of soil and soil leachate in Appalachian forests varies with the amount of acidic atmospheric deposition. A third project developed a flow management model to explore alternative approaches to future drought protection for the Monongahela River Basin and examined possible impacts of modifications in reservoir operating policies and low flow consumptive use restrictions. The Institute's technology transfer program was geared to improving the public's understanding about atmospheric deposition and Giardiasis. It was also designed to increase the knowledge of local sewage enforcement officers and water managers about maximum level water conservation devices and to educate local government officials to the potential benefits of hydraulic load reduction through water conservation for malfunctioning on-lot sewage systems.
W86-02755

FISCAL YEAR 1984 PROGRAM REPORT (CALIFORNIA WATER RESOURCES CENTER),

California Univ., Davis. Water Resources Center.
J. H. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-133238/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report No G-894-01. September 1985. 28 p. USGS G894-01. 14-08-0001-G894.

Descriptors: *California, *Research and development, *Grants, Irrigation, Drip irrigation, Water conservation, Reclamation, Water prices, Acid precipitation, Atmospheric nutrient deposition, Lake Tahoe, Monitoring, Streams, Logging, Chaparral, Burning, Steelhead, Nutrients, Algae, Watershed, DBCP, Soil organic matter, Fumigants, Path of pollutants, Soil contamination.

A synopsis is presented of the results of each of the research projects sponsored under the 1984 Water Research Institute Program (WRIP) for the University of California Water Resources Center. It also contains summaries of water problems and issues in California and the Water Resources Center's Program Goals and Priorities, Information Dissemination Activities and Cooperative Arrangements. The California WRIP package is a subset of the Center's overall research program and consists of five projects investigating the following topic areas: The Diffusion of Low-Volume Irrigation Technology in Western Agriculture, Structural Impacts of the Reclamation Reform Act of 1982 on California Agriculture, The Direct Quantification of Atmospheric Dry Acid and Nutrient Deposition on Western Mountain Lakes, Application of a Paired Watershed Research Design to Evaluate Instream Effects of Watershed Management Activities in North Coastal California, Interaction of Nemagon (DBCP) with Constituents of Water-Soil Systems.
W86-02756

FISCAL YEAR 1984 PROGRAM REPORT (MARYLAND WATER RESOURCES RESEARCH CENTER),

Maryland Water Resources Research Center, College Park.
R. E. Menzer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-133253/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-911-01, September 1985. 22 p. USGS G911-01. 14-08-0001-G911.

Descriptors: *Research, *Information transfer, *Training, *Maryland, Nitrogen, Phosphorus, Groundwater, Estuaries, Trace metals, Geologic history, Sludge, Toxicity, Mutagens, Soil amendments, Acid rain, Nitrates, Sulfates.

Within the framework of the 1984 Program of the Maryland Water Resources Research Center, three projects were focused on questions of pollution of surface and ground water and one on acid rain. An information transfer project focused on the protection of ground water supplies. In a project to assess nitrogen and phosphorus losses via subsurface ground water flow from conventional and no-till corn watersheds, evidence was obtained that the leaching of nitrates into percolate or ground water is not enhanced by the use of no-till cultivation. No phosphate was found in percolate samples from either no-till or conventional cultivation treatments. A two-year study has been conducted to assess the accumulation of toxic metals in the sediments of Maryland's Eastern Shore rivers. Information derived from sediment cores indicates that most of thg trace metals being deposited in the Nanticoke and Choptank Rivers is derived from atmospheric sources. Thus, local industries and waste treatment plants are not the sources of metal pollutants. In a project to determine the impact on human health of contaminants present in sludge applied as soil amendment, ground and surface water have been analyzed for mutagenic compounds. Although mutagens and promutagens were present in the sludge, they failed to be leached downward through the soil. During the first year of a two-year acid fog and acid rain project, collection methods have been developed. Preliminary information on acidity in rainfall indicates increased levels of H+, SO42-, Pb, and Mn over a control area in Tennessee.
W86-02757

FISCAL YEAR 1984 PROGRAM REPORT (PUERTO RICO WATER RESOURCES RESEARCH INSTITUTE).

Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-133246/AS, Price codes: A02 in paper copy, A01 in microfiche. Program Report G-930-01, September 1985. 17 p. USGS G930-01. 14-08-0001-G-930.

Descriptors: *Water resources institutes, *Research, *Information transfer, *Puerto Rico, Acid rain, Water quality, Air pollution, Industrial wastes, Fermentation, Environmental effects, Pathogenic bacteria, Activated sludge, Sludge digestion, Anaerobic digestion.

The research activity at the Puerto Rico Water Resources Research Institute during FY 1984 included three research projects and two technology transfer activities. Two of the research projects, one on acid rain in Puerto Rico and another on the anaerobic digestion of sewage sludge, were carried to completion. Still in progress is a study on the effect of treated rum distillery wastes on receiving ocean waters. The technology transfer activities developed were a bibliography of water resources

publications in Puerto Rico and a symposium on tropical hydrology.
W86-02758

FISCAL YEAR 1984 PROGRAM REPORT (SOUTH CAROLINA WATER RESOURCES RESEARCH INSTITUTE).
Clemson Univ., SC. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-133261/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G-932-01, September 1985. 30 p. USGS G932-01. 14-08-0001-G932.

Descriptors: *Research, *Information transfer, *Training, *South Carolina, Pricing evaluation, Economic predictions, Instream flow, Stream classification, Evaporation rate, Irrigation, Irrigation efficiency, Groundwater, Aquifers, Mapping, Adsorption, Activated carbon, Organic wastes.

A discussion of the water problems in South Carolina is presented. To determine the ability of the smaller water supply systems in S.C., a study was conducted of the organization, capital needs and financial capacity of the water supply utility systems. To assure that all stream requirements were met during periods of low flow, a methodology was developed for establishing in-stream requirements and for statistically predicting flow deficiency patterns. To measure water conservation in agriculture, the applicability of a new vapor budget technique for the measurement of evaporative losses from irrigated crop land was investigated. In order to better understand the basic groundwater aquifer system a continuing project is dedicated to the study of the recharge-discharge area, piezometric surface and water chemistry of the tertiary limestone aquifer in South Carolina.
W86-02759

FISCAL YEAR 1984 PROGRAM REPORT (ALASKA INSTITUTE OF WATER RESOURCES).
Alaska Univ., Fairbanks. Inst. of Water Resources.
Available from the National Technical Information Service, Springfield, VA 22161 as PB86-133279/AS, Price codes: A03 in paper copy, A01 in microfiche. Program Report G891-01, September 1985. 25 p. USGS G891-01. 14-08-001-G891.

Descriptors: *Research, *Information transfer, *Training, *Alaska, Hydrographs, Surface runoff, Snowmelt, Water balance, Permafrost, Groundwater recharge, Groundwater quality, Arsenic, Nitrate, Riparian vegetation, Frost management, Taiga, Nitrogen isotopes, Nitrogen geochemistry, Fire, Soil leaching, Groundwater geochemistry.

Five small projects were funded by the United States Geological Survey (USGS) Federal Cooperative Water Resource Program in Fiscal Year 1984. Two projects studied surface water hydrology, one project used biological indicators in streams to assess potential ecosystem perturbations caused by riparian vegetation removal, one project studied groundwater chemistry and one project studied surface water chemistry. All but one project provided partial support for at least one graduate student. Several undergraduate assistants also helped complete our research funded by USGS. During 1984, our Institute of Water Resources administered about 20 water-related research projects and provided training to approximately 15 graduate students and six undergraduate assistants. Cooperative research and/or exchanges were made with Alaskan agencies, the U.S. Environmental Protection Agency and USGS.
W86-02760

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

DIAGNOSING THE CAUSES OF GROUNDWATER CONTAMINATION USING A MATHEMATICAL MODEL,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W86-02531

INFORMATION DISSEMINATION FOR A BETTER UNDERSTANDING OF LOUISIANA'S WATER RESOURCES,
Louisiana State Univ., Baton Rouge. Hazardous Waste Research Center.
For primary bibliographic entry see Field 9D.
W86-02554

WATER-RESOURCES REPORTS PREPARED BY OR IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY, KANSAS, 1886-1983,
Geological Survey, Lawrence, KS. Water Resources Div.
L. J. Combs.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report OFR 84-609, 1984. 117 p, 1 map.

Descriptors: *Bibliographies, U.S. Geological Survey, Water data, Data collections, *Water-resources investigations, *Kansas, *Publications.

Water-resources data and the results of hydrologic investigations in Kansas are published or released by the U.S. Geological Survey, by cooperating State or Federal agencies, or by technical or scientific journals. This report lists more than 800 water-resources reports prepared by or in cooperation with the U.S. Geological Survey in Kansas for 1886 through 1983. The reports are listed by author, publication series, year of publication, and subject. The first water-resources investigations by the U.S. Geological Survey in Kansas was completed by A.C. Peale in 1886. The first cooperative program with a State agency was initiated 9 years later in 1895 and included the first stream-gaging stations operated by the Survey in western Kansas. The U.S. Geological Survey continues to investigate the occurrence, quantity, quality, distribution, and movement of surface and ground waters within the State. (USGS)
W86-02818

10D. Specialized Information Center Services

CHAPARRAL MANAGEMENT EFFECTS ON WATER AND THE ENVIRONMENT,
California Univ., Davis. Dept. of Agronomy and Range Science.
For primary bibliographic entry see Field 2I.
W86-02570

WATER DIRECTORY, WHERE TO GET WATER INFORMATION IN NEW MEXICO,
New Mexico Water Resources Research Inst., Las Cruces.
L. G. Harris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-229771/AS, Price codes: A04 in paper copy, A01 in microfiche. New Mexico State Univ. Las Cruces, Water Resources Research Institute. USGS G-858-22.

Descriptors: *New Mexico, *Water information, *Directories, Personnel, Water management, Water rights, Water resources development.

This directory lists water resources professionals in New Mexico who are affiliated with universities, state agencies with responsibilities in New Mexico. In addition, the directory contains a synopsis of the responsibility of each of the agencies with personnel listed.
W86-02606

DIRECTORY OF WATER RESOURCES PERSONNEL IN WISCONSIN.
Wisconsin Univ.-Madison. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-230035, Price codes: A07 in paper copy, A01 in microfiche. Project Completion Report, April 1985. 133 p, append. USGS G878-22. 14-08-0001-G878.

Descriptors: Education, *Scientific personnel, State jurisdiction, universities, Organizations, *Wisconsin, *Directories.

A listing of Wisconsin residents involved in all aspects of water resources research, education, and management.
W86-02611

ASSESSMENT OF THE EFFECTIVENESS OF TECHNOLOGY TRANSFER METHODS LEADING TO THE ADOPTION OF A NEW IRRIGATION DESIGN,
Texas Water Resources Inst., College Station.
For primary bibliographic entry see Field 3F.
W86-02621

DIRECTOR'S TECHNOLOGY/INFORMATION TRANSFER PROGRAM 1983-1984,
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 9D.
W86-02669

10F. Preparation Of Reviews

RIPARIAN ZONE SYSTEMS, USES, AND MANAGEMENT,
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 4D.
W86-02668

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SELECTED WATER RESOURCES ABSTRACTS

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

VOLUME 19, NUMBER 8
AUGUST 1986

W86-02920 -- W86-03419
CODEN: SWRABW

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SELECTED
WATER RESOURCES
ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 8
AUGUST 1986

W86-02920 -- W86-03419

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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SUBJECT FIELDS AND GROUPS

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

PREDICTIVE SIMULATIONS OF ALTERNATIVES FOR MANAGING THE WATER RESOURCES OF NORTH FORK SOLOMON RIVER VALLEY BETWEEN KIRWIN DAM AND WACONDA LAKE, NORTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
R. D. Burnett.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4249, 1984. 34 p, 22 fig, 2 tab, 18 ref.

Descriptors: *Simulation analysis, *Model studies, *Water management, Alluvial aquifers, *Surface-groundwater relations, Drawdown, Water levels, *North Fork Solomon River, Kirwin Reservoir, Waconda Lake, *Kansas.

Since 1974 water levels in the alluvial aquifer of the North Fork Solomon River Valley in north-central Kansas have decreased due to increases in ground-water pumpage, decreases in availability of surface water for irrigation, and below-average precipitation. A finite-element model was developed in cooperation with the U.S. Bureau of Reclamation to simulate changing conditions between 1970-79. Model results indicate that annual recharge to the aquifer due to precipitation, application of water for irrigation, and canal leakage averaged about 22,825 acre-feet and that annual ground-wate discharge to the river averaged about 16,590 acre-feet. Predictive simulations for 1980-2000 were made using management alternatives that involved clay-lining of irrigation ditches, reduction of surface-water availability with and without an increase in ground-water pumping, and continuation of 1979 pumping conditions. The simulations indicated that as much as 5.5 feet of additional average water-level drawdown in wells would occur by 2000 if surface-water supply were reduced 100 percent and ground-water pumpage increased. The simulations also indicated that a decrease in average drawdown of 0.55 foot would occur by 2000 and that base flow to the river would decrease to 12,300 acre-feet per year if 1979 conditions remained constant. (USGS)
W86-02941

HYDROLOGY AND SEDIMENT TRANSPORT MOANALUA VALLEY, OAHU, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-03034

HYDROLOGIC DATA FOR URBAN STUDIES IN THE HOUSTON, TEXAS, METROPOLITAN AREA, 1982,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03106

THEORETICAL AND OBSERVED PROFILES OF TIDAL CURRENTS AT TWO SITES ON THE SOUTHEASTERN BERING SEA SHELF,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2L.
W86-03237

AUSTIN, TEXAS, FLOOD OF MAY 24-25, 1981,
Texas Univ. at Austin. Dept. of Civil Engineering.
W. L. Moore, E. Cook, R. S. Gooch, and C. F. Nordin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-139352, Price codes: A04 in paper copy, A01 in microfiche. National Academy Press, Washington, DC, 1982. 54 p, 12 fig, 1 tab, 9 ref, 1 append.

Descriptors: *Floods, *Flood control, *Texas, *Flood damage, Flood data, Flood flow, Flood hydrographs, Flood plain management, Flood plain zoning, Flood plains, Flood protection, Flooding, Austin.

A severe flood in Austin, Texas, which occurred on May 24, 1981, is discussed, with a focus on a description of the flood, and its consequences. Local policies for flood hazard areas, local response to severe flooding, and the principles of flood hazard in urban areas, in general, are then discussed. The specific factors that caused the flooding in Austin are outlined; they include: watersheds were saturated by moderate rainfall prior to the peak intensities that produced flooding; the Shoal Creek watershed experienced a 100-year flood event; many homes along Shoal Creek built prior to adoption of current floodplain regulations were located within the 100-year floodplain; and, additional development had taken place in the upper portion of the watershed. (Halterman-PTT)
W86-03260

NATIONAL VERIFICATION PLAN: REPORT OF THE NATIONAL VERIFICATION TASK TEAM.
National Weather Service, Silver Spring, MD.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-117507, Price codes: A05 in paper copy, A01 in microfiche. June 1982. 81 p, 8 fig, 12 tab, 3 app.

Descriptors: *Data interpretation, Forecasting, *Weather forecasting, Prediction, *Flood forecasting, *Streamflow forecasting, *Baseline studies, *Management planning, Projections, Decision making, Meteorology, Water supply, Automation.

The National Verification Plan (NVP) outlines a comprehensive and ambitious forecast program designed to meet the verification needs of National Weather Service (NWS) forecasters and management at local, regional, and national levels. The plan emphasizes minimizing workload, especially at the local level, and providing results in a timely manner. The NVP provides for the establishment of baselines of skill and accuracy against which subsequent changes in forecast procedures or products can be measured. The NVP contains eight sub-plans which verify public forecast, aviation forecast, watch/warning, marine forecast, agrimeteorological forecast, forestry and fire meteorological forecast, air pollution forecast and hydrologic forecast. Analysis of the products of the hydrologic services program of the NWS suggests that the following elements should be included in the verification: stage forecast, crest stage forecast, flood event forecast, water supply forecasts and outlooks, lake level forecasts, reservoir inflow forecasts, spring flood outlook, and exteneded streamflow outlook. Included in the NVP implementation strategy are plans to automate all verification procedures. These data can then be used in making decisions concerning needed research and development and the composition of training programs.
W86-03292

WORKSHOP ON RIVERINE WATER QUALITY MODELING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 7B.
W86-03293

KEILSON-ROSS PROCEDURE FOR ESTIMATING CLIMATIC PROBABILITIES OF DURATION OF WEATHER CONDITIONS,
Air Force Geophysics Lab., Hanscom AFB, MA.
I. I. Gringorten.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A119860, Price codes: A03 in paper copy, A01 in microfiche. Environmental Research Papers, No. 775, Report No. AFGL-TR-82-0116, April, 1982. 27 p, 3 fig, 1 tab, 2 app, 8 ref.

Descriptors: *Mathematical studies, *Simulation analysis, *Mathematical models, *Weather, Climatic data, Markov process, Probabilitistic process, *Computer programs, *Computer models, *Weather forecasting, Probability distribution, Monte Carlo method, Statistical methods, Statistical analysis, Stochastic process, Prediction, Time series analysis, Fortran.

The Keilson-Ross procedure is a recent mathematical development for analytically computing the probability of the maximum of a continuous weather element over a specified time interval. As long as the weather conditioncan be defined by a Markov (Ornstein-Uhlenbeck) process, the time interval may be a duration of a few seconds to a few weeks. The procedure is applied to estimating the probability of the surface air temperatures of Minneapolis, Minnesota remaining below freezing for specified time intervals. The analytical solutions provide corrections to previously estimated probabilities that had been determined by Monte Carlo simulation. More rapid solutions to the procedure are still needed. The application of computer programs to the calculations have provided answers with a high degree of accuracy. These programs make use of cubic B-splines. A printout of the program writtern in FORTRAN is included.
W86-03294

NEPONSET RIVER BASIN MASSACHUSETTS, FLOOD PLAIN MANAGEMENT STUDY,
Corps of Engineers, Waltham, MA. New England Div.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120051, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Investigation, Review Draft, March, 1982. 110 p. 11 tab, 3 plates, 6 app.

Descriptors: *Massachusetts, *Nonstructural alternatives, *Flood control, *Flood protection, Watershed management, Flood plains, Flood profiles, Flood damage, Neponset River basin, Massachusetts, Planning, Interagency cooperation, Hydrology, Cost analysis, Economic aspects.

Analysis of alternative flood plain management measures during Stage 2 investigations for the Neponset River Basin in Massachusetts indicates that structural protection is not economically feasible for any individual damage site. Under existing conditions natural valley storage reduces flood damage in the watershed significantly. The extent of the flood plains has not changed significantly since the last major flood event in 1968. Flood damage is not expected to increase in the future. Existing legislation, if enforced, can effectively keep flood damage at a minimum. Structural local protection measures for any individual damage site are not economically justified. Acquisition of natural valley storage areas throughout the Neponset River Basin is not required because of the existence of legislation capable of controlling the extent of future development. Provision of data, including detailed mapping, compiled during this study will contribute to effective enforcement of current institutional measures.
W86-03310

LITERATURE SURVEY ON THE WETLAND VEGETATION OF ALASKA,
Alaska Univ., Fairbanks. Inst. of Arctic Biology and Museum.
A. R. Batten, and D. F. Murray.
Technical Report Y-82-2, Army Engineer Waterways Experiment Station, Vicksburg, MS, August 1982. Final Report. 222 p, 24 fig, 120 ref. DACW39-76-M-2473.

Descriptors: Wetlands, *Literature review, *Alaska, *Vegetation, *Aquatic plants, *Marsh plants, *Flora, *Plant populations, Lakes, Streams, Reviews, Marshes, Ponds, Rivers, Intertidal areas, Peat bogs, Coastal marshes, Salt marshes, Tidal marshes, Bogs, Swamps Tide lands, Submerged lands, Estuaries, Tidal flats.

This report contains a relatively comprehensive summary, through July 1977, of the literature pertaining to the wetland vegetation of Alaska. For organizational purposes, Alaska is divided into eight geographic regions namely Southeastern

Group 2A—General

Alaska, Southcentral Alaska, Aleutian Islands, Bering Sea Islands, Bering Sea Mainland, Chukchi Sea, Beaufort Sea Coast, and Interior Alaska. Alaska's wetlands are classified under a broad framework of eight categories within which specific vegetation types are discussed. These include (for fresh water wetlands) ponds and lakes, freshwater marshes, peatlands, streams and riparian gravel bars and cutbanks, and (for saline or brackish water wetlands) strands and supratidal meadows, saline or brackish marshes, and intertidal zones. The literature is reviewed for each of these categories within each of the eight geographic regions.
W86-03312

2B. Precipitation

DROUGHT OF 1980-82 IN SOUTHEAST FLORIDA WITH COMPARISON TO THE 1961-62 AND 1970-71 DROUGHTS,
Geological Survey, Miami, FL. Water Resources Div.
B. G. Waller.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4152, 1985. 29 p, 9 fig, 5 tab, 8 ref.

Descriptors: *Drought, *Rainfall, Water level, *Groundwater levels, *Lake levels, *Saline-freshwater interfaces, *Water storage, Flow augmentation, Frequency analysis, *Florida, Lake Okeechobee, Water conservation areas.

South-central Florida (the Kissimmee Basin) experienced a severe drought during 1980-82, causing Lake Okeechobee--the largest surface-water storage area in south Florida--to reach the lowest stage ever recorded, 9.75 feet above sea level, on July 29, 1981. A prolonged period of deficient rainfall extended from June 1980 to March 1982. On the southeast coast, drought conditions were mitigated on August 16, 1981, when rainfall from Tropical Storm Dennis replenished the coastal aquifers and filled the water conservation areas to near scheduled levels. South Dade County was the only area in south Florida not affected by the drought. Rainfall in the southeast coastal areas had a statistical recurrence ranging from 5 to 20 years whereas the recurrence intervals from some stations in south-central Florida were in excess of 100 years. The 1980-81 drought in southeast Flrodia was not as severe as the 1961-62 or the 1970-71 droughts in terms of rainfall conditions or the effect on water levels. The effects of the drought were less severe because of a combination of water-management practices and periodic rainfall during the otherwise rain-deficient period. (USGS)
W86-03082

RECONNAISSANCE OF MINE DRAINAGE IN THE COAL FIELDS OF EASTERN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03092

PROPOSED 10-YEAR PLAN FOR CONTINUATION OF HYDROLOGIC STUDIES OF THE EDWARDS AQUIFER, SAN ANTONIO AREA, TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03104

VEGETATION AND CLIMATES OF THE LAST 45,000 YEARS IN THE VICINITY OF THE NEVADA TEST SITE, SOUTH-CENTRAL NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2I.
W86-03168

TOTAL PRECIPITABLE WATER AND RAINFALL DETERMINATIONS FROM THE SEASAT SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR),
National Environmental Satellite, Data, and Information Service, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-138263, Price codes: A03 in paper copy, A01 in microfiche. NOAA Technical Report NESS 90, May 1982. 34 p, 7 fig, 10 tab, 19 ref, 3 append.

Descriptors: *Satellite technology, *Precipitation, *Radiometry, *Seasat, *Radiosondes, *Rainfall, *Remote sensing, Algorithms, Mathematical studies, Statistical methods, Rainfall rate, Mathematical models, Computer programs, Data acquisition, Data collections, Meteorological data collections.

Three of the five sensors of thee Scanning Multichannel Microwave Radiometer (SMMR) of the SEASAT oceanography satellite can be used to determine the total precipitable water in the atmosphere, the liquid water content, and the rainfall rate. In addition two distinct algorithms were used to derive geophysical parameters from brightness temperature. Comparisons with surface observations from the Gulf of Alaska SEASAT Experiment and with other selected sources were made for both algorithms. In general, very good agreement was found between satellite and radiosonde observations of total precipitable water. An estimate of the precision of radiosonde-derived total precipitable water amounts was made along with comparisons of precipitation occurrence as determined from the SMMR and surface observations. In the tropics, very good agreement is observed between satellite and surface observations. In the midlatitudes (Gulf of Alaska) small cells of precipitation are often missed by the SMMR, while larger synoptic scale precipitation is detected. Radiosonde observation tabulations and corrections, listings of computer programs, and radiosonde observation precision statistics are given in three appendices to this report. (Geiger-PTT)
W86-03238

PROJECT SKYWATER 1983-84 SCPP DATA INVENTORY: SIERRA COOPERATIVE PILOT PROJECT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
October 1984. 161 p, 42 fig, 37 tab, 4 append.

Descriptors: *Weather modification, *Artificial precipitation, *Cloud seeding, Satellite technology, Weather data collection, Meteorological data collection, Data collection, Precipitation, Rain gages, Cloud physics, Weather, Clouds.

An inventory of all data collected from October 15, 1983, through April, 1984, in association with the Sierra Cooperative Pilot Project, a weather modification research project, is presented. The inventory covers forecasting, radar and satellite use, aircraft, surface meteorological observations, precipitation gage network, ground-based microphysical observations, radiometry, cooperative and operational seeding activities, snow chemistry measurements, and the roles of the National Weather Service, the Federal Aviation Administration and the National Climatic Center in the program. (Halterman-PTT)
W86-03278

INTERNATIONAL COMPARISON OF NATIONAL PRECIPITATION GAUGES WITH A REFERENCE PIT GAUGE,
World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 7B.
W86-03414

2C. Snow, Ice, and Frost

PERFORMANCE OF ICE METER AND WEIGHT ASSEMBLIES,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03004

SURFACE TOPOGRAPHY OF THE LOWER PART OF COLUMBIA GLACIER, ALASKA, 1974-1981,
Geological Survey, Tacoma, WA. Water Resources Div.
L. A. Rasmussen, and M. F. Meier.
Available from Dist Branch, USGS 604 S. Pickett St. Alexandria, VA 22034. USGS Professional Paper 1258-E, 1985. 63 p, 17 fig, 8 tab, 20 ref.

Descriptors: *Glaciers, Statistical analysis, Mathematical studies, Topography, *Alaska, *Columbia Glacier, Mapping, Aerial photography.

For each of 27 series of vertical air photographs, the method of optimum interpolation was used to get surface altitudes at 154 nodes of a 762.5-m square grid over the lowest 18 km of Columbia Glacier, Alaska. Photogrammetrically produced surface topography maps for flights on July 27, 1974, and September 1, 1981, were used as the bases for norm fields for the 27 intervening flights, and the altitude deviations of individual photogrammetry points (IPP's) from those norm fields were interpolated. Between 116 and 200 IPP's were available from flight to flight. The random error in the IPP altitudes is estimated at 3.5m, and their deviations about the norm fields are also about 3.5m. The statistical structure of the surface topography was investigated; its correlation has a high degree of homogeneity and isotropy, both spatially and temporally, and is little affected by the glacier flow. The error in the interpolated results is about 2.5m. A ground-truth sample of 58 individual and averaged surface-surveyed points was used to test the interpolated results for three flights. The asymmetry of these sample deviations about the norm fields suggests that there may be a systematic error of about +1.5m in the IPP altitudes. (USGS)
W86-03039

SATELLITE OBSERVATION OF GREAT LAKES ICE: 1980-81,
National Environmental Satellite, Data, and Information Service, Washington, DC.
A. L. Bell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-156877, Price codes: A03 in paper copy, A01 in microfiche. NOAA Technical Memorandum NESS 119, December 1982. 36 p, 27 fig.

Descriptors: *Great Lakes, *Ice cover, *Ice formation, *Satellite technology, *Ice breakup, *Iced lakes, *Lake ice, Remote sensing, Radiometry, Wind, Lake breezes, Air temperature, Lakes, Ice drift.

Ice conditions on the Great Lakes and Lake St. Clair were studied from satellite imagery. Data were collected by Geostationary Operational Satellites with Visible and Spin Scan Radiometer Sensors. The study examined the formation, movement, and dissipation of lake ice from December 1980 - May 1981. Wind speed and directions were studied as components of ice formation and dissipation. Results showed that ice was present on Lake Erie from December 20 to about May 2, a total of 132 days, with maximum extent of ice occurring February 27 accompanied by 70% concentration. The ice season on Lake St. Clair began December 14 and ended near March 31 with 100% coverage observed as early as January 7. The ice season on Lake Huron began on December 13 and lasted until April 16, a total of 124 days with maximum ice extent (65% concentration) occurring February 14. The ice season on Lake Ontario lasted from December 3 until April 2, a total of 80 days, with maximum ice extent occurring about February 5. The ice season on Lake Superior began December 13 and lasted until May 6, a total of 133 days with maximum ice extent occurring February 12. In general, ice formed on the lakes in response to northwesternly and northerly winds accompanied by below freezing air temperatures, and dissipated with winds from a southernly and southwesterly direction. (Geiger-PTT)
W86-03258

FROST ACTION IN SOIL FOUNDATIONS AND CONTROL OF SURFACE STRUCTURE HEAVING,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones, D. G. Miedema, and J. S. Watkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118299, Price codes: A04 in paper copy, A01 in microfiche. REC-ERC-82-17, June, 1982. 69 p, 42 fig, 3 app, 33 ref.

Descriptors: *Frost heaving, *Frost protection, *Soil water, *Soil mechanics, *Freeze-thaw tests, *Foundation failure, *Soil structure, *Structural engineering, Frost, Frost thrusting, Heaving, Freezing, Spillways, Canal linings, Dams, Earth dams, Dam foundations.

Surveys conducted by the Bureau of Reclamation showed that seasonal frost action in soil foundations was a consideration in all regions except the Mid-Pacific, Lower Colorado, and Southwest Regions. Significant frost heave in soils occurs in cold climates when certain fine-grained soils have access to sources of water and an open-freezing system exists. Under heterogeneous soil and moisture conditions, damage to structures is caused by differential movement during freezing and thawing. Investigations for potential frost problems should consider climatic conditions, surveys of existing structures in the area, foundation exploration and soil sampling, laboratory freeze-thaw tests on soil, and location of groundwater depth. Methods of controlling frost action to prevent damage to structures include location of the foundation below the frost line, replacement of frost-susceptible soil, restriction of water supply to the frost zone, and the use of insulation to prevent frost penetration. Structures which have suffered the most heavy damage from frost action include spillways, chutes and drop structures, checks, pipe turnouts, pier-supported pipe, canal linings, and earth embankment dams. Polystyrene insulation has shown promise in field tests for the control of frost heave.
W86-03317

2E. Streamflow and Runoff

METHOD OF ESTIMATING FLOOD VOLUMES IN WESTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02922

RELATIONS OF URBAN LAND-USE AND DRY-WEATHER STORM AND SNOWMELT FLOW CHARACTERTISTICS TO STREAM-WATER QUALITY, SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02926

HYDROLOGY OF AREA 61 NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, COLORADO AND NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
P. O. Abbott, A. L. Geldon, D. Cain, A. P. Hall, and P. Edelmann.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-132, 1983. 99 p, 81 fig, 13 tab, 125 ref.

Descriptors: *Hydrology, *Coal mining, Surface water, Groundwater, Water quality, Temperature, Precipitation, Land use, Water use, Stream biota, Flow duration, High flow, Low flow, Arkansas River, *Colorado, *New Mexico, *Coal mining, Raton Mesa coal region, Huerfano River, Apishapa River, Purgatoire River, Canadian River, Vermejo River, Cimarron River, Huerffano County, Las Animas County, Colfax County, Northern Great Plains, Coal Provinces, Rocky Mountain Coal Province.

Area 61 is located on the Colorado-New Mexico boundary in Huerfano and Las Animas Counties, Colorado, and Colfax County, New Mexico, and includes the Raton Mesa coal region. The 5,900-square-mile area is an asymmetrical structural trough bounded by the Rocky Mountains on the west and the Great Plains on the east. The area is drained by the Huerfano, Apishapa, Purgatoire, and Canadian Rivers (and their tributaries), all tributary to the Arkansas River. The principal coal-bearing formations are the Vermejo Formation of Late Cretaceous age and the Raton Formation of Late Cretaceous and Paleocene age. Much of the coal in the area is of coking quality, important to the metallurgical industry. Topographic relief in the area is greater than 8,700 feet, and this influences the climate which in turn affects the runoff pattern of area streams. Summer thunderstorms often result in flash floods. Virtually all geologic units in the region yield water. Depth to ground water ranges from land surface to 400 feet. Surface and ground water in the area contain mostly bicarbonate and sulfate ions; locally in the ground water, chloride ions predominate. Potential hydrologic problems associated with surface coal mining in the area are water-quality degradation, water-table decline, and increased erosion and sedimentation. (USGS)
W86-02934

PEAK FLOW, VOLUME, AND FREQUENCY OF THE JANUARY 1982 FLOOD, SANTA CRUZ MOUNTAINS AND VICINITY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02935

HYDROLOGIC EFFECTS OF IMPOUNDMENTS IN SHERBURNE NATIONAL WILDLIFE REFUGE, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02939

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE RED OAK AREA, LATIMER COUNTY, OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02951

FLOOD-DISCHARGE PROFILES OF SELECTED STREAMS IN ROCKLAND COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
R. Lumia.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4049, 1984. 32 p, 3 fig, 3 tab, 17 ref.

Descriptors: *Flood frequency, *Flood profiles, *Rainfall-runoff relationships, Regression analysis, Regional analysis, Error analysis, Rockland County, *New York, HEC-1 model, Basin characteristics.

Flood-discharge profiles of 10 streams in Rockland County at six recurrence intervals ranging from 2 to 100 years are presented. Synthetic flood-frequency estimates were derived for nine rainfall-runoff sites from calibrated models; observed flood-frequency estimates were derived for three sites having long-term discharge records. A variance-weighting technique was applied to compare the synthetic flood-frequency estimates with the observed (gaged) estimates and estimates computed at each site from regional regression equations. For ungaged locations on the 10 streams, flood-frequency relationships were derived from regional regression equations previously developed for New Jersey streams. Regional analysis indicated the most significant basin characteristics to be drainage area, streambed slope, storage, and amount of impervious cover. A method for refining (weighting) flood-frequency estimates at selected ungaged locations near rainfall-runoff and (or) long-term gaged sites is given. This report explains analytical methods and includes a list of basin characteristics at several locations along each stream and a table of peak discharges for the six recurrence intervals at 13 gaging stations. The profiles enable the determination of flood discharge at all locations having a drainage area greater than 1 square mile on the 10 streams. (USGS)
W86-02960

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--COASTAL RIVER BASINS OF THE SOUTH SHORE AND BUZZARDS BAY,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02962

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--THAMES RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02963

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--BLACKSTONE RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02965

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--HOUSATONIC RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02966

FLOODS OF MAY 1978 IN SOUTHEASTERN MONTANA AND NORTHEASTERN WYOMING,

Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, D. D. Carlson, G. S. Craig, and E. H. Chin.
Available from Dist Branch, USGS 604 S. Pickett St. Alexandria, VA 22034. USGS Professional Paper 1244, 1984. 74 p, 33 fig, 8 tab, 14 ref.

Descriptors: *Floods, Flood Data, *Flood Discharge, *Flood Frequency, Flood Damage, Flood Peaks, *Montana, *Wyoming, *Yellowstone River, Belle Fourche River, Cheyenne River, North Platte River, Big Horn River, Powder River.

Heavy rain and some snow fell on previously saturated ground over southeastern Montana and northeastern Wyoming during May 16-19, 1978. The maximum amount of 7.60 inches within a 72-hour period observed at Lame Deer, Montana, set a record for the month of May in that region. Heavy flooding occurred in the drainages of the Yellowstone River and its tributaries as well as the Belle Fourche, Cheyenne, and North Platte Rivers. The previous maximum flood of record was exceeded at 48 gaged sites, and the 1-percent chance flood was equaled or exceeded at 24 sites. Flood damage was extensive, exceeding $33 million. Nineteen counties in the two States were declared major disaster areas. Mean daily suspended-sediment discharges exceeded previously recorded maximum mean daily values at four sites on the Powder River. The maximum daily suspended-sediment discharge of 2,810,000 tons per day occurred on May 20 at the Site Powder River near Arvada, Wyoming. (USGS)
W86-02971

Field 2—WATER CYCLE

Group 2E--Streamflow and Runoff

STREAMFLOW CHARACTERISTICS OF MOUNTAIN STREAMS IN WESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, and J. A. Hull.
Available from Dist Branch, USGS 604 S. Pickett St. Alexandria, VA 22034. USGS Water-Supply Paper 2260, 1985. 58 p, 14 fig, 24 tab, 9 ref.

Descriptors: *Annual runoff, *Flow duration, Regression analysis, Estimating equations, Gaging stations, Crest Gages, *Mean annual discharge, *Mean monthly discharge, *Montana, Basin characteristics.

Once-monthly streamflow measurements were used to estimate long-term mean annual flow, mean monthly flow, and various points on the flow-duration curve for 72 sites in the mountainous portions of western Montana. The estimated flow characteristics at 56 measurement sites, together with data from 22 gaging stations, were used to develop maps showing the variability of mean annual runoff for three areas. Data from all measurement sites plus data from 34 gaging stations were used to develop regression equations relating mean annual flow to drainage area and precipitation and equations relating flows of 10, 20, 30, 40, 50, 60, 70, 80, and 90 percent exceedance probability to mean annual flow. The study area was divided into two regions with a different set of estimating equations applicable to each region. Average errors of prediction were also calculated using data withheld from the regression analyses. The estimated average error for predicting mean annual flow was -16 percent in one region and -23 percent in the other region. The estimated average prediction errors for flows of various exceedance percentages ranged from +2 percent to -38 percent in one region and from +18 percent to -23 percent in the other region. (USGS)
W86-02972

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02973

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--TAUNTON AND TENMILE RIVER BASINS AND COASTAL RIVER BASINS OF MOUNT HOPE BAY, NARRAGANSETT BAY, AND RHODE ISLAND SOUND,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-02976

USE OF SELECTED BASIN CHARACTERISTICS TO ESTIMATE MEAN ANNUAL RUNOFF AND PEAK DISCHARGES FOR UNGAGED STREAMS IN DRAINAGE BASINS CONTAINING STRIPPABLE COAL RESOURCES, NORTHWESTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02978

MAPS TO ESTIMATE AVERAGE STREAMFLOW AND HEADWATER LIMITS FOR STREAMS IN U.S. ARMY CORPS OF ENGINEERS, MOBILE DISTRICT, ALABAMA AND ADJACENT STATES,
Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02981

TRAVELTIME, LONGITUDINAL-DISPERSION, REAERATION, AND BASIN CHARACTERISTICS OF THE WHITE RIVER, COLORADO AND UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
J. M. Boyle, and N. E. Spahr.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4050, 1985. 54 p, 13 fig, 17 tab, 34 ref.

Descriptors: *Traveltime, *Reaeration, *Longitudinal dispersion, *Streamflow, Unit concentration, Basin characteristics, *White River basin, *Colorado, *Utah.

Traveltime and longitudinal-dispersion characteristics were measured for the White River using dye tracers. Discharges ranged from 281 to 1,840 cubic feet per second and velocities ranged from 1.26 to 3.17 miles per hour. Traveltimes were determined for discharges other than measured discharges by a graphical method and a linear-regression method. Longitudinal-dispersion coefficients ranged from 284 square feet per second at a discharge of 539 cubic feet per second to 5,430 square feet per second at a discharge of 1,580 cubic feet per second. Reaeration was measured in four reaches of the White River during a medium-flow period in August 1982. Reaeration coefficients at 20 degrees Celsius ranged from 5.3 to 25.3 per day. The results of a comparison with measured reaeration coefficients and reaeration coefficients predicted using empirical equations showed that the most accurate equations were by Bennett and Rathbun (1972) and Isaacs and Gaudy (1968). Basin characteristics were computed using U.S. Geological Survey topographic maps, precipitation data from the National Weather Service, and aerial photographs taken on September 11, 1981. (USGS)
W86-02984

ESTIMATION OF INCOMPLETE STREAMFLOW FOR SELECTED SITES ON THE CARSON AND TRUCKEE RIVERS IN CALIFORNIA AND NEVADA, 1944-80,
Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Blodgett, R. N. Oltmann, and K. R. Poeschel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4058, 1984. 39 p, 3 fig, 8 tab, 8 ref.

Descriptors: *Stream discharge, Reservoir storage, Regression analysis, *California, Estimating equation, *Hydrograph analysis, *Hydrologic budget, Discharge, *Truckee River, Carson River, Reno, Truckee, *Nevada.

Daily mean and monthly discharges were estimated for 10 sites on the Carson and Truckee Rivers for periods of incomplete records and for tributary sites affected by reservoir regulation. On the basis of the hydrologic characteristics, stream-flow data for a water year were grouped by month or season for subsequent regression analysis. In most cases, simple linear regressions adequately defined a relation of streamflow between gaging stations, but in some instances a nonlinear relation for several months of the water year was derived. Statistical data are presented to indicate the reliability of the estimated streamflow data. Records of discharges including historical and estimated data for the gaging stations for the water years 1944-80 are presented. (USGS)
W86-02990

EVALUATION OF THE COST EFFECTIVENESS OF THE 1983 STREAM-GAGING PROGRAM IN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
K. D. Medina, and C. O. Geiger.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4107, 1984. 94 p, 6 fig, 5 tab, 15 ref.

Descriptors: *Network design, *Cost analysis, Hydrologic data, Regression analysis, Discharge measurements, *Stream gaging, *Kansas, *Cost effectiveness.

The results of an evaluation of the cost effectiveness of the 1983 stream-gaging program in Kansas are documented. Data uses and funding sources were identified for the 140 complete record streamflow-gaging stations operated in Kansas during 1983 with a budget of $793,780. As a result of the evaluation of the needs and uses of data from the stream-gaging program, it was found that the 140 gaging stations were needed to meet these data requirements. The average standard error of estimation of streamflow records was 20.8 percent, assuming the 1983 budget and operating schedule of 6-week interval visitations and based on 85 of the 140 stations. It was shown that this overall level of accuracy could be improved to 18.9 percent by altering the 1983 schedule of station visitations. A minimum budget of $760,000, with a corresponding average error of estimation of 24.9 percent, is required to operate the 1983 program. None of the stations investigated were suitable for the application of alternative methods for simulating discharge records. Improved instrumentation can have a very positive impact on streamflow uncertainties by decreasing lost record. (USGS)
W86-02992

LOW-FLOW CHARACTERISTICS OF KENTUCKY STREAMS, 1983,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02998

LOW-FLOW DATA FOR SELECTED PARTIAL-RECORD STATIONS IN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03003

PERFORMANCE OF ICE METER AND WEIGHT ASSEMBLIES,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03004

IMPACT OF AN OUTBURST OF SPIRIT LAKE ON THE COLUMBIA RIVER,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-03008

STORM RUNOFF AS RELATED TO URBANIZATION BASED ON DATA COLLECTED IN SALEM, AND PORTLAND, AND GENERALIZED FOR THE WILLAMETTE VALLEY, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-03015

HYDROLOGY, GEMORPHOLOGY, AND DAM-BREAK MODELING OF THE JULY 15, 1982, LAWN LAKE DAM AND CASCADE LAKE DAM FAILURES, LARIMER COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 8D.
W86-03017

WATER QUALITY AND STREAMFLOW DATA FOR THE WEST FORK TRINITY RIVER IN FORT WORTH, TEXAS,
Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03020

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1983 - NOVEMBER 30, 1984,
Geological Survey, Reston, VA. Water Resources

Div.
F. T. Schaefer, W. E. Harkness, R. W. Basbenroth, and D. W. Speight.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-339, 1985. 83 p, 6 fig, 21 tab.

Descriptors: *Delaware River, Diversion, Release, Water management, Drought, *Water quality, *Reservoir yield, Regulation, Supply, Inter-Basin transfers.

A Decree of the U.S. Supreme Court in 1954 established the position of Delaware River Master. The Decree authorizes diversions of water from the Delaware River basin and requires compensating releases from certain reservoirs of the City of New York to be made under the supervision and direction of the River Master. Reports to the Court, not less frequently than annually were stipulated. During the 1984 report year, December 1, 1983 to November 30, 1984, precipitation and runoff varied from above average to below average in the Delaware River basin. For the year as a whole, precipitation and runoff were near average. Operations were under a status of drought warning December 1, 1983; however, the above normal precipitation the first half of the year increased storage in the reservoirs to record levels by June 1, 1984. Below normal precipitation from August to November coupled with large releases to maintain the Montague flow objective and customary diversions for water supply reduced storage in the reservoirs to the drought-warning level by November 27. Diversions from the Delaware River basin by New York City and New Jersey conformed to the terms of the Amended Decree throughout the year. Releases were made as directed by the River Master at rates designed to meet the Montague flow objective on 127 days between June 23 and November 30. Releases were made at conservation rates or at rates designed to relieve thermal stress in the streams downstream from the reservoirs at other times. (USGS)
W86-03023

WATER-RESOURCES APPRAISAL OF THE UPPER ARKANSAS RIVER BASIN FROM LEADVILLE TO PUEBLO, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
T. M. Crouch, P.O. Abbott, R. D. Penley, R. T. Hurr, and D. Cain.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 82-4114, 1984. 123 p, 8 pl, 30 fig, 76 ref.

Descriptors: Geochemistry, *Hydrogeology, Surface water, Aquifers, *Water supply, *Groundwater movement, Groundwater storage, *Streamflow characteristics, *Hydrologic data, Dissolved solids, Mercury, Selenium, Transmountain diversions, *Arkansas River, Buena Vista-Salida basin, Leadville basin, Wet Mountain Valley, Pueblo Reservoir, *Colorado.

Water used for agriculture and stock and municipal supplies in the upper Arkansas River basin is derived mostly from the Arkansas River and its tributaries. The flow regime of the river has been altered by increased reservoir capacities and importation of 69,200 acre-feet per year from the Colorado River drainage through transmountain diversions. An estimated 10.2 million acre-feet of hydrologically recoverable water is present in the first 200 feet of basin-fill alluvium. Well yields of 300 gallons per minute have been reported for the Dakota-Purgatoire aquifer aquifer located east of Canon City. Water quality of ground- and surface-water resources are generally acceptable for agriculture and stock watering, but concentrations of iron, manganese, sulfate, pH, and hardness may exceed recommended drinking-water criteria during periods of river low flow. Concentrations of mercury, selenium, and select radiochemical constituents also were high in the Dakota-Purgatoire aquifer. Dissolved solids increased downstream and in local areas as a result of water use and in the Leadville area because of mine drainage. (USGS)
W86-03025

FLOOD-PROFILE ANALYSIS, BIG DARBY CREEK AT STATE ROUTE 762, ORIENT, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-03027

ASSESSMENT OF A STEADY-STATE PROPANE-GAS TRACER METHOD FOR DETERMINING REAERATION COEFFICIENTS-CHENANGO RIVER,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03033

USES, FUNDING, AND AVAILABILITY OF CONTINUOUS STREAMFLOW DATA IN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86 03036

SYNTHESIZED FLOOD FREQUENCY FOR SMALL URBAN STREAMS IN TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
C. H. Robbins.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4182, 1984. 24 p, 14 fig, 3 tab, 16 ref.

Descriptors: *Urbanization, *Flood frequency equations, Basin development factors, Effective impervious area, Rainfall, Floods, *Tennessee.

Bridge, culvert, and highway design often require knowledge of the magnitude and frequency of flood discharge from small streams where the drainage basin is urbanized. The results of a 6-year study by the U.S. Geological Survey provide methods for estimating flood magnitudes for selected frequencies on small streams draining urban areas in Tennessee. A total of 22 rainfall-runoff sites located in basins with drainage areas of 0.21 to 24.3 square miles in size and in municipalities with populations between 5,000 and 100,000 were used to derive regionalized flood-frequency equations. Impervious area, measured from recent aerial photographs, ranged between 4.7 percent and 74.0 percent of the basin. The equations were derived by multiple regression analyses of synthetic flood-frequency estimates, derived from a rainfall-runoff modeling procedure, versus physical basin characteristics and a precipitation factor. These equations can be used to estimate the magnitude of future floods with recurrence intervals of 2 to 100 years on ungaged urbanized streams in Tennessee. One equation for each recurrence interval applies statewide. Flood-frequency estimates for stations used in the analyses and example computations demonstrating applications of the regression equations to urban streams in Tennessee are given in the report. (USGS)
W86-03037

MAXIMUM KNOWN STAGES AND DISCHARGES OF NEW YORK STREAMS THROUGH SEPTEMBER 1981,

Geological Survey, Albany, NY. Water Resources Div.
J. A. Robideau, P. M. Burke, and R. Lumia.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-927, 1984. 83 p, 3 fig, 1 tab, 28 ref.

Descriptors: *Flood peak, *Stage, *Discharge, Indirect flood measurement, Gaging stations, Historic floods, Data collections, *New York, Flood potential, Envelope curves.

This report lists the maximum known stages and discharges of New York streams through September 1981. The data represent 1,189 sites. Most data were obtained from files of the U.S. Geological Survey, but some were provided by other Federal, State, and private organizations. The information is grouped by major drainage basins and listed by U.S. Geological Survey station number in downstream order. Given are county names, drainage area (in square miles), period of record, type of site (continuous record, partial record, miscellaneous measurement), date of discharge, stage, elevation, discharge, and remarks. An envelope curve for the New York data was developed from a plot of maximum known discharge versus drainage area, and was compared with a like curve derived from maximum known discharge data gathered throughout the United States. The national curve ranges from about 3.0 times higher than the New York curve at a drainage area of 1.0 square mile to about 4.5 times higher at 1,000 square miles. The relative magnitude of flood discharges in four hydrologic regions of New York (west, north, southeast, Long Island) is shown in graphs relating maximum known discharge to drainage area. (USGS)
W86-03038

PUBLICATIONS OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS,

Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 10C.
W86-03047

VALIDITY OF DARCY'S LAW UNDER TRANSIENT CONDITIONS,

Geological Survey, Reston, VA. Water Resources Div.
C. E. Mongan.
Available from Dist Branch, USGS, 604 S. Pickett, VA 22034. USGS Professional Paper 1331, 1985. 16 p, 4 fig, 1 tab, 20 ref.

Descriptors: *Darcy's law, Capillary flow, Laminar flow, Reynolds number, *Unsteady flow, Bessel description, Time constant, Navier-Stokes equation, Step functions, Ramp functions, Hankel transforms.

Darcy's Law, which describes fluid flow through porous materials, was developed for steady flow conditions. The validity of applying this law to transient flows has been mathematically verified for most ground-water flow conditions. The verification was accomplished through application of Hankel transforms to linearized Navier-Stokes equations which described flow in a small diameter cylindrical tube. The tube was chosen to represent a single pore in a porous medium. (USGS)
W86-03049

WATER BUDGET FOR MAJOR STREAMS IN THE CENTRAL VALLEY, CALIFORNIA, 1961-77,

Geological Survey, Tahoe City, CA. Water Resources Div.
J. R. Mullen, and P. Nady.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-401, 1985. 87 p, 21 fig, 20 tab, 9 ref.

Descriptors: *Streamflow data, *Water budget, Inflow, Outflow, Theoretical flow, *California, Central Valley, Sacramento Valley, San Joaquin Valley.

A compilation of annual streamflow data for 20 major stream systems in the central Valley of California, for water years 1961-77, is presented. The water-budget tables list gaged and ungaged inflow from tributaries and canals, diversions, and gaged outflow. Theoretical outflow and gain or loss in a reach are computed. A schematic diagram and explanation of the data are provided for each water-budget table. (USGS)
W86-03050

STREAM-GAGING PROGRAM IN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.

Group 2E—Streamflow and Runoff

For primary bibliographic entry see Field 7B.
W86-03057

SIMULATED EFFECTS OF PROPOSED RESERVOIR-DEVELOPMENT ALTERNATIVES ON STREAMFLOW QUANTITY IN THE WHITE RIVER, COLORADO AND UTAH,
Geological Survey, Lakewood CO. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-03061

STREAMFLOW IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. L. Lindskov, and B. A. Kimball.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Supply Paper 2224, 1984. 72 p, 60 fig, 15 tab, 54 ref.

Descriptors: *Streamflow, *Water quality, Flow characteristics, Variability, Frequency analysis, *Utah, Oil shale, *Uinta Basin, Energy development.

Baseline conditions for streamflow and water-quality characteristics are defined for a 3,000 square-mile area in northeastern Utah and northwestern Colorado where oil-shale mining is expected to impact the water resources. Areal and time variances in these characteristics are illustrated for the Green and White Rivers and for tributary streams originating within the area. The area receives an average of 5,900 cubic feet per second from an outside drainage area of about 34,000 square miles. This is more than 100 times the runoff that originates within the study area. The average flow per unit area of the Green and White Rivers is 0.17 cubic foot per second per square mile, whereas the average flow for the tributary streams varies from less than 0.001 to more than 0.10 cubic foot per second per square mile. Evapotranspiration losses are large, causing average flows of some tributary streams to decrease in a downstream direction. The water quality in the Green and White Rivers generally is better than that in the tributary streams. Dissolved-solid concentrations average 572 milligrams per liter for the Green River and 500 milligrams per liter for the White River, whereas mean concentration for the tributary streams range from 549 milligrams per liter for ephemeral streams to 5,320 milligrams per liter for Bitter Creek. Dissolved-solids concentrations in base flow for short reaches of Bitter Creek can exceed 10,000 milligrams per liter. (USGS)
W86-03064

STREAMFLOW AND SUSPENDED-SEDIMENT DISCHARGE FROM TWO SMALL WATERSHEDS IN SOUTHWESTERN WYOMING AND NORTHEASTERN UTAH, 1984,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. W. Lenfest, and B. H. Ringen.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-161, 1985. 26 p, 8 fig, 7 tab, 7 ref.

Descriptors: *Suspended sediments, Water quality, *Streamflow, Stage-discharge relations, Discharge hydrographs, Thief Creek, Chicken Creek, *Wyoming, *Utah.

Accelerated erosion due to mineral exploration and production in southwestern Wyoming has caused concern that the streams will transport excess sediment in these areas. Two adjacent drainage basins with different levels of development were studied to determine the effects of minerals development on water quality. A high level of minerals development was occurring in the Thief Creek drainage basin; little or no development was occurring in the Chicken Creek drainage basin. Streamflow, suspended sediment, water temperature, and specific conductance data were collected at each creek from May through September, 1984. Water samples were analyzed for common characteristics and constituents, and for trace metals, iron, and manganese. (USGS)

W86-03066

SUMMARY OF WATER-RESOURCES ACTIVITIES OF THE UNITED STATES DEPARTMENT OF INTERIOR, GEOLOGICAL SURVEY-FISCAL YEAR 1984, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
E. F. LeRoux, and E. M. Decker.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-422, 1985. 59 p, 7 fig, 4 tab.

Descriptors: *Hydrologic data, Water-resources studies, *Data collections, *Hydrologic data, Groundwater, Surface waters, *South Dakota.

Project descriptions, water-resources summaries, and lists of hydrologic-data stations are presented to show the status of the U.S. Geological survey water-resources studies in South Dakota. (USGS)
W86-03067

DATA USES AND FUNDING OF THE STREAM-GAGING PROGRAM IN MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-03070

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-03073

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS OKLAHOMA, 1984 WATER YEAR,
Geological Survey, Little Rock, AR. Water Resources Div.
M. A. Moore, and T. E. Lamb.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-179, 1985. 30 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Interstate compacts, Stream discharge, Reservoir storage, *Hydrologic data, *Water yield, *Arkansas River Basin, *Arkansas, *Oklahoma, *Annual yield.

The computer annual yield and deficiency of the subbasins as defined in the Arkansas River Compact, Arkansas-Oklahoma, are given in tables. Actual runoff from the subbasins and depletion caused by major reservoirs in the compact area are also given in tabular form. Monthly, maximum, minimum, and mean discharges are shown for the 14 streamflow stations used in computing annual yield. (USGS)
W86-03074

SURFACE-WATER QUANTITY AND QUALITY IN THE LOWER KENAI PENINSULA, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
C. S. Savard, and D. R. Scully.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4161, 1984. 62 p, 15 fig, 17 tab, 16 ref, append.

Descriptors: *Surface water availability, Low flow, High flow, *Water quality, *Alaska, Kenai Peninsula.

New information on stream discharge and quality were collected over a 2-year period in the lower Kenai Peninsula. This new information improved understanding of the area's surface-water hydrology. Average annual runoff ranges from 11 inches in the lowland portions of the peninsula to 100 inches in the Seldovia area. For drainage basins in the Kenai Lowland, maximum flood runoff rates range from about 10 to 82 cubic feet per second per square mile. In the Seldovia area maximum peak discharges range from about 65 to 280 cubic feet per second per square mile. Low-flow discharges are higher in the Seldovia area than on the lower peninsula. Calcium and bicarbonate ions dominate the water in streams draining the study area; the water is soft and has a low dissolved-solids content. Measured stream water temperatures range from 0 to 23 degrees Celsius in the Kenai Lowland and from 0 to 11.5 degrees Celsius in the Seldovia area. (USGS)
W86-03076

PRELIMINARY INVESTIGATION OF FLOW CHARACTERISTICS OF THE ALABAMA RIVER UPSTREAM FROM SELMA, ALABAMA,
Geological Survey, Montgomery, AL. Water Resources Div.
G. H. Nelson, C. O. Ming, and W. L. Psinakis.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4055, 1985. 44 p, 26 fig, 6 tab, 11 ref.

Descriptors: *Historic floods, *Water-surface profiles, *Stage-discharge relation, *Control structures, *Backwater effect, Discharge coefficient, *Alabama River, Robert F. Henry Lock and Dam, Autauga-Lowndes County Line, *Alabama.

Available data for floods in the vicinity of Montgomery since the late 1800's indicate that the flood of 1886 is the highest since settlement of the area in 1814. Profiles for floods in 1948, 1961, 1976, and 1979 were defined using floodmarks and recorded peak stages at gaging stations at Selma and Montgomery. The floods in 1948 and 1961 occurred before construction of Robert F. Henry Lock and Dam (formerly Jones Bluff Lock and Dam and Millers Ferry Lock and Dam). Considerable water-surface differences are indicated between the profiles for periods before and after construction of the dams. The investigation included a step-backwater model to reproduce profiles based on the actual flood profiles. After the actual flood profiles were reproduced, the model was used to compute additional profiles showing the effects of varying tributary inflow. The profiles were computed for discharges ranging from 80,000 ft3/s to 500,000 ft3/s. Stage-discharge relations were then developed for five sites upstream from Selma. Discharge coefficient curves for prevalent types of flow over the spillway at Robert F. Henry Lock and Dam were developed using discharges obtained from current-meter measurements and standard discharge equations for flow through gate-controlled spillways. (USGS)
W86-03077

FLOOD FREQUENCY AND STORM RUNOFF OF URBAN AREAS OF MEMPHIS AND SHELBY COUNTY, TENNESSEE,
Geological Survey, Memphis, TN. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-03078

GROUND-WATER RESOURCES OF THE MATTAPOISETT RIVER VALLEY, PLYMOUTH COUNTY, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
J. C. Olimpio, and V. de Lima.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4043, 1984. 83 p, 24 fig, 11 tab, 27 ref.

Descriptors: *Glacial aquifers, *Groundwater model, *Water table, *Water level fluctuations, Geohydrologic boundaries, Municipal pumping, *Streamflow, Streambed infiltration, Plymouth County, *Massachusetts, Surface-groundwater relationships, Mettapoisett River Valley.

Ground-water withdrawals by municipal wells in the Mattapoisett River valley, Massachusetts, are expected to triple in the next two decades. State and local concern about the long-term impacts of these withdrawals on ground-water levels and streamflow made it necessary to assess the ground-water resources of the valley and to develop a digital ground-water-flow model for management purposes. Ten pumping scenarios, which represent the present and proposed withdrawals from the aquifer, were simulated using reduced recharge conditions. Under conditions simulating 1965 average annual recharge, predicted water levels in the aquifer are as much as 9 feet lower than average annual levels. At the highest withdrawal rates, the predicted drawdown in four wells exceeds the estimated available drawdown. Under conditions representative of the 7-day 10-year low flow of the river, predicted water levels decline as much as 19 feet. Simulated withdrawals in six scenarios use all of the available ground-water discharge. If this drought condition should occur and streamflow is not supplemented by surface water, the model results indicate that the river in the southern half of the valley will stop flowing under most pumping plans. (USGS)
W86-03079

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN ORLANDO SUBDISTRICT, FLORIDA,

Geological Survey, Orlando, FL. Water Resources Div.
R. A. Miller, W. Anderson, and L. D. Fayard.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-resources Investigations Report 84-4116, 1984. 89 p, 24 fig, 9 tab, 48 ref.

Descriptors: Cost allocation, *Gaging stations, *Hydrography, Optimization, Data collections, *Cost-benefit analysis, *Florida, *Cost effectiveness, Traveling-salesman problem.

The results of a study of the cost-effectiveness of the stream-gaging program in central Florida are documented. Data uses and funding sources were identified for the 94 continuous-record gaging stations currently being operated in central Florida with a budget of $462,000. No stations were identified as unnecessary in the present network and no station could be replaced by data simulation using alternate methods (flow routing or regression analysis). The average standard error in estimating instantaneous discharge for the present operation is 27.8 percent. Given a budget of $550,000 and unlimited site visits the average standard error could be reduced to 17.8 percent. However this would require that one-third of the stations be visited at a frequency greater than monthly, with the remainder being visited less frequently. The logistics required for controlling personnel and vehicles would prohibit this approach from actually being used in the field. By limiting the maximum number of visits to 11 per year, a budget of $550,000 would reduce the average standard error to 20.2 percent. One presently operating site in the Withlacoochee River basin should be replaced with dam-monitoring equipment, and telecommunication equipment should be placed at remote sites in the Kissimmee River basin for the purpose of determining operating status of the recorder. (USGS)
W86-03086

FLOODING IN NORTHWESTERN HILLSBOROUGH AND SOUTHERN PASCO COUNTIES, FLORIDA, IN 1979,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. R. Murphy, R. P. Evans, and J. K. Whalen.
USGS Open-File Report 82-96, 1984. 13 map sheets, 38 fig, 4 tab, 20 ref.

Descriptors: *Flooding, *Flood stage, *Flood peak, *Flood frequency , Flood damage, *Florida, Hillsborough County, Northwestern Hillsborough County.

Heavy rainfall in the late spring and summer of 1979 caused severe flooding in northwestern Hillsborough and southern Pasco counties, including north Tampa. May 7-9 rainfall for some stations had a recurrence interval in excess of 100 years; the August and September rainfall total had a recurrence interval in excess of 50 years. The frequency of flooding of streams and lakes in the study area for the May 7-9 storm ranged from less than 2 to 25 years; for the period August to October, recurrence intervals ranged from 3 to 25 years. Areas of maximum flooding for a 48-square-mile area of northwestern Hillsborough and southern Pasco Counties are indicated on 12 sheets of aerial photography. Drainage patterns, control structures, drainage basins, and existing and proposed urban developments are shown and related to flooding. Stage and streamflow hydrographs are shown for 12 lakes and 2 streams. (USGS)
W86-03109

HYDROLOGIC DATA FOR THE LARIMER-WELD REGIONAL WATER-MONITORING PROGRAM, COLORADO, 1975-1982,

Geological Survey, Lakewood, CO. Water Resources Div.
S. R. Blakely.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-139, 1984. 201 p, 1 fig, 13 tab, 25 ref.

Descriptors: Water quality, Streamflow, Reservoir capacity, Period of record, Chemical analysis, Statistics, *Hydrologic data, Larimer County, Weld County, Big Thompson River, Cache La Poudre River, Horsetooth Reservoir, Joe Wright Creek, Michigan River, Platte River basin, *Colorado.

The Larimer-Weld, Colorado, regional Monitoring Program was begun in 1976 to provide information on the quality and quantity of the surface-water resources in the area. Three stations on the big Thompson River and five stations on the Cache La Poudre River were selected for a data-collection network. Four previously established stations were added to complete the data-collection network: Horsetooth Reservoir, Joe Wright Creek above and below Joe Wright Reservoir, and Michigan River near Cameron Pass. Station description, location, and period of record are given for each station. A statistical summary of the water-quality data for each station is tabulated. Frequency of occurrence is given at the 95th, 75th, 50th, and 25th percentiles. Monthly water-quality data and daily average streamflow data are tabulated for each streamflow station for which this data was collected; Monthly contents data are presented for Horsetooth Reservoir. All data tabulated and summarized are from the period October 1, 1975, through September 30, 1982. (USGS)
W86-03110

HYDROLOGY OF AREA 29, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
K. K. Fitzgerald, C. A. Peters, and E. E. Zuehls.
USGS Water-Resources Investigation/Open-File Report 82-858, 1983. 70 p, 57 fig, 14 tab, 64 ref.

Descriptors: Coal, *Coal mines, *Coal mine wastes, *Hydrology, Strip mines, Water pollution sources, Hydrologic data, *Illinois, Coal hydrology, Water data sources.

Hydrologic information and analysis that should be useful to mine owners, mine operators, and consulting engineers in the preparation of permits and to regulatory authorities in appraising the adequacy of permit applications is presented. The Kaskaskia River is the major river draining Area 29. Glacial deposits cover most of the area and coal-bearing Pennsylvanian rocks underlie about 95 percent of the area. Agriculture is the dominant land use. As of June, 1980, there were five active underground coal mines and two active surface mines. Ninety-six percent of the water used in Area 29 is obtained from surface-water resources. Ground-water yields vary throughout the area. There are 21 active streamflow gaging stations in Area 29. Equations have been developed for estimating mean annual streamflow, 7-day, 10-year low flow, 7-day, 10-year high flow, and the 10-year peak discharge. Water-quality data are available for 39 sites in the area. Natural conditions neutralize acidic waters resulting from drainage from coal-mining areas in Area 29, but increased concentrations of metals, such as iron, manganses, and aluminum, and other elements remain in the waters. (USGS)
W86-03111

HYDROLOGIC-DATA STATIONS AND LAKE LEVELS, KENAI-NIKISKI AREA, ALASKA, 1983,

Geological Survey, Anchorage, AK. Water Resources Div.
B. J. Bailey.
USGS Open-File Report 83-938, 1983. 2 p, 13 fig, 1 tab, 3 ref.

Descriptors: *Hydrologic data, Stations, *Networks, *Water levels, Lakes, *Lake levels, *Alaska, Kenai, Nikiski.

The locations of 2 National Weather Service stations, 29 observation wells, 4 stream gages, and 12 lake-stage stations are depicted on a 1:63, 360-scale map. The periods of record and station descriptions are listed. Hydrographs depict water-level fluctuations of 12 lakes during the period 1970-1983. (USGS)
W86-03115

TRAVELTIME AND DISPERSION IN THE POTOMAC RIVER, CUMBERLAND, MARYLAND, TO WASHINGTON, D.C.,

Geological Survey, Towson, MD. Water Resources Div.
K. R. Taylor, R. W. James, and B. M. Helinsky.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-861, 1984. 55 p, 14 fig, 7 tab, 35 ref.

Descriptors: *Traveltime, *Dye dispersion, *Solute transport, *Dye concentrations, Dam effects, Average velocity, Dye releases, *Potomac River, *Maryland, Concentration attenuation, Unit concentration, Dye cloud, Time of passage.

Data from two traveltime and dispersion studies, using rhodamine dye, are used to develop a generalized procedure for predicting traveltime and downstream concentrations resulting from spillage of water-soluble substances at any point along the Potomac River from Cumberland, Maryland, to Washington, D.C. The procedure will allow the approximate solution to almost any spillage problem concerning traveltime and concentration during periods of relatively steady flow between 50- and 95-percent flow duration. A new procedure for calculating unit peak concentration is derived. The new procedure, based on the similarity in shape of a time-concentration curve and a scalene triangle, allows unit peak concentration to be expressed in terms of the length of the dye cloud. This approach facilitates the linking of peak-concentration attenuation curves for long reaches of rivers which are divided into subreaches for study. An example problem is solved for a hypothetical spill of 20,000 pounds of contaminant at Magnolia, West Virginia. The predicted traveltime of the leading edge, peak concentration, and trailing edge to Point of Rocks, Maryland (110 miles downstream), are 295, 375, and 540 hours, respectively, for a flow duration of 80 percent. The predicted maximum concentration is 340 micrograms/L. (USGS)
W86-03123

GENERALIZED SKEW COEFFICIENT FOR FLOOD FREQUENCY COMPUTATIONS FOR THE STATE OF HAWAII,

Geological Survey, Honolulu, HI. Water Resources Div.
R. Lee.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4027, 1984. 21 p, 6 fig, 5 tab, 5 ref.

Group 2E—*Streamflow and Runoff*

Descriptors: *Generalized skew coefficient, *Hawaii, *Flood frequency, Streams, *Log-Pearson Type III distribution.

In 1976, the Hydrology Committee of the U.S. Water Resources Council estimated a generalized skew coefficient for flood frequency computations of -0.05 for the State of Hawaii. This value is the average of 30 stream gaging stations with 25 or more years of record through water year 1973. This report updates the generalized skew coefficient for the State of Hawaii to -0.14. It is the average of 68 stream gaging stations with 25 or more years of record. (USGS)
W86-03143

WATER RESOURCES DATA, ALASKA WATER YEAR 1981.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03146

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03147

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 3. DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03148

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03149

WATER RESOURCES DATA, LOUISIANA WATER YEAR 1983, VOLUME 1. CENTRAL AND NORTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03150

WATER RESOURCES DATA, LOUISIANA WATER YEAR 1983, VOLUME 2, SOUTHERN LOUSIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03151

WATER RESOURCES DATA, NEW MEXICO WATER YEAR 1983,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03152

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1982, VOLUME 1. DELAWARE RIVER BASIN,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03153

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 1. DELAWARE RIVER BASIN,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03154

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03155

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASINS,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03156

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 2. LONG ISLAND,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03157

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 3. WESTERN NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03158

WATER RESOURCES DATA, HAWAII AND OTHER PACIFIC AREAS WATER YEAR 1983. VOLUME 1, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03159

WATER RESOURCES DATA, HAWAII AND OTHER PACIFIC AREAS WATER YEAR 1983. VOLUME 2,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03160

WATER RESOURCES DATA, KENTUCKY WATER YEAR 1983.
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03161

STORAGE ANALYSIS FOR EPHEMERAL STREAMS IN SEMIARID REGIONS,
Geological Survey, Cheyenne, WY. Water Resources Div.
K. C. Glover.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4078, 1984. 55p, 6 fig, 7 tab, 7 ref.

Descriptors: *Reservoir storage, *Storage-frequency curves, Semiarid climates, Probability, *Computer models, *Water supply, *Queuing theory, Computer programs(Fortran).

A model has been developed for determining the probability of a reservoir being unable to provide a specified downstream water supply. By applying the model with a number of assumed storage capacities, the long-term water supply potential of a stream below a reservoir can be evaluated. Previous methods for determining available water supply from streamflow records using a reservoir storage analysis have met with limited success in semiarid regions. The shortcomings are due to the failure of the methods to account for zero-flow periods and the high day-to-day variability of discharge of many streams. The reservoir storage model presented in this report is designed to account for these streamflow characteristics. Reservoir inflow, outflow, and evaporation are modeled as varying daily, and values of storage probability are adjusted for zero-flow periods. (USGS)
W86-03171

CHARACTERISTICS OF STREAMFLOW IN MARYLAND,
Geological Survey, Towson, MD. Water Resources Div.
D. H. Carpenter.
Maryland Geological Survey, Annapolis, Report of Investigations No 35, 1983. 237 p, 18 fig, 14 tab, 39 ref.

Descriptors: *Flow characteristics, *Low flow, *Flow duration, *Flood frequency, Regression analysis, Design floods, Regional analysis, Natural streams, Soils types, Regulated flow, Flood data, *Maryland, Peak flow, Flood volume, Low-flow frequency, Design low flows, Basin characteristics, Coastal Plain, Piedmont, Recurrence interval.

Mean-annual discharge, peak-flow, flood-volume, low-flow, and flow-duration data are presented for 124 continuous-record gaging stations reflecting both the drought of the 1960's and most of the floods of the 1970's. In addition, peak-flow data are presented for 30 crest-stage partial-record stations and selected low-flow data are presented for 111 low-flow partial-record stations. Methods are presented for estimating peak-flow magnitudes and frequencies and low-flow magnitudes and frequencies at ungaged sites. Multiple-regression techniques are used to develop equations which relate physical and climatological features of drainage basins to peak-flow and low-flow discharges for selected recurrence intervals. These regression equations are used to estimate the peak- and low-flow magnitudes at ungaged sites. The methods can be used to evaluate the reliability of the estimates. (USGS)
W86-03172

DRAINAGE AREAS IN NEW JERSEY: ATLANTIC COASTAL BASINS, SOUTH AMBOY TO CAPE MAY,
Geological Survey, Trenton, NJ. Water Resources Div.
A. J. Velnich.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-150, 1984. 33 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Drainage area, *Watersheds(Basin), *New Jersey, *Gaging stations, *Water resources, Rivers, Drainage system, Surface water, Basin characteristics, Stream gazetteer.

Drainage areas of New Jersey streams in the coastal basin from South Amboy to Cape May are listed for more than 700 sites. Tables list the descriptive location of each site, the latitude and longitude, county, and National Topographic map name. For gaged sites established through 1982, the U.S. Geological Survey station name and site number are also shown. The data are presented alphabetically by stream name and in downstream order. Drainage areas were tabulated for named streams and unnamed streams with a drainage area greater than 5 square miles. The methods used to delineate the drainage divides, measure areas, and determine mouths of streams follow the guidelines developed by the U.S. Water Resources Council. (USGS)
W86-03178

WATER RESOURCES DATA, SOUTH DAKOTA WATER YEAR 1983,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03179

WATER RESOURCES DATA, TENNESSEE WATER YEAR 1983,
Geological Survey, Nashville, TN. Water Re-

sources Div.
For primary bibliographic entry see Field 7C.
W86-03180

WATER RESOURCES DATA, IDAHO WATER YEAR 1983,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03181

WATER RESOURCES DATA, IOWA WATER YEAR 1983,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03182

WATER RESOURCES DATA, KANSAS WATER YEAR 1983,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03183

WATER RESOURCES DATA, GEORGIA WATER YEAR 1983,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03184

WATER RESOURCES DATA, NEW JERSEY WATER YEAR 1983, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03185

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 1: EASTERN NEW YORK EXCLUDING LONG ISLAND,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03186

WATER RESOURCES DATA, ARKANSAS WATER YEAR 1983,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03187

WATER RESOURCES DATA, OREGON, WATER YEAR 1983, VOLUME 2: WESTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03188

WATER RESOURCES DATA, INDIANA WATER YEAR 1983,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03189

WATER RESOURCES DATA, NEW HAMPSHIRE AND VERMONT WATER YEAR 1983,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03190

WATER RESOURCES DATA, SOUTH CAROLINA WATER YEAR 1983,
Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03191

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 4. NORTHERN CALIFORNIA VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03192

WATER RESOURCES DATA, CALIFORNIA, WATER YEAR 1982, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03193

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03194

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 1. SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03195

WATER RESOURCES DATA, ILLINOIS WATER YEAR 1983, VOLUME 2: ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03196

WATER RESOURCES DATA, ILLINOIS WATER YEAR 1983, VOLUME 1: ILLINOIS EXCEPT ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03197

WATER RESOURCES DATA, NORTH DAKOTA WATER YEAR 1983,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03198

WATER RESOURCES DATA, NEVADA WATER YEAR 1983,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03199

WATER RESOURCES DATA, OREGON WATER YEAR 1983, VOLUME 1: EASTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03200

WATER RESOURCES DATA, UTAH WATER YEAR 1983,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03201

WATER RESOURCES DATA, FLORIDA WATER YEAR 1981, VOLUME 4, NORTHWEST FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03202

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1982,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03204

WATER RESOURCES DATA, MAINE WATER YEAR 1982,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03205

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03206

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 1A: NORTHEAST FLORIDA SURFACE WATER,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03207

WATER RESOURCES DATA, TEXAS, WATER YEAR 1982, VOLUME 3; COLORADO RIVER, LAVACA RIVER, GUADALUPE RIVER, NUECES RIVER, RIO GRANDE BASINS AND INTERVENING COASTAL BASINS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03208

WATER RESOURCES DATA, MISSOURI WATER YEAR 1983,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03209

WATER RESOURCES DATA, WYOMING WATER YEAR 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03210

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03211

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 1B: NORTHEAST FLORIDA GROUND WATER,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03212

WATER RESOURCES DATA, VIRGINIA WATER YEAR 1983,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03213

WATER RESOURCES DATA, MAINE WATER YEAR 1983,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03214

WATER RESOURCES DATA, WISCONSIN WATER YEAR 1983,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03215

WATER RESOURCES DATA, WEST VIRGINIA WATER YEAR 1983,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03216

WATER RESOURCES DATA, OKLAHOMA WATER YEAR 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03217

WATER RESOURCES DATA, NEBRASKA WATER YEAR 1982,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03218

WATER RESOURCES DATA, MICHIGAN WATER YEAR 1983,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03219

WATER RESOURCES DATA, ALABAMA WATER YEAR 1983,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03220

WATER RESOURCES DATA, MINNESOTA WATER YEAR 1982, VOLUME 1. GREAT LAKES AND SOURIS-RED-RAINY RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03221

WATER RESOURCES DATA, MINNESOTA WATER YEAR 1982, VOLUME 2: UPPER MISSISSIPPI AND MISSOURI RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03222

WATER RESOURCES DATA, OHIO WATER YEAR 1983, VOLUME 1. OHIO RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03223

WATER RESOURCES DATA, OHIO WATER YEAR 1983, VOLUME 2. ST. LAWRENCE RIVER BASIN STATEWIDE PROJECT DATA,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03224

WATER RESOURCES DATA, NEBRASKA WATER YEAR 1983,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03225

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1983,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03226

WATER RESOURCES DATA, ARIZONA WATER YEAR 1982,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03227

WATER RESOURCES DATA, MONTANA WATER YEAR 1983, VOLUME 1: HUDSON BAY AND MISSOURI RIVER BASINS,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03228

WATER RESOURCES DATA, MONTANA WATER YEAR 1983, VOLUME 2, COLUMBIA RIVER BASIN,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03229

QUEBEC: SURFACE WATER DATA, 1984,
Inland Waters Directorate, Ottawa (Ontario).
1985. 49 p.

Descriptors: *Surveys, *Hydrometric stations, *Stream discharge, *Quebec, Water level, *Sediment discharge, Gages, Data collections, Hydrologic data collections, Hydrometry, Gaging, Stream gages, Flow discharge, Water level fluctuations, Tides, Rivers, Streams.

The results of the hydrometric surveys carried out by the Water Survey of Canada Division in the province of Quebec for 1984 are presented. A list of all hydrometric stations managed by the Water Survey of Canada Division in Quebec is also included. This publication summarizes the annual water level data for the Tides and Water Level Network in Quebec on the St. Lawrence River upstream of Lac St. Pierre. For gaging stations where a systematic record of water level or discharge was obtained during the year under review, the following are given where available: table of daily water level or discharge; summary of monthly and annual data; and descriptive information about the gaging station. Descriptive information tells which stations are international gaging stations, the type of gage used, location, drainage area, data contributor, whether the flow is natural or regulated, gage datum, and any unusual conditions which may occur at a station. Revisions or corrections to previously published data are included. The overall accuracy or the degree of reliability of hydrometric data depends upon the type of gage, gage stability, accuracy of observation of stage, measurement of reference datum, stability of stage-discharge relationship, and computation procedures and interpretation of records. All published daily discharge, water level and sediment data are available in metric units on microfiche. (Geiger-PTT)
W86-03235

AUSTIN, TEXAS, FLOOD OF MAY 24-25, 1981,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-03260

MORPHOLOGICAL MODELLING FOR RIVERS WITH NON-UNIFORM SEDIMENT,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-03269

MANITOBA: SURFACE WATER DATA, 1984,
Inland Waters Directorate, Ottawa (Ontario).
1985. 175 p.

Descriptors: *Stream gages, *Hydrologic data collections, *Hydrometric stations, *Discharge measurement, *Surface water, Gaging, Gaging stations, Gages, Fluvial sediments, Hydrometry, Data collections, Discharge hydrographs, Flow discharge, Surveys, *Canada, *Manitoba.

The results of the hydrometric survey studies which were made in Mannitoba by the Water Survey of Canada for 1984 are presented. For gaging stations where a systematic record of water level or discharge was obtained, data on the daily water level or discharge, monthly and annual data, and descriptive information about the sampling site are given. Waters adjacent to an international boundary contain records approved jointly by both the United States and Canada. A number of revisions that have been made to previously published data are included. The overall accuracy or the degree of reliability of hydrometric data included in this report depends upon the type of gage, stability of the gage, accuracy of observation of stage and measurement of reference datum. The degree of reliability also depends upon the stability of the stage-discharge relationship, the frequency and accuracy of discharge measurements, and the computation procedures and interpretation of records. All published daily discharge, water level, and sediment data are available in metric units on microfiche. (Geiger-PTT)
W86-03287

ALTERNATIVE FOR CHARACTERIZING STREAM SIZE,
Corvallis Environmental Research Lab., OR.
R. M. Hughes, and J. M. Omernik.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 87-101, 2 fig, 1 tab, 71 ref.

Descriptors: *Stream classification, *Stream order, Stream discharge, Flow discharge, Watersheds, Hydrologic cycle, Hydrologic cycle, Hydraulic geometry, Hydrologic models.

There are disadvantages to using stream order to compare streams and watershed size on a regional or national scale because of the lack of uniform map specifications, lack of agreement on definition of a first-order stream, and the problem of deciding the appropriate map scale to determine stream order. To overcome these problems, an alternative technique for the characterization of stream size was explored. Seventy-one watershed/stream ecosystems in 31 states within major physiographic and climatic regions of the conterminous United States were examined. The objective was to demonstrate the value of using discharge characteristics and watershed area instead of stream order to provide a rough but useful characterization of watershed and stream sizes throughout the nation. The authors found that streams of a given order show vast ranges in discharges and watershed area, greatly overlapping the ranges for lower and higher order streams. Therefore, they suggest using mean annual discharge per unit area and watershed area instead of stream order to quantify stream and watershed size. (Author)
W86-03380

SIGNIFICANCE OF FLOODPLAIN SEDIMENTS IN NUTRIENT EXCHANGE BETWEEN A STREAM AND ITS FLOODPLAIN,

East Carolina Univ., Greenville, NC. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-03385

ORGANIC CARBON SUPPLY AND DEMAND IN THE SHETUCKET RIVER OF EASTERN CONNECTICUT,

East Carolina Univ., Greenville, NC. Dept. of Biology.
E. A. Matson, and R. L. Klotz.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 247-269 p, 3 fig, 4 tab, 64 ref.

Descriptors: *Aquatic environment, *Organic carbon, *Lotic environment, Organic matter, Microbial studies, Nutrients, Controlled streams, Aquatic productivity, Productivity, Shetucket River, Connecticut.

Autochthonous and allochthonous supplies of organic carbon were compared in the Shetucket River of eastern Connecticut during 1974. The biomass of the sixth-order river segment was dominated by epilithic, unicellular algae, and heterotrophic activity was at least 75% microbial. Imported and exported dissolved organic carbon was measured, and gross primary production and total community respiration were estimated. Light-limited in situ gross primary production (2000 kcal/sq m/yr) provided the equivalent of 40% of the carbon respired in the river segment, and calculated net primary production (60% of gross) supplied about 14% of the calculated carbon assimilated by heterotrophs. Even though primary production was two orders of magnitude greater than in small, shaded New England brooks, total community respiration was only twice as great. The supply of allochthonous carbon per square meter of river bottom was at least 400,000 times greater than autochthonous production per square meter, and total carbon import and export were equal. (Author)
W86-03387

AQUATIC MACROPHYTE CONTRIBUTION TO THE NEW RIVER ORGANIC MATTER BUDGET,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
B. H. Hill, and J. R. Webster.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 273-282 p, 1 fig, 4 tab, 29 ref.

Descriptors: *Aquatic environment, *Lotic environment, *Aquatic macrophytes, *Organic matter, New River, Virginia, Periphyton, Model studies, Cycling nutrients, Organic carbon, Detritus.

Recent studies of energy flow in lotic ecosystems indicate that streams are strongly dependent on watershed-derived organic matter. However, appreciable in situ production of organic matter can occur under favorable conditions of insolation and nutrient availability, especially in higher order streams. This paper reports on studies estimating the relative contribution of aquatic macrophytes to the organic matter budget of the New River. Production rates were measured by the harvest method and extrapolated to the entire reach on the basis of measurements of cover made by aerial photography. The estimated macrophyte contribution was compared with measurements of periphyton production and model estimated allochthonous inputs. Macrophytes contributed 13.1% of the total input and 28% of the input generated within the reach. Macrophyte input to the New River trophic dynamics occurs as an autumnal pulse of rapidly decomposed detritus. This pulse forms an important link between spring-summer periphyton production and fall-winter allochthonous-based production. (Author)
W86-03388

PRIMARY PRODUCTION AND DECOMPOSITION OF SUBMERGENT AND EMERGENT AQUATIC PLANTS OF TWO APPALACHIAN RIVERS,

North Texas State Univ., Denton. Inst. of Applied Sciences.
For primary bibliographic entry see Field 5C.
W86-03389

BIOTIC INTERACTIONS OR ABIOTIC LIMITATIONS. A MODEL OF LOTIC COMMUNITY STRUCTURE,

Cornell Univ., Ithaca, NY. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W86-03390

DYNAMICS OF LEAF PROCESSING IN A MEDIUM-SIZED RIVER,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-03393

ROLE OF SHREDDERS IN DETRITAL DYNAMICS OF PERMANENT AND TEMPORARY STREAMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-03394

MICROBIAL ACTION IN DETRITAL LEAF PROCESSING AND THE EFFECTS OF CHEMICAL PERTURBATION,

Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W86-03395

CHARACTERIZATION OF THE KINETICS OF 'DENITRIFICATION' IN STREAM SEDIMENTS,

Guelph Univ. (Ontario).
For primary bibliographic entry see Field 5C.
W86-03397

2F. Groundwater

SIMULATED GROUND-WATER FLOW IN THE POTOMAC AQUIFERS, NEW CASTLE COUNTY, DELAWARE,

Geological Survey, Towson, MD. Water Resources Div.
M. M. Martin.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4007, 1984. 85 p, 58 fig, 1 plate, 4 tab, 20 ref.

Descriptors: *Groundwater flow, *Simulation analysis, Confined aquifers, Aquifer characteristics, *Delaware, Coastal plain aquifers, Finite-difference model.

Flow in three aquifers of the Potomac Formation in New Castle County, Delaware, was simulated. Results of the calibrated flow model show the maximum transmissivity of the lower aquifer is between 1,000 and 1,500 square feet per day; the middle aquifer, between 3,000 and 3,500 square feet per day; and the upper aquifer, between 5,000 and 6,000 square feet per day. Vertical leakance values for the three confining beds are similar and range 1 x 10 to the (1-8) power per day in downdip areas and .01 per day in subcrop areas. A storage coefficient of 0.00056 was used for each aquifer. A specific storage value of 0.000006 per foot was used for each confining bed. Estimated storage coefficients were not changed during calibration. Changes in water levels resulting from five scenarios of future pumpage were evaluated. Results of these simulations show: (1) the reduction in pumpage at Amoco causing a 120 foot local recovery of heads; (2) water levels generally will change less than 25 feet if there is no change in pumpage; (3) proposed pumpage in western Delaware may cause drawdowns below the tops of the aquifers; and (4) expected increases in pumpage would cause the greatest head decline, about 40 feet, in the lower aquifer at Getty. (USGS)
W86-02920

GEOHYDROLOGY OF THE MADISON AND ASSOCIATED AQUIFERS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,

Geological Survey, Lakewood, CO. Water Resources Div.
J. S. Downey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Professional Paper 1273-G, 1984. 47 p, 44 fig, 2 tab, 112 ref.

Descriptors: *Geohydrology, *Aquifer systems, *Simulation models, Flow systems, Montana, North Dakota, South Dakota, Wyoming, *Hydrogeology, Model studies, Saline water, Water quality, Paleozoic aquifers, Ground-water flow systems, Madison Limestone, *Northern Great Plains.

The ground-water system in the Northern Great Plains can be subdivided into at least five major regional aquifers. Two of these are discussed in this report--the Madison aquifer of Mississippian age and the Cambrian-Ordovician aquifer, which includes the Red River Formation. These aquifers are recharged in high areas of Montana and Wyoming and in the Black Hills of South Dakota. Regional flow is generally to the east and northeast, with most of the discharge from the system occurring in eastern North Dakota and in the Canadian Province of Manitoba. High-density brine occurs in both aquifers on the eastern flank of the Williston basin, and freshwater flow appears to divert to the north and south around the brine area or to leak upward into aquifers overlying the Madison. Fracture systems traverse the entire geologic section and exert a major influence on both vertical and horizontal flow. Prior to Pleistocene glaciation, the flow system probably was similar to that which exists today. During the Pleistocene Epoch, ice sheets covered the northern and eastern parts of the study area causing extensive changes in recharge and discharge patterns. These changes probably did not cause major shifting in the position of the high-density brines. The flow system was analyzed with the help of a three-dimensional mathematical simulation. (USGS)
W86-02921

WATER-SUPPLY POTENTIAL OF THE FLORIDAN AQUIFER IN OSCEOLA, EASTERN ORANGE, AND SOUTHWESTERN BREVARD COUNTIES, FLORIDA,

Geological Survey, Orlando, FL. Water Resources Div.
M. Planert, and W. R. Aucott.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4135, 1985. 69 p, 35 fig, 5 tab, 30 ref.

Descriptors: *Groundwater availability, *Model studies, Areal hydrogeology, *Florida, Areal assessment, Floridan aquifer, *Water supply potential.

The city of Melbourne and adjacent areas in south Brevard County obtain their water supply from Lake Washington. As of 1982, the lake could provide a maximum of 15 million gallons per day but the projected need for the year 2000 is nearly three times that amount. As one alternative for a future water supply, this study investigated with a digital model, the potential yields of well fields completed in the Floridan aquifer. Seven pumping schemes were simulated with the digital model. Each simulation was made under steady-state conditions so that storage properties of the ground-water system were not included. The most advantageous area for ground-water development was in central Osceola County. Poor quality of water precluded locating a well field within Brevard County. If the ground-water alternative is chosen for the future supply, an observation well network is advisable to monitor head changes; chloride concentration trends east of the pumping centers; and chloride concentration trends in zones below the pumped zone. (USGS)
W86-02924

ESTIMATION OF VERTICAL HYDRAULIC CONDUCTIVITY OF THE CLAY LAYER BETWEEN THE EUTAW AND GORDO AQUIFERS IN THE VICINITY OF FAUNSDALE, MARENGO COUNTY, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
M. Planert, and A. K. Sparks.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4083, 1985. 23 p, 19 fig, 1 tab, 4 ref.

Descriptors: *Groundwater, *Confined aquifers, *Confining beds, Aquicludes, Groundwater movement, Groundwater management, Groundwater availability, *Alabama, Marengo County.

The vertical hydraulic conductivity of the confining bed between the Eutaw and Gordo aquifers in the vicinity of Faunsdale, in northeast Marengo County, Alabama, is 1x10(-5) foot per day or less. Modeling vertical conductivities larger than 1x50(-5) foot per day produced drawdowns in the Eutaw aquifer greater than those observed in a test where 750 gallons per minute were pumped from the Gordo aquifer. Modeling has shown that vertical hydraulic conductivity of the confining bed is the controlling factor on the drawdown in the Eutaw aquifer. At equilibrium (steady-state) pumping 750 gallons per minute there was 3 feet of drawdown in the Eutaw aquifer with a confining bed conductivity of 1x10(-5) foot per day. When the conductivity was decreased to 1x10(-6) foot per day drawdown in the Eutaw aquifer was only 0.35 foot. A conductivity of 1x10(-5) foot per day in the 48-hour simulation reproduced the drawdown in the well from the 48-hour pumping test, but the conductivity may be as small as an untested 1x10(-6) foot per day. (USGS)
W86-02925

MODEL PROJECTIONS, 1980-99, FOR ARKANSAS RIVER VALLEY, HAMILTON AND KEARNY COUNTIES, SOUTHWESTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
L. E. Dunlap, R. J. Lindgren, and J. E. Carr.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4082, 1984. 168 p, 28 fig, 2 tab, 6 ref.

Descriptors: *Computer models, River regulations, *Surface-groundwater relations, Leakage, *Finite element method, Model studies, *Arkansas River, Hamilton County, Kearny County, *Kansas.

A study was made, in cooperation with the Kansas State Board of Agriculture, to determine the effects that additional ground-water development would have on streamflow and water levels on an area along the Arkansas River in Hamilton and Kearny Counties, southwestern Kansas. A computer model was used to simulate the changes in streamflow and water levels from 1980 through 1999. Six pumpage options were tested using variations in pumpage rate and number of wells pumping in the model area. If the full amount appropriated by water rights were pumped rather than actual 1979 conditions of pumpage, annual pumpage would be reduced 24 percent, but net annual river loss would be reduced only 1 percent. A pumpage increase of approximately 19 percent over 1979 pumpage conditions would cause an increase of net annual river loss from 5 to 9 percent. Increased pumpage, in the form of additional wells in the model area, would cause additional ground water to be removed from storage in the aquifer and an increase in net annual river loss. (USGS)
W86-02928

HYDROLOGY OF AREA 61 NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, COLORADO AND NEW MEXICO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02934

RECONNAISSANCE STUDY OF SALTWATER CONTAMINATION IN THE EL DORADO AQUIFER, UNION COUNTY, ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02936

HYDROGEOLOGIC DATA FROM A TEST WELL IN EAST-CENTRAL DUVAL COUNTY, FLORIDA,

Geological Survey, Jacksonville, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-02938

HYDROLOGIC EFFECTS OF IMPOUNDMENTS IN SHERBURNE NATIONAL WILDLIFE REFUGE, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
R. G. Brown.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4175, 1984. 20 p, 8 fig, 5 tab, 10 ref.

Descriptors: *Impoundments, *Groundwater movement, Surface water, *Water quality, *Surface-groundwater relationships, Sherburne National Wildlife Refuge, *Minnesota, Sherburne County.

The hydrologic effects of proposed impoundments in Sherburne National Wildlife Refuge were found to be insignificant with respect to both ground- and surface- water flow patterns and water quality. Monitoring of water levels in 23 observation wells and of discharge in the St. Francis River during 1980 and 1981 has shown that ground water in the surficial aquifer responds quickly to areal recharge and subsequently discharges to the St. Francis River. The impoundment of surface water in the refuge was not found to affect water levels in the refuge significantly. The impoundments may affect ground-water-flow systems beneath and adjacent to the impoundments. Quality of ground and surface water was found to be similar except ground water contained higher concentrations of dissolved nitrite plus nitrate nitrogen than surface water. Phytoplankton removed dissolved nitrite plus nitrate nitrogen from surface water. The effects of impoundments on water quality are expected to be minor. (USGS)
W86-02939

SURFICIAL AQUIFER IN PINELLAS COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
K. W. Causseaux.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4289, 1985. 26 p, 9 fig, 4 tab, 38 ref.

Descriptors: *Water quality, *Water supply, *Groundwater, Water table aquifer, Well field, Drawdown, Well drilling, Pinellas County, *Florida.

The surficial aquifer in Pinellas County, Florida, contains potable water throughout most of the county and is a potential source of water to augment the public supply that is presently imported from adjacent counties. The county accounts for 38 percent of the public supply consumption of ground water in the 11-county area of west-central Florida and 68 percent of this water is imported from two adjacent counties. The surficial aquifer has a saturated thickness of more than 30 feet throughout most of the county. Specific capacity per foot of screen for wells is less than 0.1 gallon per minute per foot of drawdown in some parts of the county, but yield is sufficient in most of the county for many small uses with shallow-well pumps. Minimum potential yield varies from 5 gallons per minute in the northern part of the county to more than 30 gallons per minute in the south. Concentrations of iron are high enough in parts of the county to cause staining. Chloride concentrations are less than 100 milligrams per liter in most of the county and do not pose a problem for many uses. (USGS)
W86-02946

GROUND-WATER SYSTEM AND SIMULATED EFFECTS OF GROUND-WATER WITHDRAWALS IN NORTHERN UTAH VALLEY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
D. W. Clark.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4007, 1985. 56 p, 27 fig, 7 tab, 10 ref.

Descriptors: *Groundwater, *Model studies, *Utah, Groundwater, Recharge, Groundwater movement, Discharge, Potentiometric levels, Great Basin, Utah Valley, *Simulation analysis, *Withdrawals.

The effects of withdrawals from the principal ground-water reservoir in northern Utah Valley, Utah, were projected by means of a three-dimensional, finite-difference, digital-computer model, which was constructed to study and simulate the ground-water system. The model was calibrated against (1) water levels measured in 1947, which were assumed to represent steady-state conditions; (2) observed water-level changes from 1947-83 for transient-state conditions; and (3) the results of an aquifer test. The calibrated model was used to simulate varying quantities of ground-water withdrawal and recharge and to estimate water-level changes for 1980-2000. The average annual rate of recharge for the area is assumed to be 190,000 acre-feet per year, and the average annual discharge from wells at the end of transient-state calibration was assumed to be 50,100 acre-feet per year. Water-level declines of as much as 25 feet are projected for the 20-year period if the average recharge rate is assumed and the discharge from wells is as much as 91,400 acre-feet per year. During transient-state calibration, changes in recharge to the principal ground-water reservoir were shown to be a major cause of the variations in water levels. (USGS)
W86-02948

FEASIBILITY OF ARTIFICIAL RECHARGE IN THE COASTAL PLAIN NEAR ATLANTIC CITY, NEW JERSEY, WITH EMPHASIS ON THE 800-FOOT SAND OF THE KIRKWOOD FORMATION,

Geological Survey, Trenton, NJ. Water Resources Div.
J. E. May.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4063, 1985. 24 p, 5 fig, 2 tab, 27 ref.

Descriptors: *Artificial recharge, *Recharge wells, Aquifer management, Groundwater availability, Atlantic Coastal Plain, *New Jersey, Atlantic City, Kirkwood Formation, Kirkwood-Cohansey aquifer system.

Renewed development of the Atlantic City area since the mid-1970's has increased the demand for water. Increased pumpage from the 800-foot sand of the Kirkwood Formation has reversed an antecedent water-level recovery in this aquifer, thus reducing water in storage and increasing the potential for saltwater intrusion. Practicable approaches to providing a dependable water supply while properly managing withdrawals from the 800-foot sand include development of surface- and ground-water supplies but artificial recharging the 800-foot sand is the principal alternative discussed. Investigation of its feasibility locally included a review of methods of artificial recharge and attendant operational problems, investigation of local hydrogeologic conditions, and collection and interpretation of water-quality data. System design and quality of

injected water are important for successful artificial recharge. Mixtures of water from the 800-foot sand and from a representative local public-supply system may become supersaturated with oxygen. Significant temperature differences between two such waters would likely exacerbate that condition. Limited chemical analyses suggest that suspended solids concentration of water from local public supplies may at times be high enough to cause clogging of recharge-well screens. These problems are soluble by appropriate conditioning of recharge water. (USGS)
W86-02949

DESCRIPTION OF AQUIFER UNITS IN WESTERN OREGON,

Geological Survey, Portland, OR. Water Resources Div.
W. D. McFarland.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 82-165, 1983. 35 p, 13 fig, 5 tab, 84 ref.

Descriptors: *Groundwater, *Aquifer evaluation, *Dissolved solids, Underground waste disposal, *Aquifer delineation, *Aquifer characteristics, *Oregon, Groundwater quality, Underground injection control.

Hydrogeologic information for western Oregon was compiled to aid the U.S. Environmental Protection Agency in evaluating proposals for underground injection of waste fluid. Geologic formations were grouped into seven aquifer units according to hydraulic and geologic similarities. The bedrock aquifer units in the Klamath Mountains, Coast Range, and Western Cascade Range all have low permeabilities and yield only small quantities of water to wells for domestic and stock uses. The Columbia River Basalt Group aquifer unit, which crops out along the Columbia River and the northern Willamette Valley, also has overall low permeability; however, the basalt supplies water for public, domestic, and stock, and some irrigation uses in western Oregon. The most important aquifer unit, and generally most permeable is the Tertiary-Quaternary sedimentary deposits that occur in lowlands throughout the area and provide water for irrigation, industry, public supplies and domestic and stock uses. All aquifer units generally contain water with low concentrations of dissolved solids at shallow depths. In the Tertiary marine rocks of the Coast Range, analyses from a limited number of deep wells indicated that water with more than 10,000 milligrams per liter dissolved solids is widespread at depths greater than about 2,000 feet. (USGS)
W86-02950

PROJECTED WATER-LEVEL DECLINES IN THE OGALLALA AQUIFER IN LEA COUNTY, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
D. P. McAda.
Available from OFSS, USGS, Box 25424 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4062, 1984. 84 p, 49 fig, 14 tab, 26 ref.

Descriptors: *Computer models, Mathematical models, Model studies, *Groundwater depletion, Groundwater availability, Groundwater storage, Water table decline, *New Mexico, Lea County, High Plains, *Ogallala aquifer.

A two-dimensional digital ground-water flow model was constructed of the Ogallala aquifer in Lea County, New Mexico. Simulations of predevelopment steady-state and historical pumping conditions were used to fit the model. Projections of water-level declines were made based on the condition of no additional development and the condition of a 0.44 percent annual increase in irrigation withdrawals to 1990 and a 0.88 percent annual increase in nonirrigation withdrawals to 2020. Based on no additional development, projected maximum water-level declines from 1980 were 31 feet in 2000 and 59 feet in 2020. The amount of recoverable water remaining in the aquifer as simulated by the model was 24.6 million acre-feet in 2000 and 22.4 million acre-feet in 2020, compared to an estimated 28 million acre-feet in 1980, with increased withdrawals, projected maximum declines were 33 feet in 2000 and 67 feet in 2020. As simulated by the model, 24.4 million acre-feet of recoverable water remained in 2000 and 21.8 million acre-feet remained in 2020. The sensitivity of the model to variation in hydraulic conductivity, specific yield, and recharge was tested over their range of uncertainty. Projected water-level declines were most sensitive to specific yield. In response to changes in specific yield, declines varied by as much as 6.2 feet from the standard simulation to 2020 with no additional development. (USGS)
W86-02952

APPLICATION OF THE CONJUGATE-GRADIENT METHOD TO GROUND-WATER MODELS,

Geological Survey, Denver, CO. Water Resources Div.
T. A. Manteuffel, D. B. Grove, and L. F. Konikov.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4009, 1983. 24 p, 4 fig, 1 tab, 9 ref.

Descriptors: *Groundwater, *Mathematical models, Model studies, Numerical analysis, *Simulation analysis, Matrix solution method, Conjugate gradient method.

The conjugate-gradient method can solve efficiently and accurately finite-difference approximations to the ground-water flow equation. An aquifer-simulation model using the conjugate-gradient method was applied to a problem of ground-water flow in an alluvial aquifer at the Rocky Mountain Arsenal, Denver, Colorado. For this application, the accuracy and efficiency of the conjugate-gradient method compared favorably with other available methods for steady-state flow. However, its efficiency relative to other available methods depends on the nature of the specific problem. The main advantage of the conjugate-gradient method is that it does not require the use of iteration parameters, thereby eliminating this partly subjective procedure. (USGS)
W86-02954

DISTRIBUTION AND SOURCE OF BARIUM IN GROUND WATER, CATTARAUGUS INDIAN RESERVATION, SOUTHWESTERN NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
R. B. Moore, and W. W. Staubitz.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. Water-Resources Investigations Report 84-4129, 1984. 17 p, 4 fig, 4 tab, 15 ref.

Descriptors: Groundwater, Water quality, *Barium, Sulfate, Hydrogen sulfide, *Groundwater quality, Barite, Bedrock aquifer, *New York, Cattaraugus Indian Reservation, Sulfate bacteria, Potable water.

High concentrations of dissolved barium have been found in ground water from bedrock wells on the Seneca Nation of Indians Reservation on Cattaraugus Creek in southwestern New York. Concentrations in 1982 were as high as 23.0 milligrams per liter, the highest found reported from any natural ground-water system in the world. The highest concentrations are in a bedrock aquifer and in small lenses of saturated gravel between bedrock and the overlying till. The bedrock aquifer is partly confined by silt, clay, and till. The high barium concentrations are attributed to dissolution of the mineral barite ($BaSO_4$), which is present in the bedrock and possibly in overlying silt, clay, or till. The dissolution of barite seems to be controlled by action of sulfate-reducing bacteria, which alter the $BaSO_4$ equilibrium by removing sulfate ions and permitting additional barite to dissolve. Ground water from the surficial, unconsolidated deposits and surface water in streams contain little or no barium. Because barium is chemically similar to calcium, it probably could be removed by cation exchange or treatments similar to those used for water softening. (USGS)
W86-02955

REGIONAL GEOHYDROLOGY OF THE NORTHERN LOUISIANA SALT-DOME BASIN, PART II, GEOHYDROLOGIC MAPS OF THE TERTIARY AQUIFERS AND RELATED CONFINING LAYERS,

Geological Survey, Baton Rouge, LA. Water Resources Div.
G. N. Ryals.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4135, 1984. 6 p, 8 fig, 1 tab, 19 ref.

Descriptors: *Hydrologic maps, *Geohydrologic units, Geologic units, *Aquifers, Confining beds, *Hydrogeology, Northern Louisiana salt-dome basin, *Louisiana, Vacherie salt dome, Cockfield aquifer, Sparta aquifer, Wilcox-Carrizo aquifer.

Regional geohydrologic maps show the altitude of the base and the thickness of the aquifers of Tertiary age and related confining layers in the northern Louisiana salt-dome basin. The limit of freshwater in aquifers is also shown. The basin has an area of about 3,000 square miles, and four geologic units of Tertiary age contain regional aquifers. From oldest (deepest) to youngest, the aquifers are in the Wilcox Group, Carrizo Sand, Sparta Sand, and Cockfield Formation. As the Wilcox is hydraulically interconnected with the overlying Carrizo, they are treated as one hydrologic unit, the Wilcox-Carrizo aquifer. The aquifers are separated by confining layers that retard water movement. In the northwestern part of the area, the Wilcox-Carrizo aquifer is separated from the underlying sand facies of the Nacatoch Sand (Cretaceous age) by a confining layer composed of the Midway Group (Tertiary age) and the underlying Arkadelphia Marl and an upper clay and marl facies of the Nacatoch Sand (both of Cretaceous age). In the remainder of the area, the Wilcox-Carrizo aquifer is separated from an underlying Cretaceous aquifer comprised of the Tokio Formation and Brownstown Marl by the Midway Group and several underlying Cretaceous units which in order of increasing age are the Arkadelphia Maril, Nacatoch Sand, Saratoga Chalk, Marlbrook Marl, and Annona Chalk. The Wilcox-Carrizo aquifer is separated from the Sparta aquifer by the overyling Cane River Formation. The Sparta aquifer is separated from the Cockfield aquifer by the overlying Cook Mountain Formation. (USGS)
W86-02956

AVAILABILITY OF GROUND WATER IN THE OUTWASH AQUIFER, MARION COUNTY, INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
B. S. Smith.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4144, 1983. 70 p, 23 fig, 6 tab, 27 ref.

Descriptors: *Aquifer characteristics, Computer models, *Groundwater availability, Groundwater budget, Hydraulic conductivity, *Hydrologic models, *Water-table aquifers, Withdrawals, Digital models, Effective recharge, *Groundwater flow, Groundwater pumpage, *Indiana, Marion County, *Outwash aquifer, Stream-aquifer connection, *Surface-groundwater relationships, White River.

The outwash aquifer in Marion County, Indiana is a continuous, unconfined sand and gravel deposit containing isolated boulder, till, silt, and clay deposits along the White River, Fall Creek, and Eagle Creek. Flow in the aquifer is from the boundaries of the aquifer with the Tipton till plain toward the streams and major pumping centers in the aquifer. A two-dimensional, finite-difference model of the outwash aquifer was calibrated to water levels of October 6 to 10, 1980 and used to estimate availability of water in the aquifer. A

drawdown limit of 50-percent saturated thickness applied to 78 simulated-pumping wells assumed to be 1 foot in diameter produced 97 cubic feet per second from the outwash aquifer. Streamflow reductions caused by 97 cubic feet per second simulated pumpage and constant-flux boundaries were estimated to be 85 cubic feet per second in the White River and 12 cubic feet per second in Fall Creek. In comparison, the 7-day, 10-year low flows were 83 cubic feet per second in the White River near Nora and 23 cubic feet per second in Fall Creek at Millersville. Simulated pumpage of 115 cubic feet per second and constant-flux boundaries produced streamflow reductions of 101 cubic feet per second on the White River and 13 cubic feet per second on Fall Creek. (USGS)
W86-02958

HYDROLOGY OF AREA 45, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, MONTANA AND NORTH DAKOTA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02959

PRELIMINARY EVALUATION OF HYDROLOGY AND WATER QUALITY IN RELATION TO THE TACOMA LANDFILL, PIERCE COUNTY, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02961

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE HORSE CREEK AREA, SHERIDAN AND MOORHEAD COAL FIELDS, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02968

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, 1970,

Geological Survey, Garden City, KS. Water Resources Div.
M. E. Pabst, and L. E. Stullken.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 82-448, 1982. 1 p (map), 3 fig, 10 ref.

Descriptors: *Water table, *Potentiometric level, *Groundwater, Unconfined aquifers, Underflow, Underground storage, Water-bearing formations, *Kansas, High Plains.

The High Plains aquifer in Kansas is a part of a regional system that extends from South Dakota to Texas. The aquifer in Kansas underlies an area of 31,000 square miles in the western and south-central part. This aquifer is a hydraulically connected assemblage of unconsolidated water-bearing deposits of Tertiary and Quaternary age. Maps published at a scale of 1:500,000 show the altitude and configuration of the water table in Kansas during 1970. Ground water moved from higher altitudes in the western part of the High Plains to lower altitudes in the eastern part under an average gradient of 10 feet per mile. The upgradient flexure of water-table contours along some of the valleys indicates that ground water was discharged to the streams in those areas. (USGS)
W86-02970

CONCEPTUAL HYDROLOGIC MODEL OF FLOW IN THE UNSATURATED ZONE, YUCCA MOUNTAIN, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02974

CORRELATION OF PALEOSTRUCTURE AND SEDIMENT DEPOSITION IN THE MADISON LIMESTONE AND ASSOCIATED ROCKS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, WYOMING, AND NEBRASKA,

Geological Survey, Lakewood, CO. Water Resources Div.
D. L. Brown, R. K. Blankennagel, L. M. MacCary, and J. A. Peterson.
Available from Dist. Branch, USGS 604 S. Pickett St., Alexandria, VA 22034. USGS Professional Paper 1273-B, 1984. 24 p, 3 fig, 34 pl, 1 tab, 39 ref.

Descriptors: *Structural geology, Geological units, *Facies(Sedimentary), *Porosity, Sedimentary basins, *Carbonate rocks, Hydrogeology, Aquifers, Paleogeography, *Paleostructure, Marker beds, Thickness(Sedimentary rocks), *Northern Great Plains.

The present demand for energy has created interest in the Fort Union coal region of the Northern Great Plains. Extensive development of this coal will place an intense demand on the region's limited water resources. Water from Paleozoic rocks might supply a significant part of the required water. The area of greatest interest for evaluation of ground-water potential is in and near the Powder River basin and near the Black Hills. Paleostructural elements have affected the thickness, rock facies, and distribution of porosity in all of the Paleozoic and Mesozoic rocks studied. Major structural elements, such as the Transcontinental arch, Alberta shelf, and Canadian Shield have affected sediment deposition continuously for long intervals of geologic time, while smaller elements, like the Lake Basin fault and Weldon-Brockton fault trends have operated intermittently for long intervals of time. Some paleostructural elements were of limited duration and may appear one time in the geologic record. Knowledge of the relation between paleostructures an sediment thickness, porosity, and facies is useful for predicting the location and water-bearing potential of aquifers in the study area. (USGS)
W86-02977

SELECTED TEST-WELL DATA FROM THE MX-MISSILE SITING STUDY, TOOELE, JUAB, MILLARD, BEAVER, AND IRON COUNTIES, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02980

POTENTIOMETRIC SURFACE AND WATER QUALITY IN THE PRINCIPAL AQUIFER, MISSISSIPPIAN PLATEAUS REGION KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
R. O. Plebuch, R. J. Faust, and M. A. Townsend.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4102, 1985. 45 p, 14 fig, 5 tab, 41 ref.

Descriptors: *Groundwater movement, *Water quality, *Karst hydrology, Carbonate rocks, Water level, Groundwater recharge, Water levels, *Groundwater levels, *Kentucky.

The Mississippian Plateaus region is the outcrop area of rocks of Mississippian age which extends as a broad arcuate band around the Western Coal Field in westcentral Kentucky. Much of the area is characterized by plains of low relief containing numerous sinkholes, subsurface drainage, and a low density of surface streams. The principal aquifer consists of a thick sequence of limestones extending downward stratigraphically from the base of the Chesterian Series to the black shales at the top of the Devonian rocks. Well yields range from several gallons per minute to as much as 500 gallons per minute in some karst areas where secondary openings are well developed. The potentiometric map indicates that ground-water movement generally conforms to the surface drainage pattern. The actual direction of movement varies from river basin to river basin. Most water from the principal aquifer is a calcium magnesium bicarbonate type and is generally good relative to current drinking water standards. The lower St Louis Limestone, in places, yields a calcium magnesium sulfate water that is corrosive and has a strong hydrogen sulfide odor. The karst areas of the principal aquifer are vulnerable to contamination because of the well-developed subsurface drainage. Urban areas, industries, and agriculture are sources of contaminants that can be easily flushed into the ground-water system. (USGS)
W86-02983

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, SEPTEMBER 1984,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02985

GEOHYDROLOGY OF THE VALLEY AQUIFER IN THE COHOCTON AREA, UPPER COHOCTON RIVER, STEUBEN COUNTY, NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02987

SYNOPSIS OF SALTWATER INTRUSION IN DADE COUNTY, FLORIDA, THROUGH 1984,

Geological Survey. Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02988

HAZARDOUS WASTE RESEARCH, PENSACOLA, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02989

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02991

STREAMFLOW AND BASIN CHARACTERISTICS AT SELECTED SITES IN KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02993

QUANTITATIVE ANALYSIS OF THE HYDROTHERMAL SYSTEM IN LASSEN VOLCANIC NATIONAL PARK AND LASSEN KGRA,

Geological Survey, Menlo Park, CA. Water Resources Div.
M. L. Sorey, and S. E. Ingebritsen.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4278, 1984. 87 p, 17 fig, 4 tab, 21 ref.

Descriptors: *Geothermal studies, *Numerical nodeling, *Thermal springs, *Lassen Volcanic National Park, *California, Groundwater, Hydrothermal systems.

The conceptual model of the Lassen system is termed a liquid-dominated hydrothermal system with a parasitic vapor-dominated zone. The essential feature of this model is that steam and steam-heated discharge at relatively high elevations in Lassen Volcanic National Park (LVNP) and liquid discharge with high chloride concentrations at relatively low elevations outside LVNP are both fed

by an upflow of high-enthalpy two-phase fluid within the Park. Liquid flows laterally away from the upflow area towards the areas of high-chloride discharge, and steam rises through a vapor-dominated zone to feed the steam and steam-heated features. Numerical simulations show that several conditions are necessary for the development of this type of system, including (1) large-scale topographic relief, (2) an initial period of convective heating within an upflow zone followed by some change in hydrologic or geologic conditions that initiates drainage of liquid from portions of the upflow zone, and (3) low permeability barriers that inhibit the movement of cold water into the vapor zone. Simulations of thermal fluid withdrawal south of LVNP, carried out in order to determine the effects of such withdrawal on portions of the hydrothermal system within the Park, showed decreases in pressure and liquid saturation beneath the vapor zone which result in a temporary increase and subsequent decrease in the rate of upflow of steam. (USGS)
W86-02994

HYDROGEOLOGY OF THE CLAYTON AQUIFER OF SOUTHWEST GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.
J. S. Clarke, R. E. Faye, and R. Brooks.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Georgia State Hydrologic Atlas 13, 1984. 89 p, 30 fig, 5 tab, 37 ref.

Descriptors: *Georgia, *Hydrogeology, *Groundwater, Subsurface mapping, Aquifer characteristics, Potentiometric level, Water-level fluctuations, Chemical analyses, Water use, Well drilling, Groundwater divide, Clayton aquifer, Chattahoochee River, Flint River, Ocmulgee River, *Georgia.

The Clayton aquifer of southwest Georgia consists of limestone and calcareous sand of Paleocene age and ranges in thickness from about 10 to 265 feet. Estimated transmissivities range from 400 feet squared per day in Dougherty County to 11,000 feet squared per day in Randolph and Terrell Counties. During 1980, an estimated 20 million gallons per day was pumped from the Clayton aquifer. The greatest pumpage was in the Dawson and Albany areas where, by 1981, water levels in the Clayton aquifer had declined below predevelopment levels by as much as 150 and 175 feet, respectively. The rate of decline accelerated after 1976, corresponding to a significant increase in irrigation pumping throughout the study area. The aquifer is recharged by precipitation in the northeast-trending outcrop belt, by leakage from the underlying Providence aquifer and overlying Wilcox confining zone downdip, and through idle multiaquifer wells. Declining water levels in the Clayton aquifer have increased the potential for leakage from the overlying and underlying units. Constituent concentrations in water from the Clayton aquifer generally do not exceed drinking water standards. Exceptions are high concentrations of iron in Randolph County and possibly high dissolved constituent concentrations in the vincinity of the Gulf Trough. (USGS)
W86-02995

WATER-LEVEL HYDROGRAPHS FOR OBSERVATION WELLS IN VIRGINIA, 1982,

Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02996

DESCRIPTION AND SOME HYDROGEOLOGIC IMPLICATIONS OF CORES FROM THE RADIOACTIVE WASTE MANAGEMENT COMPLEX, IDAHO,

Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 5E.
W86-02999

GROUND-WATER DEVELOPMENT ALTERNATIVES IN THE CHIPUXET GROUND-WATER RESERVOIR, RHODE ISLAND,

Geological Survey, Providence, RI. Water Resources Div.
H. E. Johnston, and D. C. Dickerman.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4254, 1985. 100 p, 24 fig, 16 tab, 54 ref.

Descriptors: *Manganese, *Nitrates, *Hydrologic models, Groundwater, Low flow, Groundwater recharge, Induced recharge, Glacial aquifers, Groundwater budget, Transmissivity, Well yield, Water yield, *Groundwater quality, *Rhode Island.

A glacial sand and gravel aquifer in the Chipuxet River basin of Rhode Island forms a ground-water reservoir that could yield as much as 8.6 million gallons per day to wells; however, some streams would go dry for extended periods of time. The State Water Resources Board has tested five site that it proposes to develop for a public supply of 3 million gallons per day. A digital model was used to determine how withdrawal at this rate from alternative combinations of wells would affect water levels and streamflow. Results show that withdrawal of 3 million gallons per day would have a minimal effect on water levels, but that withdrawal at this rate from some well combinations could cause the Chipuxet River to have little or no flow for 90 consecutive days on the average of 1 year in 20. Quality of ground water is generally good, but leaching of fertilizers applied to croplands, which overlie much of the aquifer, has caused locally excessive concentrations of nitrate. Induced infiltration of surface water through organic sediments that line the bottoms of ponds and streams also seems to be the cause of elevated concentrations of manganese in water from some heavily pumped wells. (USGS)
W86-03001

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, ASH-FLOW TUFF, AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, IDAHO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03005

BOUGUER GRAVITY ANOMALY MAP OF THE TWENTYNINE PALMS MARINE CORPS BASE AND VICINITY, CALIFORNIA,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03006

EFFECT OF EUSTATIC SEA-LEVEL CHANGES ON SALTWATER-FRESHWATER RELATIONS IN THE NORTHERN ATLANTIC COASTAL PLAIN,

Geological Survey, Trenton, NJ. Water Resources Div.
H. Meisler, P. P. Leahy, and L. L. Knobel.
Available from Dist. Branch, USGS 604 S. Pickett St. Alexandria, VA 22304. USGS Water-Supply Paper 2255, 1984. 28 p, 17 fig, 2 tab, 44 ref.

Descriptors: Brines, Chlorides, Coastal Plains, Computer models, Continental Shelf, Continental Slope, *Geochemistry, Geohydrology, *Saline-Freshwater Interfaces, Saltwater, Sea Level, Seawater, Simulation, Transition Zone, *Saline Water Instrusion, *Atlantic Coastal Plain, Delaware River estuary, New Jersey, North Carolina, Pleistocene, Virginia.

A finite-difference computer model was used to analyze the effect of eustatic sea-level changes on the development of the transition zone between fresh ground water and underlying saltwater in the northern Atlantic Coastal Plain. The model simulates, in cross section, the sedimentary wedge from the Delaware River estuary in New Jersey to the Continental Slope. Simulated steady-state freshwater flow is separated from static saltwater by a sharp interface. The model was used to test the sensitivity of the simulated interface position to anisotropy as well as to sea-level elevation. Increasing anisotropy causes the interface to be shallower and extend farther offshore. Lowering sea level causes the interface to be deeper and to extend farther offshore. Simulations using hydraulic conductivities based on available data suggest that the transition zone is not in equilibrium with present sea level. The position of the transition zone probably reflects a long-term average sea level of between 50 and 100 ft below present sea level. The cyclic movement of salty ground water in response to sea-level fluctuations during the Quaternary and Late Tertiary caused the saltwater to mix with freshwater, thus producing a broad transition zone. The freshwater is predominantly sodium bicarbonate in character. The saltwater, from New Jersey to Virginia, probably is a sodium calcium chloride brine. In North Carolina, it is primarily seawater. (USGS)
W86-03010

HYDROGEOLOGIC DATA RELATED TO THE POTENTIAL FOR STOCK-WATER DEVELOPMENT ON FEDERALLY OWNED RANGELAND NEAR DILLON, MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03016

GEOHYDROLOGY OF ROCKS PENETRATED BY TEST WELL UE-25PNO1, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,

Geological Survey, Denver, CO. Water Resources Div.
R. W. Craig, and J. H. Robinson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4248, 1984. 57 p, 30 fig, 5 tab, 23 ref.

Descriptors: *Groundwater, *Aquifer testing, *Aquifer characteristics, Pumping tests, Hydrogeology, Dual porosity, Nevada Test Site, *Nevada, Nye County.

Test well UE-25pNo1 was drilled in cooperation with the U.S. Department of Energy in the southwestern part of the Nevada Test Site, for investigations related to the isolation of high-level nuclear wastes. Rocks penetrated in the well are predominantly ash-flow tuffs of Tertiary age to a depth of 1,244 meters and dolomite of Paleozoic age to a total depth of 1,805 meters. Hydraulic head is 20 meters higher in the Paleozoic dolomite than in most of the Tertiary tuffs; this hydraulic-head difference indicates a major hydrologic barrier to the downward movement of fluid. Any vertical fluid movement from the Tertiary to the Paleozoic sections would be small, as would be movement from the Paleozoic rocks into the Tertiary rocks. In the Tertiary section, an interval of less than 30 meters in the upper Prow Pass Member of Crater Flat Tuff has an apparent transmissivity of 14 meters squared per day. In the Paleozoic section, an interval of less than 22 meters has an apparent transmissivity of 69 meters squared per day. Compositions of water from the Tertiary and Paleozoic sections are similar to regional waters from rocks of the same ages. (USGS)
W86-03024

WATER-RESOURCES APPRAISAL OF THE UPPER ARKANSAS RIVER BASIN FROM LEADVILLE TO PUEBLO, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03025

COMPILATION OF GROUND WATER QUALITY DATA IN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03026

POTENTIOMETRIC SURFACES ON LONG ISLAND, NEW YORK--A BIBLIOGRAPHY OF MAPS,

Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03030

ANNUAL WATER-RESOURCES REVIEW, WHITE SANDS MISSILE RANGE, NEW MEXICO 1983,

Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03031

EFFECTS OF ARTIFICIAL RECHARGE ON AN ALLUVIAL AQUIFER, OGALLALA FORMATION, TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-03032

PRINCIPLE OF SUPERPOSITION AND ITS APPLICATION IN GROUND-WATER HYDRAULICS,

Geological Survey, Reston, VA. Water Resources Div.
T. E. Reilly, O. L. Franke, and G. D. Bennett.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-459, 1984. 36 p, 16 fig, 7 ref.

Descriptors: *Drawdown, *Groundwater, Hydaulics, Hydrogeology, *Groundwater hydraulics, Groundwater movement, *Superposition.

The principle of superposition, a powerful methematical technique for analyzing certain types of complex problems in many areas of science and technology, has important application in groundwater hydraulics and modeling of ground-water systems. The principle of superposition states that solutions to individual problems can be added together to obtain solutions to complex problems. This principle applies to linear systems governed by linear differential equations. This report introduces the principle of superposition as it applies to groundwater hydrology and provides background information, discussion, illustrative problems with solutions, and problems to be solved by the reader. (USGS)
W86-03040

HYDROGEOLOGIC FRAMEWORK FOR THE SAND AQUIFER OF THE SOUTHEASTERN UNITED STATES COASTAL PLAIN,

Geological Survey, Atlanta, GA. Water Resources Div.
R. A. Renken.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4243, 1984. 26 p, 11 fig, 8 pl, 3 tab, 116 ref.

Descriptors: *Coastal aquifers, *Sand aquifers, *Areal hydrogeology, Geohydrologic units, *Coastal plains, *Hydrogeologic framework, *Regional aquifer system, South Carolina, Georgia, Alabama, Mississippi.

Tertiary and Cretaceous age sand aquifers of the southeastern United States Coastal Plain constitute a distinct multistate hydrogeologic regime informally defined as the southeastern sand aquifer. Seven regional hydrogeologic units are defined; four regional aquifer units and three regional confining beds. Sand aquifers of this system consist of quartzose, feldspathic, and coarse to fine sand and sandstone and minor limestone; confining beds are composed of clay, shale, chalk, and marl. Three hydrogeologic units of Cretaceous to Holocene age overlie the sand system: the surficial aquifer, upper confining unit, and Floridan aquifer system. These three units are not part of the southeastern sand aquifer, but are an integral element of the total hydrogeologic system, and some act as a source of recharge to, or discharge from the underlying clastic sediments. Low-permeability strata of Paleozoic to early Mesozoic age form the base off the total system. (USGS)
W86-03041

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF PRAIRIE DU CHIEN-JORDAN, AQUIFER, SOUTHEAST MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
J. F. Ruhl, R. J. Wolf, and D. G. Adolphson.
Available from the OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4045, 1983. 2 p, 15 fig, 2 tab, 16 ref.

Descriptors: *Aquifer characteristics, Water quality, *Underground waste disposal, *Hydrogeology, *Groundwater quality, Path of pollutants, Water pollution sources, Hollandale embayment, Prairie du Chien-Jordan aquifer, *Minnesota.

The Prairie du Chien-Jordan aquifer is part of a sequence of sedimentary bedrock units in southeast Minnesota. The Jordan Sandstone is a white to yellow, fine- to coarse-grained sandstone. The Prairie du Chien Group comprises two dolomitic formations, which are vuggy and fractured and interbedded with thin layers of shale. The aquifer was deposited from Paleozoic seas that occupied the Hollandale embayment. The surface of the aquifer dips toward the interior of the embayment where it is as deep as 750 feet below land surface and as thick as 500 feet. Permeability is secondary in the Prairie du Chien Group because of solution cavities and fractures and is intergranular in the Jordan Sandstone. Water in the aquifer is confined and generally flows to the north and east into the Minnesota and Mississippi Rivers. A ground-water divide separates part of the flow southward into Iowa. This aquifer supplies more water than any other in the State. Quality of water is generally good throughout the aquifer. Calcium magnesium bicarbonate type water is most common. The potential for contamination from surface sources is low except near the Mississippi River valley, where the overlying drift is thin. The most serious water-quality problem is contamination by chemical wastes in St. Louis Park. (USGS)
W86-03042

RECORDS OF WELLS, DRILLERS' LOGS, WATER-LEVEL MEASUREMENTS, AND CHEMICAL ANALYSES OF GROUND WATER IN HARRIS AND GALVESTON, COS., TEXAS, 1975-79,

Geological Survey, Austin, TX. Water Resources Div.
K. W. Ratzlaff, C. W. Bonnet, and L. S. Coplin.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Texas Department of Water Resources, Austin, Report 285, 1984. 219 p, 2 fig, 8 tab, 3 ref.

Descriptors: *Texas, *Groundwater data, *Data collections, Groundwater, Drillers' logs, Water levels, Chemical analyses, Water quality, Water levels.

Information on major new water wells in Harris and Galveston Counties was compiled by the U.S. Geological Survey from 1975 to 1979. This report presents the results of the hydrologic data collection on new large-capacity and other selected wells, including well location and completion data, drillers' logs of the strata penetrated, water levels, and chemical quality of the produced water. These water-well data are supplementary to similar data on older wells in these counties and descriptive evaluations of the ground-water resources which have been published previously. (USGS)
W86-03045

GROUND-WATER LEVELS IN WYOMING, 1974 THROUGH 1983,

Geological Survey, Cheyenne, WY. Water Resources Div.
J. O. Ragsdale, and C. B. Oberender.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-403, 1985, 194 p, 163 fig, 20 tab, 8 ref.

Descriptors: *Hydrographs, *Groundweter, *Observation wells, Water-level recorders, *Groundwater data, Hydrologic data, Data collections, *Wyoming.

Ground-water levels are measured periodically in a network of about 270 observation wells in Wyoming, mostly in areas where ground water is used in large quantities for irrigation or municipal purposes. The program is conducted by the U.S. Geological Survey in cooperation with the Wyoming State engineer and the Wyoming Department of Economic Planning and Development. This report contains hydrographs for most observation wells showing water-level fluctuations from 1974 through 1983. Also included in the report are maps showing locations of observation wells and tabulations of well depths, use of water, geologic source, records available, and highest and lowest water levels for the period of record. (USGS)
W86-03046

PUBLICATIONS OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS,

Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 10C.
W86-03047

VALIDITY OF DARCY'S LAW UNDER TRANSIENT CONDITIONS,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03049

MEASUREMENT OF GROUND-WATER VELOCITY USING RHODAMINE WT DYE NEAR SHEFFIELD, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
G. Garklavs, and L. G. Toler.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-856, 1985. 14 p, 4 fig, 4 tab, 2 ref.

Descriptors: *Groundwater movement, *Waste disposal, *Tracers, *Radioactive waste disposal, *Path of pollutants, *Illinois, Groundwater flow, Environmental tracers.

Ground-water flow velocity was estimated in a tract of land adjacent to a low-level radioactive-waste disposal site near Sheffield, Illinois, by measuring the time-of-travel between two wells spaced 110 feet apart. Rhodamine WT dye was the principal tracer used in the test. The leading edge and peak concentrations of Rhodamine WT were well defined. A ground-water velocity of 6.9 feet per day (2,500 feet per year) was computed from the arrival time of the leading edge of the tracer cloud. (USGS)
W86-03051

DATA COLLECTION FOR A TIME-OF-TRAVEL AND DISPERSION STUDY ON THE COOSA RIVER NEAR CHILDERSBURG, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
R. A. Gardner.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-411, 1985. 61 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Dye dispersion, *Flow rates, Surface water, *Streamflow, *Coosa River, Childersburg, *Alabama, *Time-of-Travel.

Approximately 2,300 dye-tracer samples were collected and analyzed during a 5-day time-of-travel study on a 23-mile reach of the Coosa River between Logan Martin and Lay dams near Childers-

burg, Alabama, October 27 to 31, 1984. Rhodamine WT was used as the tracer-dye. Unsteady flow conditions prevailed in the study reach. The rate of movement of the dye cloud between sampling cross sections ranged from 0.15 to 1.36 feet per second. The average rate of movement of the dye cloud between the injection cross section and the downstream sampling cross section was 0.42 foot per second. (USGS)
W86-03052

DEFINITION OF BOUNDARY AND INITIAL CONDITIONS IN THE ANALYSIS OF SATURATED GROUND-WATER FLOW SYSTEMS–AN INTRODUCTION,

Geological Survey, Reston, VA. Water Resources Div.
O. L. Franke, T. E. Reilly, and G. D. Bennett.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-458, 1984. 26 p, 11 fig, 1 tab, 11 ref.

Descriptors: Groundwater, Hydraulics, *Boundary conditions, Mathematical analysis, *Aquifer systems, *Groundwater movement, *Model studies, *Initial conditions.

Accurate definition of boundary and initial conditions is an essential part of conceptualizing and modeling ground-water flow systems. This report explains the properties of the seven most common boundary conditions encountered in ground-water systems and discusses major aspects of their application. It also discusses the significance and specification of initial conditions and evaluates some common errors in applying this concept to ground-water system models. (USGS)
W86-03053

WATER-RESOURCES MONITORING IN THE COTTONWOOD CREEK AREA, SHASTA AND TEHAMA COUNTIES, CALIFORNIA, 1982-83,

Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman, and K. P. Evenson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4187, 1985. 70 p, 9 fig, 6 tab, 12 ref.

Descriptors: *Groundwater, Water quality, *Groundwater levels, Surface water, Dams, *Surface-groundwater relationships, Tehama County, Shasta County, Cottonwood Creek, *California, *Monitoring.

The Cottonwood Creek study area in the Redding basin, California, contains a network of wells established to provide baseline information on ground-water levels and quality prior to the completion of two proposed dams, one on Cottonwood Creek and one on South Fork Cottonwood Creek. Analysis of monthly ground-water levels from September 1982 through September 1983 shows lowest water levels in autumn and highest in spring. The ground-water surface slopes east and has a mound at Anderson-Cottonwood Irrigation District Canal near the town of Cottonwood. Future studies here could provide additional information needed for subsequent modeling studies. Data are insufficient upstream from the damsites, specifically in areas of future impoundment where the monitoring network could be expanded. Comparison of ground-water quality samples collected from periods of lowest and highest water levels showed little chemical variation. Ground water is good to excellent with respect to recommended drinking-water standards. Ground-water types north of Cottonwood Creek are sodium magnesium or magnesium sodium bicarbonate and south of Cottonwood Creek are calcium magnesium or magnesium calcium bicarbonate. Surface-water samples from Cottonwood and South Fork Cottonwood Creeks indicate water chemically similar to ground water south of Cottonwood Creek. (USGS)
W86-03054

IMPACTS OF THE TAMPA BYPASS CANAL SYSTEM ON THE AREAL HYDROLOGY, HILLSBOROUGH COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-03056

PROPOSED ARTIFICIAL RECHARGE STUDIES IN NORTHERN QATAR,

Geological Survey, Orlando, FL. Water Resources Div.
J. O. Kimrey.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-343, 1985. 31 p, 6 fig, 6 ref.

Descriptors: *Hydrogeology, *Groundwater recharge, *Geologic formations, *Injection, Desalination, *Aquifer testing, Water utilization, *Water management(Applied), *Qatar, Rus Formation, Umm er Radhuma Formation, Doha, Artificial recharge.

The aquifer system in northern Qatar comprises a water-table aquifer in the Rus Formation which is separated by an aquitard from a partially confined aquifer in the top of the overlying Umm er Radhuma Formation. These two aquifers are composed of limestone and dolomite of Eocene and Paleocene age and contain a fragile lens of freshwater which is heavily exploited as a source of water for agricultural irrigation. Net withdrawals are greatly in excess of total recharge, and quality of ground water is declining. Use of desalinated seawater for artificial recharge has been proposed for the area. Artificial recharge, on a large scale, could stabilize the decline in ground-water quality while allowing increased withdrawals for irrigation. The proposal appears technically feasible. Recharge should be by injection to the Umm er Radhuma aquifer whose average transmissivity is about 2,000 meters squared per day (as compared to an average of about 200 meters squared per day for the Rus aquifer). Implementation of artificial recharge should be preceded by a hydrogeologic appraisal. These studies should include test drilling, conventional aquifer tests, and recharge-recovery tests at four sites in northern Qatar. (USGS)
W86-03058

TEST WELLS IN CENTRAL WASHINGTON, 1977-79: DESCRIPTION AND RESULTS,

Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, and D. R. Cline.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4259, 1985. 77 p, 16 fig, 7 tab, 16 ref.

Descriptors: *Aquifer characteristics, Basalts, Observation wells, Water table, Deep wells, Aquifers, Chemical quality, *Aquifer testing, *Columbia River Basalt Group, *Washington.

During the period October 1977-March 1979, four wells were added to a network of wells in central Washington State to provide information on potential sources of ground-water supplies from aquifers in the Columbia River Basalt Group and supplemental ground-water data for water-management purposes where they cannot be obtained by other means. Two were drilled in the Yakima River canyon between Ellensburg and Yakima–one to 602 feet in the Burbank Creek valley and the other to 1,019 feet near the mouth of Umtanum Creek. A third well was drilled to 725 feet in the Badger Pocket area of the Ellensburg-Kittitas valley. A test well near George, Washington, was deepened from 975 to 1,610 feet and three piezometers were installed in this interval. The Burbank Creek, Umtanum Creek, and George test wells are completed in basalts and associated interflow zones of the Yakima Basalt Subgroup of the Columbia River Basalt Group. The Badger Pocket well penetrated more than 725 feet of unconsolidated materials without reaching the basalt. Specific capacities of the Umtanum Creek and George wells after 20 hours of pumping were 190 and 160 to 190 gallons per minute per foot of drawdown, respectively. Specific capacity of the Burbank Creek well after flowing for 24 hours was 32.5 gallons per minute per foot of drawdown. The Badger Pocket well was not tested for water yield. (USGS)
W86-03062

SUMMARY OF WATER-RESOURCES ACTIVITIES OF THE UNITED STATES DEPARTMENT OF INTERIOR, GEOLOGICAL SURVEY-FISCAL YEAR 1984, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03067

SELECTED HYDROGEOLOGIC DATA FOR THE BIG MUDDY CREEK VALLEY NEAR PLENTYWOOD, NORTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-03068

PLANNING REPORT FOR THE WESTERN GULF COAST REGIONAL AQUIFER SYSTEM ANALYSIS, GULF OF MEXICO COASTAL PLAIN, UNITED STATES,

Geological Survey, Austin, TX. Water Resources Div.
H. F. Grubb.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4219, 1984. 30 p, 4 tab, 53 ref.

Descriptors: *Project planning, *Scheduling, *Aquifer systems, *Coastal aquifers, *Computer models, Geohydrologic units, Water quality, Regional aquifer-system, *Gulf Coastal Plain, Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, Texas.

Large quantities of water for municipal, industrial and agriculture use are supplied from the aquifers in Tertiary and younger sediments over an area of about 225,000 square miles in the coastal plain of Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, and Texas. Three regional aquifer systems, the Mississippi Embayment aquifer system, the Coastal Lowlands aquifer system, and the Texas Coastal Uplands aquifer system have been developed to varying degrees throughout the area. A variety of problems have resulted from development such as movement of the saline-freshwater interface into parts of aquifers that were previously fresh, lowering of the potentiometric surface with resulting increases in pumping lift, and land-surface subsidence due to the compaction of clays within the aquifer. Increased demand for ground water is anticipated to meet the needs of urban growth, expanded energy development, and growth of irrigated agriculture. The objectives, plan and organization of study of these problems are described in this report and the major tasks to be undertaken are outlined. (USGS)
W86-03069

GROUND-WATER RESOURCES OF BOTTINEAU AND ROLETTE COUNTIES, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
P. G. Randich, and R. L. Kuzniar.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. North Dakota State Water Commission County Ground-Water Studies 35, North Dakota Geological Survey Bulletin 78, 1984. 41 p, 14 fig, 5 tab, 52 ref.

Descriptors: *Groundwater, *Aquifers, Transmissivity, Recharge, Water use, *Chemical properties, Potential yield, Storage, Bottineau County, Rolette County, *North Dakota.

Large quantities of water can be obtained from glacial-drift aquifers in Bottineau and Rolette Counties. These aquifers underlie about 317 square miles and contain approximately 762,000 acre-feet of available ground water. Potential well yields range from less than 50 to 1,000 gallons per minute.

The water generally is a mixed type. The dominant cations are calcium and sodium and the dominant anions are bicarbonate and sulfate. The Hell Creek and Fox Hills aquifers, which consist of very fine to medium-grained sanstone beds are the major bedrock aquifers. Wells developed in these aquifers generally yield less than 50 gallons per minute. The water is a sodium chloride or sodium sulfate type and generally contains more dissolved solids than water from glacial-drift aquifers. The population of Bottineau and Rolette Counties depends on ground water as a source of water supply. (USGS)
W86-03075

GROUND-WATER RESOURCES OF THE MATTAPOISETT RIVER VALLEY, PLYMOUTH COUNTY, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03079

GROUND-WATER QUALITY APPRAISAL OF SURFICIAL SAND-PLAIN AQUIFERS IN HUBBARD, MORRISON, OTTER TAIL, AND WADENA COUNTIES, MINNESOTA,

Geological Survey, Grand Rapids, MN. Water Resources Div.
C. F. Myette.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4080, 1984. 49 p, 22 fig, 9 tab, 27 ref.

Descriptors: *Groundwater appraisal, *Water quality, Sand aquifers, Statistical analysis, Solute transport, Hubbard County, Morrison County, Otter Tail County, Wadena County, Staples, *Minnesota, Pollutant identification.

Water samples were collected periodically from 124 wells completed in sand-plain aquifers in Hubbard, Morrison, Otter Tail, and Wadena Counties, Minnesota, during a 3-year study that began in October 1979. The study determined baseline groundwater quality, provided data for evaluation of trends, and investigated seasonal variations in concentration of selected chemical constituents. The ground water is predominately a calcium bicarbonate type with low to moderate concentrations of dissolved solids (77 to 710 milligrams per liter), and is chemically suitable for most uses. In local areas, concentrations of nitrogen, iron, and manganese exceed limits recommended by the Minnesota Pollution Control Agency for drinking water. Comparison to historical data indicates a trend towards local degradation of ground-water quality, which is attributed to the accumulation of nitrogen within and immediately downgradient from several major agricultural areas. Seasonal and annual variations in concentrations of some chemical constituents are related to ground-water-level fluctuations caused by recharge. At the Staples Irrigation Center near Staples, Minnesota, concentrations of nigrogen, chloride, and iron differ significantly with depth, which suggests local chemical stratification within the aquifer at least several hundred feet downgradient from the Center. The stratification exists throughout annual cycles, and is most pronounced during periods of little recharge (winter months). (USGS)
W86-03080

APPARENT WATER RESISTIVITY, POROSITY, AND WATER TEMPERATURE OF THE MADISON LIMESTONE AND UNDERLYING ROCKS IN PARTS OF MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,

Geological Survey, Lakewood, CO. Water Resources Div.
L. M. MacCary.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1273-D, 1984. 14 p, 25 fig, 1 tab, 13 ref.

Descriptors: Energy, Fuels, *Water quality, *Porosity, Geothermal studies, Groundwater utilization, Permeability, *Saline water - freshwater interfaces, Montana, Nebraska, North Dakota, Wyoming, *Apparent water resistivity, Porosity logs, Resistivity logs, *Thermal gradient, *Northern Great Plains.

The need for large quantities of energy has created interest in the Fort Union coal region of the Northern Great Plains. Extensive development of this coal will place an intense demand on the region's limited water resources. Water from Paleozoic rocks might supply, at least temporarily, a significant part of the required water. The quality of water in the Paleozoic rocks was estimated by an apparent water resistivity (Rwa) calculation using resistivity and porosity curves recorded on geophysical logs. Rwa is used to determine the areal distribution of fresh and salty water and the probable direction of water movement. The largest Rwa occurs in the recharge areas and the smallest occurs in the areas of dense brine in the Williston basin. The brine areas are not in the deepest part of the basn, but are shifted to the east and south owing to the hydrodynamic effects of less salty water moving around the brine. The coolest ground-water temperatures occur in the recharge areas and the hottest temperatures are in the deep basins. Thermal gradients, determined from well temperatures, indicate how the rocks function as either insulators or conductors of heat. (USGS)
W86-03081

GEOHYDROLOGIC SECTIONS, NORTHERN LOUISIANA,

Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03083

HYDROGEOLOGIC APPRAISAL OF FIVE SELECTED AQUIFERS IN ERIE COUNTY, NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
T. S. Miller, and W. W. Staubitz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4334, 1985. 89 p, 26 fig, 10 tab, 22 ref.

Descriptors: *Glacial aquifers, *Water quality, *Groundwater movement, Well data, *New York, Erie County, Onondaga Limestone, Landfills, Carbonate aquifer.

Hydrogeologic conditions and water quality at four stratified-drift aquifers and a bedrock (Onondaga Limestone) aquifer were investigated by the U.S. Geological Survey in cooperation with the Erie County Department of Environment and Planning. The Clarence-Lancaster-Newstead area includes two aquifers--one is a complex of morainal, beach, and outwash sand and gravel; the second is the underlying production aquifer in Onondage Limestone. Most wells tap the limestone aquifer. Water quality is suitable for most uses in both aquifers except for road-salt contamination at shallow wells near the New York State Thruway. A landfill on the aquifer has affected the water quality in some areas along its perimeter. The Sardinia and Springville areas each include an aquifer consisting of surficial outwash sand and gravel ranging in thickness from less than 10 feet to 95 feet. Several deeper water-bearing zones occur within till and lacustrine deposits 400 to 600 feet thick in the valleys. Ground water moves from the north and from the aquifer's edges to the center of the valley and discharges into the main streams in the middle of the valley and to springs along the southern edge of the aquifers. Water quality is generally suitable for most uses. A landfill adjacent to the Sardinia aquifer has not significantly affected the aquifer. The Alden area includes an aquifer that consists of two sand and gravel zones separated by 10 to 20 feet of clay or till. The more productive lower zone has mineralized water derived from underlying shale. (USGS)
W86-03084

ALTITUDE OF WATER TABLE, SURFICIAL AQUIFER, PALM BEACH COUNTY, FLORIDA, APRIL 24-26, 1984,

Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03085

GRAVITY SURVEY AND DEPTH TO BEDROCK IN CARSON VALLEY, NEVADA-CALIFORNIA,

Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 8E.
W86-03087

GEOHYDROLOGY OF THE AQUIFER IN THE SANTA FE GROUP, NORTHERN WEST MESA OF THE MESILLA BASIN NEAR LAS CRUCES, NEW MEXICO,

Geological Survey, Las Cruces, NM. Water Resources Div.
R. G. Myers, and B. R. Orr.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4190, 1985. 37 p, 13 fig, 6 tab, 20 ref.

Descriptors: *Groundwater, *Alluvial aquifers, *Groundwater movement, Water quality, Drilling, Well logs, *New Mexico, Dona Ana County, Las Cruces, Mesilla Basin, West Mesa.

Because of the heterogeneity of the Santa Fe Group, New Mexico, the hydrologic characteristics of the aquifer vary substantially from place to place. Hydraulic conductivities of 12 and 30 feet per day were estimated from aquifer tests for two wells in the eastern one-half of the study area. Well yields in the western one-half of the study area generally are less than 5 gallons per minute. Some of the well yields in the eastern one-half of the study area are greater than 1,000 gallons per minute. Ground water flows southeastward across the western one-half of the study area at a gradient of about 50 feet per mile. Across the eastern one-half of the study area, ground water flows southeastward at a gradient of less than 5 feet per mile. Dissolved-solids concentrations in groundwater range from 906 to 1,470 milligrams per liter in the western one-half of the study area and from 378 to 556 milligrams per liter in the eastern one-half. (USGS)
W86-03088

TEST WELLS T27 AND T28 WHITE SANDS MISSILE RANGE, DONA ANA COUNTY, NEW MEXICO,

Geological Survey, Las Cruces, NM. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-03089

TEST WELLS T23, T29, AND T30, WHITE SANDS MISSILE RANGE AND FORT BLISS MILITARY RESERVATION, DONA ANA COUNTY, NM,

Geological Survey, Las Cruces, NM. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-03090

HYDROLOGIC DATA FOR LEVIATHAN MINE AND VICINITY, ALPINE COUNTY, CALIFORNIA, 1981-83,

Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03091

DISTRIBUTION OF POLYCHLORINATED BIPHENYLS IN THE HOUSATONIC RIVER AND ADJACENT AQUIFER, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03093

GROUNDWATER LEVELS IN NEBRASKA, 1983,

Geological Survey, Lawrence, KS. Water Resources Div.
M. S. Johnson, and D. T. Pederson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. The University of Nebraska-Lincoln, Conservation and Survey Division, Nebraska Water Survey Paper Number 57, 1984. 67 p, 22 fig, 12 tab, 30 ref.

Descriptors: Groundwater, *Hydrographs, Water table, *Observation wells, *Water-level fluctuations.

Summaries are presented of ground-water level changes in Nebraska for the year 1983, both statewide and for major areas where there were significant changes from estimated predevelopment water levels. The amounts of change from predevelopment levels are shown on maps, and hydrographs are used to show trends in water-level changes. Also described are availability of data on water levels, changes in the water-level measurement program during the year, and the two major causes of water-level change--recharge from precipitation and withdrawal of ground water. (USGS)
W86-03094

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1985,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03095

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1984,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03096

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER SYSTEM IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1984,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03097

TEST WELL DO-CE 88 AT CAMBRIDGE, DORCHESTER COUNTY, MARYLAND,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-03098

PROPOSED 10-YEAR PLAN FOR CONTINUATION OF HYDROLOGIC STUDIES OF THE EDWARDS AQUIFER, SAN ANTONIO AREA, TEXAS,

Geological Survey, Austin, TX. Water Resources Div.
L. F. Land.
Avilable from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-817, 1984. 26 p, 8 fig, 1 tab, 20 ref.

Descriptors: Hydrology, Recharge, Withdrawal, Water level, Water quality, *Hydrogeology, Geohydrology, Aquifers, *Texas, *Groundwater levels, Water balance, *Edwards aquifer.

The importance of the Edwards aquifer as a freshwater resource and its susceptibility to being contaminated, being over utilized, or both resulted in the development of a proposed 10-year plan to monitor and study its hydrology. The plan proposes adjustments to the current monitoring activities of computing and measuring recharge, discharge, withdrawals, water levels, and water quality. To conduct the needed special studies, the plan recognizes the need for the construction and drilling of many new wells at specific locations and to selected depths. Many of the wells will be in clusters so that data can be obtained on a stratigraphic basis. Some of the topics identified for special study include: (1) The potential of saline water entering the freshwater zone from the downdip boundary; (2) the possibility of water leaking into the aquifer from an overlying aquifer; (3) the effects of urbanization on ground-water quality in local areas; (4) the movement and dissipation of a recharge water plume; (5) the influx of water from the Glen Rose Formation; (6) the effects of the fault barriers, regional dense bed, and irregular geologic framework on ground-water flow patterns; (7) natural recharge-discharge relationships; (8) the aquifer stage-storage relationship; (9) natural water-quality evolution; and (10) a refinement of the hydrogeologic framework in a local area. (USGS)
W86-03104

GENERALIZED POTENTIOMETRIC SURFACE OF THE EVANGELINE AND EQUIVALENT AQUIFERS IN LOUISIANA, 1980,

Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03107

DEVELOPMENT OF A TWO-DIMENSIONAL DIGITAL MODEL FOR THE ANALYSIS OF THE GROUND-WATER FLOW SYSTEM IN THE SAN ANTONIO CREEK VALLEY, SANTA BARBARA COUNTY, CALIFORNIA,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
P. Martin.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4340, 1985. 68 p, 17 fig, 9 tab, 14 ref.

Descriptors: *Mathematical model, *Finite difference method, Groundwater basins, Groundwater budget, Least-squares method, San Antonio Creek valley, *California, Santa Barbara County, Barka Slough.

A two-dimensional finite-difference model was used to simulate ground-water flow conditions in San Antonio Creek valley. The model was calibrated to simulate steady-state conditions as approximated by ground-water conditions in 1943 and transient conditions during the period 1944-77. The transmissivity of the aquifer and the vertical hydraulic conductivity of the confining bed underlying Barka Slough at the western edge of the basin were calibrated during the steady-stage simulation. Calibrated transmissivity values ranged from more than 20,000 feet squared per day along the axis of the valley to less than 100 feet squared per day along the perimeter. Net flux values (the difference between recharge and net discharge) along the San Antonio Creek channel were determined during the transient-state simulation by a least-squares calibration technique. Results of the calibration indicated that the net flux out of the system along the stream channel increased by about 4,030 acre-feet per year from 1943 to 1977. The model simulated that about 70 percent of the increase in net flux was derived from the reduction in ground-water discharge to Barka Slough and about 30 percent from water coming out of storage. (USGS)
W86-03108

HYDROGEOLOGIC DATA FROM THE U.S. GEOLOGICAL SURVEY TEST WELLS NEAR WAYCROSS, WARE COUNTY, GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.
S. E. Matthews, and R. E. Krause.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4204, 1984. 29 p, 10 fig, 7 tab, 25 ref.

Descriptors: *Groundwater, *Carbonate aquifer, Hydrogeology, Water quality, Groundwater geology, *Tertiary limestone aquifer, *Georgia.

Two wells were constructed near Waycross, Ware County, Georgia, from July 1980 to May 1981 to collect stratigraphic, structural, geophysical, hydrologic, hydraulic, and geochemical information for the U.S. Geological Survey Tertiary Limestone Regional Aquifer-System Analysis. Data collection included geologic sampling and coring, borehole geophysical logging, packer testing, water-level measuring, water-quality sampling, and aquifer testing. In the study area, the Tertiary limestone aquifer system is about 1,300 feet thick and is confined and overlain by about 610 feet of clastic sediments. The aquifer system consists of limestone, dolomite, and minor evaporites and has high porosity and permeability. A 4-day continuous discharge aquifer test was conducted, from which a transmissivity of about 1 million feet squared per day and a storage coefficient of 0.0001 were calculated. Water from the upper part of the aquifer is of a calcium bicarbonate type. The deeper highly mineralized zone produces a sodium bicarbonate type water in which concentrations of magnesium, sulfate, chloride, sodium, and some trace metals increase with depth. (USGS)
W86-03113

EFFECTS OF HYDRAULIC BOREHOLE MINING ON GROUND WATER AT A TEST SITE IN NORTHEAST ST. JOHNS COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-03116

GLACIAL AQUIFERS SYSTEMS IN THE NORTHEASTERN UNITED STATES--A STUDY PLAN,

Geological Survey, Albany, NY. Water Resources Div.
F. P. Lyford, J. E. Dysart, A. D. Randall, and A. L. Kontis.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-928, 1984. 33 p, 6 ref, 4 tab, 57 ref.

Descriptors: *Alluvial aquifers, *Aquifer characteristics, Aquifer systems, *Glacial aquifers, Glacial drift, Regional analysis, *Northeast US, Regional aquifer-system analysis, Northeast US Glacial Aquifers.

The U.S. Geological Survey project designed to study the availability and quality of water in glacial aquifers in the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and Ohio is scheduled for completion in 1986. It will focus on general principles that define aquifer geometry, hydraulic properties of sediments, recharge, discharge, physical-chemical properties of water, rock and water-rock interactions, and mechanisms for mixing of water from multiple sources. Planned project activities include compilation and analysis of available data for a regionwide analysis of glacial-aquifer systems, studies of selected system components such as recharge and chemical processes, classification of aquifers with regard to water-supply potential, and construction of generalized ground-water models to predict responses of types of aquifer systems to pumping and climatic stress. This report describes the general characteristics of glacial aquifer systems in the Northeastern United States and of planned work elements of the study. (USGS)
W86-03117

IMPACT OF DEVELOPMENT ON AVAILABILITY AND QUALITY OF GROUND WATER IN EASTERN NASSAU COUNTY, FLORIDA, AND SOUTHEASTERN CAMDEN COUNTY, GEORGIA,

Geological Survey, Tallahassee, FL. Water Resources Div.
D. P. Brown.

Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4190, 1984. 113 p, 24 fig, 19 tab, 96 ref.

Descriptors: *Aquifer characteristics, *Artesian wells, *Carbonate rocks, *Confined aquifers, Unconfined aquifers, Connate water, Groundwater movement, *Potentiometric level, Saline-freshwater interfaces, Saline-water intrusion, Floridan aquifer, Surficial aquifer, *Florida, *Georgia, Fernandina Beach.

The primary sources of water in the area are from the surficial and Floridan aquifers. The surficial aquifer, consisting of thin permeable zones of sand, shell, and limestone, provides limited water supplies (10-50 gallons per minute). Its estimated transmissivity ranges from less than 100 to 10,000 feet squared per day. Its water is generally of acceptable quality for most uses, except near the coast. The Floridan aquifer consists of three zones of permeable limestone and dolomite separated by semiconfining beds of hard, massive dolomite and limestone, all of which are confined by leaky confining beds. The upper and middle zones, about 530-1,000 feet and 1,200-1,700 feet below land surface, respectively, have transmissivities ranging from 20,000-50,000 and 40,000-60,000 feet squared per day, respectively. The lower zone, about 2,000-2,100 feet below land surface contains very saline water. Water in the upper zone contains chloride concentrations generally ranging from 20-40 milligrams per liter. In Fernandina Beach, water from a few wells tapping this zone has relatively high chloride concentrations (190 milligrams per liter), probably due to upward migration of saline water from deeper zones through uncased or improperly-plugged well bores and not by lateral intrusion. (USGS)
W86-03119

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03120

GEOHYDROLOGY OF TEST WELL USW-H1, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,

Geological Survey, Denver, CO. Water Resources Div.
F. E Rush, W. Thordarson, and D. G. Pyles.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4032, 1984. 56 p, 21 fig, 15 tab, 25 ref.

Descriptors: *Aquifer tests, *Hydraulic conductivity, *Transmissivity, *Geophysical logging, *Chemical analysis, *Nevada, Crater Flat Tuff, Yucca Mountain, Nevada Test Site, Nye County.

Well USW-H1 is one of several wells drilled in cooperation with the U.S. Department of Energy near the southwestern part of the Nevada Test Site for hydraulic testing, hydrologic monitoring, and geophysical logging. The rocks penetrated by the well to a total depth of 1,829 meters were volcanic tuffs of Tertiary age. The most transmissive zone in this well is in the Prow Pass Member of the Crater Flat Tuff that was penetrated at a depth from 572 to 653 meters; transmissivity is about 150 meters squared per day. The remainder of the rocks penetrated between depths of 653 to 1,829 meters have a transmissivity of about 1 meter squared per day, and are predominantly in the Bullfrog Member of the Crater Flat Tuff in the depths from 736 to 741 meters. The water is a sodium bicarbonate type that is typical of tuffaceous rocks in this area. The water has an apparent age of 12,000 to 13,000 years. (USGS)
W86-03121

POTENTIAL GROUND-WATER LEVEL CHANGES IN THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN RESPONSE TO PROPOSED NAVIGATION IMPROVEMENTS ON THE YAZOO RIVER IN MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
A. G. Lamonds, and J. M. Kernodle.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4039, 1984. 65 p, 39 fig, 1 tab, 21 ref.

Descriptors: *Environmental effects, *Inland waterways, *Groundwater, Aquifers, Hydrographs, *Mississippi, *Yazoo navigation study, Yazoo River, Mississippi River alluvial aquifer, Aquifers.

A proposed navigation project on the Yazoo River between Vicksburg and Greenwood, Mississippi, will increase minimum river stages by more than 19 feet at the site of the proposed lock and dam near Vicksburg, and will decrease minimum river stages by 2 to 7 feet in much of the upper reach of the river. Water-level data for 65 observation wells in the alluvial aquifer in the vicinity of the proposed project indicate that post-project minimum ground-water levels in wells very near the river will range from more than 19 feet higher than pre-project minimum levels near Vicksburg to about 7 feet lower than pre-project levels at Greenwood. Post-project ground-water levels will generally be between 15 and 25 feet below land surface during the dry season but will be at or near land surface during the wet season. The change in ground-water levels will decrease with distance from the river but may extend as far as the Bluff Hills to the east and the auxiliary channel or other major drainage features to the west. In the upper reach of the river the decrease in ground-water levels may extend beyond the auxiliary channel to the areas of large ground-water withdrawals several miles to the west of the river. (USGS)
W86-03122

HYDROLOGY OF THE OGALLALA AQUIFER IN FORD COUNTY, SOUTHWESTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
J. M. Spinazola, and M. T. Dealy.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4226, 1983. 58 p, 14 fig, 5 tab, 33 ref.

Descriptors: *Groundwater depletion, *Irrigation requirements, Estimating, *Water quality, *Aquifer management, Ford County, Arkansas River, Crooked Creek-Fowler fault, *Ogallala aquifer, *Kansas, *Withdrawal, Groundwater.

The rapid increase of ground-water withdrawal has caused concern over the future use of the Ogallala aquifer, the principal source of water in Ford County, in southwestern Kansas. Saturated portions of deposits of Tertiary and Quaternary age--excluding the Arkansas River alluvium--form the Ogallala aquifer. Saturated thickness of the Ogallala ranged from 0 to about 350 feet on the downthrown side of the Crooked Creek-Fowler fault and from 0 to about 120 feet on the upthrown side. Ground-water withdrawal was calculated by two methods. The time-discharge method computed withdrawal of about 81,000 acre-feet during 1980 and about 58,000 acre-feet during 1981. The irrigation-requirement method computed withdrawal of about 121,000 acre-feet during 1980 and about 131,000 acre-feet during 1981. Results from the irrigation-requirement method are probably closer to the actual amount of ground-water withdrawal because of problems encountered when applying the time-discharge method. Water-level declines between 1939 and 1981 ranged from about 10 to 50 feet. Water withdrawal from the Ogallala aquifer depleted the volume of water in storage by about 688,000 acre-feet (8 percent) during this same period. If withdrawals continue to the point where the water table drops below the top of the bedrock surface on the upthrown side of the Crooked Creek-Fowler fault, base flow in the Arkansas River could cease. (USGS)
W86-03128

GROUND-WATER-LEVEL TRENDS IN IDAHO, 1971-82,

Geological Survey, Boise, ID. Water Resources Div.
H. W. Young, and R. F. Norvitch.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4245, 1984. 28 p, 7 fig, 1 tab, 7 ref.

Descriptors: Wells, *Water-level fluctuations, Groundwater, Groundwater irrigation, Surface-water irrigation, Recharge, Water levels, *Well hydrographs, Water-resources development, *Groundwater depletion, *Idaho, *Groundwater-level trends.

Water-level trends, net water-level changes, and major causes governing these water-level fluctuations are presented for 366 wells in the Idaho statewide observation-well network. Water-level trends were determined for 293 wells. Downward trends in 176 of these wells ranged from less than 1 foot per year to a maximum of 7 feet per year; upward trends in 90 wells ranged from less than 1 foot per year to a maximum of 6 feet per year. Trends were level (no change) in 27 wells. Net water-level changes were determined for 361 wells. Net declines in 269 of these wells ranged from less than 1 foot to a maximum of 52.65 feet; net rises in 92 wells ranged from less than 1 foot to a maximum of 25.12 feet. Significant net water-level declines and downward trends were most apparent in or near areas designated as critical ground-water areas by the Idaho Department of Water Resources. (USGS)
W86-03129

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1984,

Geological Survey, Denver, CO. Water Resources Div.
G. L. Barr, and G. R. Schiner.
USGS Open-File Report 84-620, 1984. 1 map, 2 fig, 2 ref.

Descriptors: *Potentiometric level, *Potentiometric flow, Hydrology, *Hydrogeology, *Maps, *Florida, Southwest Florida Water Management District.

A May 1984 potentiometric surface map of the Southwest Florida Water Management District depicts the annual low water-level period. Water levels in most wells measured in May 1984 were lower than in September 1983. May levels averaged about 1 foot lower than September levels in areas north of latitude 28 07'10" and about 9 feet lower in southern areas. Generally, water levels in May 1984 were lower when compared to May 1983. Water levels in most wells measured in May 1984 averaged less than 1 foot lower than May 1983 levels in the north and about 2 feet lower in the south. (USGS)
W86-03130

GENERALIZED THICKNESS AND CONFIGURATION OF THE TOP OF THE INTERMEDIATE AQUIFER, WEST-CENTRAL FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
M. A. Corral, and R. M. Wolansky.
USGS Water-Resources Investigation Report 84-4018, 1984. 1 p, 3 fig, 14 ref.

Descriptors: Hydrology, *Geologic mapping, *Aquifers, Aquifer characteristics, Water quality, *Maps, *Florida, Southwest Florida Water Management District, Intermediate aquifer, Confining beds.

Generalized map show the thickness and top of the intermediate aquifer in west-central Florida within the boundaries of the Southwest Florida Water Management District. The intermediate aquifer consists of a series of water-bearing units and confining beds between the surficial aquifer (water table) and the Floridan aquifer. This aquifer contains from one to several water-bearing units in west-central Florida. The aquifer and confining

beds consist of the Tamiami and Hawthorn Formations of late and middle Miocene age and parts of the Tampa Limestone of early Miocene age. The top of the intermediate aquifer is about 100 feet above sea level in the north and slopes to about 100 feet below sea level in the south. The thickness ranges from zero in the north to more than 600 feet in the south. Despite the high mineral content of the water in some areas, the intermediate aquifer offers the best source of ground water to the coastal and southern areas of west-central Florida. (USGS)
W86-03137

GROUND-WATER DATA FOR GEORGIA, 1983,
Geological Survey, Doraville, GA. Water Resources Div.
J. S. Clarke, M. F. Peck, S. A. Longsworth, and K. W. McFadden.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-605, 1984. 145 p, 70 fig, 47 tab, 36 ref.

Descriptors: *Groundwater, *Water levels, *Aquifers, *Georgia, *Water quality, *Groundwater levels, Groundwater quality.

Continuous water-level records from 134 wells and more than 700 water-level measurements made in Georgia during 1983 provide the basic data for this report. Selected wells illustrate the effects that changes in recharge and pumping have had on the various ground-water resources in the State. Daily mean water levels are shown in hydrographs for 1983. Monthly means are shown for the 10-year period 1974-83. Mean annual water levels ranged from 9 feet higher to 6 feet lower in 1983 than in 1982. Water-quality samples are collected periodically throughout Georgia and analyzed as part of areal and regional ground-water studies. Along the coast, chloride concentrations in the upper and lower water-bearing zones of the Floridan aquifer system generally remained steady in the Brunswick and Hilton Head Island areas. (USGS)
W86-03139

EVALUATION OF THE EFFECTS OF LAKE AUDUBON ON GROUND- AND SURFACE-WATER LEVELS IN THE LAKE NETTIE AREA, EASTERN MCLEAN COUNTY, NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
C. A. Armstrong.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4242, 1983. 41 p, 19 fig, 7 ref.

Descriptors: *Surface-groundwater relationships, *Groundwater, *Aquifers, Water level, *Hydrographs, *Water-level fluctuations, McLean County, *North Dakota.

Flooding of some roads and agricultural lands has occurred in the Lake Nettie area of eastern McLean County. Part of the flooding was caused by the raising of the level of Lake Audubon to an elevation of 1,848 feet and the construction and filling of the McClusky Canal. Water levels have risen in the Lake Nettie aquifer as a result of raising the level of Lake Audubon. As of 1982, water levels have risen as much as 4 feet in the lower unit of the Lake Nettie aquifer and between 1 and 2 feet in the upper unit of the Lake Nettie aquifer, which is hydraulically connected to Lake Nettie and Crooked Lake. Water levels have risen in the Turtle Lake aquifer both as a result of raising the water level in Lake Audubon and the filling of McClusky Canal. Water levels have risen as much as 6 feet near the canal, but generally are less than 1 foot higher at distances of about 0.5 mile. (USGS)
W86-03140

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN NORTH DAKOTA,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03144

WATER RESOURCES DATA, ALASKA WATER YEAR 1981.
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03146

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03147

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 3. DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03148

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03149

WATER RESOURCES DATA, LOUISIANA WATER YEAR 1983, VOLUME 1. CENTRAL AND NORTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03150

WATER RESOURCES DATA, LOUISIANA WATER YEAR 1983, VOLUME 2, SOUTHERN LOUSIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03151

WATER RESOURCES DATA, NEW MEXICO WATER YEAR 1983,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03152

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1982, VOLUME 1. DELAWARE RIVER BASIN,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03153

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 1. DELAWARE RIVER BASIN,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03154

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 2, SUSQUEHANNA AND POTOMAC RIVER BASINS,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03155

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASINS,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03156

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 2. LONG ISLAND,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03157

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 3. WESTERN NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03158

WATER RESOURCES DATA, HAWAII AND OTHER PACIFIC AREAS WATER YEAR 1983. VOLUME 1, HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03159

WATER RESOURCES DATA, HAWAII AND OTHER PACIFIC AREAS WATER YEAR 1983. VOLUME 2,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03160

WATER RESOURCES DATA, KENTUCKY WATER YEAR 1983.
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03161

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY FOR THE RICHFIELD 1 DEG. BY 2 DEG. QUADRANGLE AND ADJACENT PART OF SOUTHWESTERN UTAH,
For primary bibliographic entry see Field 7C.
W86-03165

DATA FROM PUMPING AND INJECTION TESTS AND CHEMICAL SAMPLING IN THE GEOTHERMAL AQUIFER AT KLAMATH FALLS, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
S. M. Benson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-146, 1984. 101 p, 76 fig, 7 tab, 17 ref.

Descriptors: Geohydrology, *Geochemistry, *Temperature, Geothermal resources, Hydrology, Aquifers, Water quality, Pumping, *Injection tests, *Oregon, Klamath Falls, Klamath County.

A seven-week pumping and injection tests in the geothermal aquifer at Klamath Falls, Oregon, in 1983 provided new information on hydraulic properties of the aquifer. The Open-File Data Report on the tests includes graphs of water levels measured in 50 wells, temperature measurement in 17 wells, daily air-temperatures in relation to discharge of thermal water from more than 70 pumped and artesian wells, tables of monthly mean air temperatures and estimates of discharges of thermal water during a normal year, and tables of chemical and isotopic analyses on samples from 12 wells. The water-level measurements reflect the effects of pumping, injection, and recovery over about 1.7 square miles of the hot-well area of Klamath Falls. The pumped well, City Well No 1, and the injection well at the Klamath County Museum are components of a proposed District

Heating Plan. The study was funded principally under contracts from the U.S. Department of Energy to the Lawrence Berkeley Laboratory, Stanford University, and the Oregon Institute of Technology, with coordination and chemical sampling provided under the Geothermal Research Program, U.S. Geological Survey. Support was received from the City of Klamath Falls, Klamath County Chamber of Commerce, Citizens for Responsible Geothermal Development, and many citizen volunteers. (USGS)
W86-03169

GEOHYDROLOGY OF THE NORTHERN PART OF THE TOWN OF BROOKHAVEN, SUFFOLK COUNTY, NEW YORK,

Geological Survey, Syosset, NY. Water Resources Div.
E. J. Koszalka.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4042, 1984. 37 p, 19 fig, 7 tab, 21 ref.

Descriptors: *Geology, Hydrology, *Groundwater, *Aquifers, *Hydraulic properties, Long Island, NY, Town of Brookhaven, Upper glacial aquifer, Magothy aquifer, Lloyd aquifer.

In general, ground water in the area is of suitable quality for drinking and most other uses. Some constituents, however, particularly iron, chloride, and nitrogen, occur locally in unacceptable concentrations. Average hydraulic conductivity ranges from 100 to 300 feet per day (ft/d) in the upper glacial aquifer and from 50 to 70 ft/d in the Magothy aquifer. Transmissivity ranges from 25,000 to 105,000 feet squared per day (ft2/d) in the upper glacial aquifer and from 13,000 to 41,000 ft2/d in the Magothy aquifer. Only sparse data are available for the Lloyd aquifer; average hydraulic conductivity and transmissivity are estimated to be 40 ft/d and 10,000 ft2d, respectively. Precipitation (44.4 inches per year) is the only source of ground water in central and eastern Long Island. In the area studied, about 21.5 inches per year reaches the ground-water reservoir. The remainder is lost to over-land runoff (0.5 inch) and evapotranspiration (22.4 inches). Total public-water-supply pumpage in the area is estimated to be 23.2 million gallons per day. Of this total, 15.8 million gallons per day is withdrawn from the upper glacial aquifer and 7.4 million gallons per day from the Magothy aquifer; the Lloyd aquifer is not used for water supply in the area. (USGS)
W86-03173

INDEX OF HYDROLOGIC DATA FOR SELECTED SITES IN DADE COUNTY, FLORIDA, 1923-80,

Geological Survey, Tallahassee, FL. Water Resources Div.
R. S. Sonenshein, C. R. Causaras, and J. E. Fish.
USGS Open-File Report 84-430, 1984. 3p (maps), 10 fig, 5 tab, 18 ref.

Descriptors: Hydrology, Geology, *Water quality, *Florida, *Dade County, Surficial aquifers, *Biscayne aquifer.

A comprehensive assessment of the surficial aquifers of southeast Florida, including the Biscayne aquifer, was begun in 1979 by the U.S. Geological Survey, in cooperation with the South Florida Water Management District. In the initial phase of the study, an inventory was made of existing data available in the files of the U.S. Geological Survey and other public agencies of Dade, Broward, and Palm Beach Counties. This report indexes, through tables and maps, the ground-water quality, ground-water level, surface-water stage, and geologic data bases for Dade County. (USGS)
W86-03175

DESCRIPTIVE, GEOLOGIC, AND BOREHOLE GEOPHYSICAL LOGS FOR 23 TEST HOLES IN SOUTH-CENTRAL NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
R. A. Hiergesell.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-073, 1984. 143p, 3 fig, 17 ref.

Descriptors: *Hydrogeology, *Borehole geophysical logs, Data collection, *Nebraska.

This report presents logs for 23 test holes drilled in eight counties in south-central Nebraska as part of a study of the hydrogeology of the area. Five logs are presented for each of the test holes. The first is a written description summarizing the sediments penetrated during drilling; the second is a geological log providing a diagrammatic representation of the stratigraphic units; the remaining three show spontaneous potential, single-point resistance, and natural-gamma radiation measured in the test holes. The test holes penetrate silts, sands, and gravels of Quaternary age, and siltstones, sandstones, and silts of the Ogallala Formation of Tertiary age. Each test hole was drilled deep enough to penetrate about 20 feet of the underlying Cretaceous-age bedrock. (USGS)
W86-03176

OVERVIEW OF GROUND-WATER QUALITY DATA IN WISCONSIN,

Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-03177

WATER RESOURCES DATA, SOUTH DAKOTA WATER YEAR 1983,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03179

WATER RESOURCES DATA, TENNESSEE WATER YEAR 1983,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03180

WATER RESOURCES DATA, IDAHO WATER YEAR 1983,

Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03181

WATER RESOURCES DATA, IOWA WATER YEAR 1983,

Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03182

WATER RESOURCES DATA, KANSAS WATER YEAR 1983,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03183

WATER RESOURCES DATA, GEORGIA WATER YEAR 1983,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03184

WATER RESOURCES DATA, NEW JERSEY WATER YEAR 1983, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03185

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 1: EASTERN NEW YORK EXCLUDING LONG ISLAND,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03186

WATER RESOURCES DATA, ARKANSAS WATER YEAR 1983,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03187

WATER RESOURCES DATA, OREGON, WATER YEAR 1983, VOLUME 2: WESTERN OREGON,

Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03188

WATER RESOURCES DATA, INDIANA WATER YEAR 1983,

Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03189

WATER RESOURCES DATA, NEW HAMPSHIRE AND VERMONT WATER YEAR 1983,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03190

WATER RESOURCES DATA, SOUTH CAROLINA WATER YEAR 1983,

Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03191

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 4. NORTHERN CALIFORNIA VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03192

WATER RESOURCES DATA, CALIFORNIA, WATER YEAR 1982, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03193

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03194

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 1. SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.

W86-03195

WATER RESOURCES DATA, ILLINOIS WATER YEAR 1983, VOLUME 2: ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03196

WATER RESOURCES DATA, ILLINOIS WATER YEAR 1983, VOLUME 1: ILLINOIS EXCEPT ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03197

WATER RESOURCES DATA, NORTH DAKOTA WATER YEAR 1983,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03198

WATER RESOURCES DATA, NEVADA WATER YEAR 1983,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03199

WATER RESOURCES DATA, OREGON WATER YEAR 1983, VOLUME 1: EASTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03200

WATER RESOURCES DATA, UTAH WATER YEAR 1983,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03201

WATER RESOURCES DATA, FLORIDA WATER YEAR 1981, VOLUME 4, NORTHWEST FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03202

WATER RESOURCES DATA, MAINE WATER YEAR 1982,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03205

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03206

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 1A: NORTHEAST FLORIDA SURFACE WATER,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03207

WATER RESOURCES DATA, MISSOURI WATER YEAR 1983,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03209

WATER RESOURCES DATA, WYOMING WATER YEAR 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03210

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03211

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 1B: NORTHEAST FLORIDA GROUND WATER,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03212

WATER RESOURCES DATA, VIRGINIA WATER YEAR 1983,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03213

WATER RESOURCES DATA, MAINE WATER YEAR 1983,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03214

WATER RESOURCES DATA, WISCONSIN WATER YEAR 1983,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03215

WATER RESOURCES DATA, WEST VIRGINIA WATER YEAR 1983,
Geological Survey, Charleston, WV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03216

WATER RESOURCES DATA, NEBRASKA WATER YEAR 1982,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03218

WATER RESOURCES DATA, MICHIGAN WATER YEAR 1983,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03219

WATER RESOURCES DATA, ALABAMA WATER YEAR 1983,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03220

WATER RESOURCES DATA, MINNESOTA WATER YEAR 1982, VOLUME 1. GREAT LAKES AND SOURIS-RED-RAINY RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03221

WATER RESOURCES DATA, MINNESOTA WATER YEAR 1982, VOLUME 2: UPPER MISSISSIPPI AND MISSOURI RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03222

WATER RESOURCES DATA, OHIO WATER YEAR 1983, VOLUME 1. OHIO RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03223

WATER RESOURCES DATA, OHIO WATER YEAR 1983, VOLUME 2, ST. LAWRENCE RIVER BASIN STATEWIDE PROJECT DATA,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03224

WATER RESOURCES DATA, NEBRASKA WATER YEAR 1983,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03225

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1983,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03226

WATER RESOURCES DATA, ARIZONA WATER YEAR 1982,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03227

WATER RESOURCES DATA, MONTANA WATER YEAR 1983, VOLUME 1: HUDSON BAY AND MISSOURI RIVER BASINS,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03228

WATER RESOURCES DATA, MONTANA WATER YEAR 1983, VOLUME 2, COLUMBIA RIVER BASIN,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03229

SIMULATION OF GROUNDWATER FLOW AND CONTAMINANT TRANSPORT USING THE DETERMINISTIC-PROBABILISTIC CONTAMINANT TRANSPORT (DPCT) MODEL,
CGS, Inc., Urbana, IL.
For primary bibliographic entry see Field 5B.
W86-03288

UNDERGROUND RESIDENCE TIMES AND CHEMICAL QUALITY OF BASAL GROUNDWATER IN PEARL HARBOR AND HONOLULU AQUIFERS, O'AHU, HAWAII,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
T. H. Hufen, P. Eyre, and W. McConachie.
Technical Report No 129, February 1980, 75 p, 28 fig, 5 tab, 1 app, 24 ref.

Descriptors: *Groundwater movement, *Saline water intrusion, *Water quality, *Aquifers, *Hydrology, *Pearl Harbor, Honolulu, *Hawaii, Infiltration, Rainfall infiltrtion, Nitrates, Chlorides, Silica, Geohydrology.

Groundwater movement and origin in southern Oahu, Hawaii, were studied by analyzing water samples for carbon-14, carbon-13, tritium, major ions, nitrate, silica, and pH. Striking differences exist among the six basal groundwater systems: Pearl Harbor, Moanalua, Kalihi, Beretania, Moiliili, and Waialae. In Moiliili, Beretania, and Kalihi water residence times are several hundred years, with no measurable water younger than 20 years. This groundwater is derived from rain infiltration in high elevations far inland. Moanalua groundwater varies in isotopic and chemical composition. Some residence times are >950 years, and several regions have water with high chloride levels. Young water is located close to the caprock boundary. Waialae water has residence times <200 years. Little rainfall infitrates from the high elevations. At Pearl Harbor mean residence time is shorter than in the other five regions. Young water, probably from overland infiltration of rain or return irrigation water, is found in the discharge of many sources in the western part of the system.
W86-03290

EVALUATION OF WATER RESOURCES FOR ENHANCED OIL RECOVERY OPERATIONS, CEMENT FIELD, CADDO AND GRADY COUNTIES, OKLAHOMA,
Oklahoma Geological Survey, Norman.
D. A. Preston, W. E. Harrison, K. V. Luza, L. Prater, and R. J. Reddy.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-007713, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy, Washington, DC. DOE/BC/10115-1. February 1982. 64 p, 7 fig, 9 tab, 1 app, 70 ref. DE-AC19-79BC10115.

Descriptors: *Water supply, *Surface water, *Groundwater, Subsurface water, Dissolved solids, *Water quantity, Water quality, *Oklahoma, Oilfield water supply.

The intent of this report is to present a semi-quantitative estimate of the volume deliverability and chemistry of the water potentially available for enhanced oil recovery in the Cement Oil Field. The total storage capacity of impounded water in the reservoirs, lakes, and ponds that lie within the area of study is 362,000 acre-feet. 93.5 percent of this capacity is contained in four reservoirs: Fort Cobb, Ellsworth, Lawtonka and Sprint Creek. The total dissolved solids in the waters impounded in the four reservoirs range from 245 mg/L to 1,948 mg/L. The principal recharging agent for the impounded water is runoff which averages 3.8 in./yr. Groundwater aquifiers included in this report are only those that yield 25 gallons per minute (gpm) or more. The four major aquifiers are the Rush Springs Sandstone, the EL Reno Group, the Arbuckle-Timbered Hills (Cambrian-Ordovician), and the Quaternary deposits. The aquifiers yield from 60 to 150 gpm from the Quaternary to an average of 500 gpm from parts of the Rush Springs. Eliminating water containing above 5,000 mg/L total dissolved solids, the volume of water producible from all aquifiers is estimated at 131 billion barrels. The amount of sub-surface water in place from the formations penetrated by wells drilled within the Cement Field is 41-1/3 billion barrels; 16 1/2 billion from the Permian reservoirs, 25 billion from the pre-Permian reservoirs. Estimates of the water volumes accessible in the four reservoirs are: Rowe sand, 3.3 billion barrels; Niles sand, 2.7 billion barrels; Wade sand, 1.5 billion barrels; Marchand sand, 2.4 billion barrels. A nomograph from which initial open-flow potentials can be estimated after a set of producing parameters is given.
W86-03316

2G. Water In Soils

HYDROLOGIC CHARACTERISTICS OF NEBRASKA SOILS,
Geological Survey, Lincoln, NE. Water Resources Div.
J. T. Dugan.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2222, 1984. 19 p, 4 fig, 12 pl, 13 ref.

Descriptors: *Soil properties, *Soil water movement, Hydrology, *Permeability, Slopes, Water table, Soil classification, Soil genesis, Soil profiles, *Soil physical properties, Soil types, *Hydrologic maps, Soil texture, Available water, Soil surveys, Maps, *Nebraska, *Hydrologic soil groups, Available water capacity, Least permeable horizon, Maximum soil slopes.

Soil characteristics that most affect hydrology in Nebraska are identified and soils of the State are grouped according to those characteristics through use of a 3-digit coding system. The location and extent of the resulting hydrologic soil groups in the State are shown on maps at scales of 1:750,000 and 1:250,000. The interpretation of maps and physical data led to the selection of three chaacteristics as classification variables in grouping the soils: average permeability of the 60-inch soil profile; average maximum soil slope; and depth to the seasonal high water table. Permeability of the least-permeable horizon and available water capacity are given for each soil but are not used as classification variables. U.S. Department of Agriculture Soil Conservation Service general soils maps and data on the physical properties of the soils were well suited to hydrologic interpretation. The basis soil units used in grouping and interpreting the soils were soil associations. Through computer assistance, the 147 soil associations in Nebraska were grouped into 29 hydrologic soil groups and statistics are presented for each group. (USGS)
W86-03028

2H. Lakes

WATER-QUALITY RECONNAISSANCE AND STATISTICAL ANALYSIS FOR SELECTED WATER-SUPPLY LAKES IN EASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02927

SURVEY OF FENA RESERVOIR, ISLAND OF GUAM: LIMNOLOGICAL RECONNAISSANCE,
Geological Survey, Lakewood, CO. Water Resources Div.
J. W. LaBaugh.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4241, 1985. 17 p, 11 fig, 13 ref.

Descriptors: *Limnology, *Reservoirs, Phosphorus, Nitrogen, Organic carbon, Cations, Anions, Sediment chemistry, Sediments, *Guam, *Fena Reservoir.

During the limnological reconnaissance of Fena Reservoir, samples of the water columns and bottom sediment were obtained and analyzed at five locations within the reservoir. Major ion analyses of filtered surface water indicated that calcium and bicarbonate are the dominant cation and anion in the reservoir. Thermal stratification was recorded at all five locations. Temperature data indicated a distinct hypolimnion at three of the sampling locations below a depth of 8 meters. Vertical profiles of pH exhibited changes with depth as did conductivity. Marked clinograde distributions of dissolved osygen were evident at all but the shallowest locations. Inverse clinograde distributions of total phosphorus, dissolved nitrate plus nitrite and dissolved ammonia were observed at the two deepest stations. Total organic carbon had no distinct profile and had an average concentration of 13.8 milligrams per liter. Data are also provided for nutrient analysis of the sediment. (USGS)
W86-03018

MAY 1984-APRIL 1985 WATER BUDGET OF REELFOOT LAKE WITH ESTIMATES OF SEDIMENT INFLOW AND CONCENTRATIONS OF PESTICIDES IN BOTTOM MATERIAL IN TRIBUTARY STREAMS–BASIC DATA REPORT,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03100

CHLOROPHYLL A CONCENTRATION AND DISTRIBUTION IN TWIN LAKES, COLORADO, PRIOR TO OPERATION OF MT. ELBERT PUMPED-STORAGE POWERPLANT, 1977-81,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. G. Campbell, and J. F. LeBounty.
REC-ERC-85-6, January 1985. 42 p, 11 fig, 6 tab, 26 ref, 2 append.

Descriptors: *Oligotrophic lakes, *Chlorophyll, *Primary productivity, *Limnology, *Seasonal variation, *Baseline studies, Pumped storage, Powerplants, Oligotrophy, Phytoplankton, Water quality, Lakes, Mountain lakes.

Studies were performed to identify changes in the limnology of Twin Lakes resulting from the operation of the Mt. Elbert Pumped-Storage Powerplants. This report presents preoperation chlorophyll concentrations in the lakes from 1977-1981. Twin Lakes are oligotrophic, dimictic, and cool, high-mountain lakes that are thermally stratified between spring and fall turnover periods. They are ice-covered in winter and poor in P and N nutrients. The mean average chlorophyll a concentration in Twin Lakes was 3.2 mg/cu m. The minimum observed chlorophyll a concentration was < 0.1 mg/cu m, while the maximum was 52.1 mg/cu m. Twin Lakes tend to be more productive after fall turnover and continue to be productive into winter if snow cover is light. Midwinter peaks in chlorophyll concentration occurred in the upper lake in 1977, 1978, and 1981, and in the lower lake in 1981. Summer peaks in chlorophyll a concentration have occurred in both lakes, but have never been observed simultaneously. The upper lake experienced summer peaks in chlorophyll concentration in 1977 and 1981; the lower lake in 1979. Summer chlorophyll distribution peaks occur at or near the thermocline; in winter they are closer to the surface. The minimum chlorophyll concentrations in both lakes occurs just before spring and fall turnover. Chlorophyll a biomass and other primary-productivity parameters are more variable in the upper lake because it acts as a receiving basin for the western slope and Lake Creek. (Geiger-PTT)
W86-03234

LIMNOLOGICAL APPLICATIONS OF MULTISPECTRAL REMOTE SENSING,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 7B.
W86-03277

ESTIMATING PHYTOPLANKTON BIOMASS AND PRODUCTIVITY,
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
J. J. Janik, W. D. Taylor, and V. W. Lambou.
Miscellaneous Paper E-81-2, U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. June 1981, Final Report. 23 p, 1 tab, 38 ref. Interagency Agreement No WES-78-12.

Descriptors: *Biomass, *Algae, *Phytoplankton, *Chlorophyll, *Photosynthesis, *Trophic level, *Comparison studies, *Aquatic productivity, Carbon dioxide, Oxygen, Nitrogen, Reservoirs, Lakes.

Methods for estimating phytoplankton biomass and productivity are compared to aid reservoir managers in answering questions about the status of primary producers. Estimations of numerical abundance is limited as a microscopic method for meas-

uring biomass due to variations in cell size of different organisms and species. Measurements of standing crop by cell volume is widely accepted in quantitative surveys. Cell surface area computations are of value when estimating the assimilative area for nutrients. Plasma (cytoplasm) volume measurements are difficult to make in phytoplankton surveys. Dry weight estimates of biomass are fast but subject to sample preparation errors; most of these errors are avoided in ash-free dry weight estimates of biomass. Chlorophyll a analysis is the most popular method for estimating standing crop. C, N and P analysis are also used for obtaining approximate estimations of standing crop. Oxygen measurements provide estimates of net and gross primary productivity as well as respiration. The use of CO2 measurements for estimating primary productivity must be accompanied by adjustments for pH. There is uncertainty as to whether the radiocarbon method measures net or gross photosynthesis or a rate between the two. Chlorophyll measurements may also be used to calculate productivity, but they are not as widely used as the other methods. Algae-related conversion formulas used to calculate particular biological and chemical components from available data are listed along with limitations and qualifications for each conversion.
W86-03303

THEODORE ROOSEVELT LAKE: 1981 SEDIMENTATION SURVEY,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2J.
W86-03331

STUDIES OF THE LIMNOLOGY, FISH POPULATIONS, AND FISHERY OF TURQUOISE LAKE, COLORADO: 1979-80,

Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Available from Engineering and Research Center, Denver, CO. Report No REC-ERC-82-5, Bureau of Reclamation, Engineering and Research Center, Denver, CO., July 1981. 31 p, 5 fig, 17 tab, 5 app, 21 ref.

Descriptors: *Limnology, *Fish populations, *Lake fisheries. *Fish management, Fisheries, Reservoir fisheries, Reservoirs, Lake morphology, Ecosystems, Algae, Chlorophyll, Trout, Pumped storage, Phytoplankton, Salmon, Turquoise Lake, Colorado, Fish.

Turquoise Lake is one of the primary storage reservoirs in the Fryingpan-Arkansas Water Project and provides supplementary water by conduit to the Mt. Elbert Forebay-Twin Lakes system for pump-back storage power generation. The reservoir may be characterized as a dimictic, coldwater lake that is well oxygenated, relatively unbuffered, and slightly acidic. The lake may be classified as oligotrophic on the basis of total dissolved solids, algal nutrients (N-P), and chlorophyll concentrations. Depletion of dissolved oxygen occurs regularly in the hypolimnion during late summer and late winter. Turquoise Lake is limnologically similar to Twin Lakes (Colo.) in most respects, but Twin Lakes may be affected by the colder temperatures of the water imports from Turquoise Lake and from the introduction of Tabellaria and Daphnia. The Turquoise Lake fishery is based on the stocked, creel-sized rainbow trout (Salmo gairdneri Richardson), which made up 95% of the 1980 summer harvest. Catch rates have remained in the 0.59-0.70 fish/hour range between 1972-73 and 1980 despite similar levels of rainbow trout stocking and a 45 percent increase in fishermen effort to 62,000 man-hours (84 hours/hectare). Marked rainbow trout returned in the harvest at only a 28% return rate during one summer season but continued to contribute to the fishery in the following year. Fall stocking of rainbow trout and a good winter survival of these fish contributed significantly to high catch rates in the following spring and summer. Lake trout (Salvelinus namaycush Walbaum) have been unable to establish a self-sustaining population in the reservoir and recruitment past a 356 mm length or 5 years is negligible. The lake trout population must be maintained by periodic stocking. Turquoise Lake demonstrates potential as a kokanee salmon (Oncorhynchus nerka Sockley) fishery and spawn source.
W86-03339

DYNAMICS OF LOTIC SYSTEMS,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5C.
W86-03375

RESOURCE SPIRALING: AN OPERATIONAL PARADIGM FOR ANALYZING LOTIC ECOSYSTEMS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-03376

SERIAL DISCONTINUITY CONCEPT OF LOTIC ECOSYSTEMS,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
For primary bibliographic entry see Field 5C.
W86-03377

CONCEPTUAL FRAMEWORK FOR PROCESS STUDIES IN LOTIC ECOSYSTEMS,

Oregon State Univ., Corvallis. Dept. of Botany and Plant Physiology.
For primary bibliographic entry see Field 5C.
W86-03378

PREDICTABILITY OF STREAM ECOSYSTEM MODELS OF VARIOUS LEVELS OF RESOLUTION,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
J. H. Wlosinski, and G. W. Minshall.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 69-86 p, 5 fig, 7 tab, 13 ref.

Descriptors: *Aquatic environment, *Model studies, Stream biota, Aquatic communities, Invertebrates, Nutrients, Fish, Dissolved solids, Detritus, Organic matter, Organic carbon, Functional groups.

One of the major decisions that must be made when developing ecosystem models concerns the level of resolution at which the ecosystem is to be simulated. The studies reported here were conducted to show the relationship between model resolution and predictability for the Aquatic Model developed by the Desert Biome, United States International Biological Program (US/IBP). To meet the objective of this study, data collected in a small desert stream (Deep Creek, Idaho-Utah) were used to create four data sets, each at a different level of resolution. Each data set included four plant groups, two detrital categories, decomposers, nutrients, fish, and macroinvertebrates. The invertebrates were sampled in a manner that allowed simulation of the ecosystem at four levels of resolution. Validation of the model consisted of comparing model predictions to the 95% confidence intervals of over 1000 measured values. Totals calculated for a number of state variables representing invertebrates at higher levels of resolution were compared with values predicted by models of lower resolution. Of 235 comparisons common to all four levels of resolution, 127, 142, 154, and 142 predicted values were within the 95% confidence intervals of empirical data for the finest through coarsest levels of resolution, respectively. Therefore, it was concluded that modeling the invertebrates at the functional level gave the best predictions of the Deep Creek ecosystem by the Desert Biome Aquatic Model. (Author)
W86-03379

EFFECT OF SIMULATED CANOPY COVER ON REGULATION OF NITRATE UPTAKE AND PRIMARY PRODUCTION BY NATURAL PERIPHYTON ASSEMBLAGES,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5B.
W86-03382

ENERGY BASIS OF ECOSYSTEM CONTROL AT SILVER SPRINGS, FLORIDA,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
R. L. Knight.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 161-179, 6 fig, 5 tab, 23 ref.

Descriptors: *Aquatic environment, *Lotic environment, *Energy regulation, *Metabolism, Stream biota, Microcosm studies, Primary productivity, Silver Springs, Florida, Cycling nutrients, Snails, Mosquito fish, Community metabolism, Ecosystems.

It has been suggested by some investigators that consumer populations (herbivores, primary carnivores, etc.) regulate system energy flow by such mechanisms as nutrient regeneration or cropping producers to optimal growth levels. A need exists, however, to examine such effects by experimentally regulating consumers over realistic density ranges. This paper presents an hypothesis predicting consumer effect on system functioning, along with evidence of consumer control of system metabolism at Silver Springs, Florida. The hypothesis predicts feedback of controlling action equal to energy invested in consumer components of ecosystems. This hypotheses was tested with field measurements of system productivity, after major alterations in fish populations were noted, and in replicable flow-through microcosms located in the river channel. Overall system metabolism of Silver Springs was found to be unchanged; this possibly indicates adaptation to loss of dominant consumers by replacement with functionally similar fish species. Optimal primary productivity in microcosms corresponded with snail densities ranging from 22 to 44 g/sq m, compared to 42 g/sq m in the natural river ecosystem. For mosquito fish, optimal primary productivity in microcosms corresponded to 3.2 g/sq m and 4 g/sq m in the river. (Author)
W86-03383

INFLUENCE OF HYDROLOGIC VARIATIONS ON PHOSPHORUS CYCLING AND RETENTION IN A SWAMP STREAM ECOSYSTEM,

North Carolina Univ. at Chapel Hill.
L. A. Yarbro.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 223-245, 5 fig, 3 tab, 49 ref. N-084-NC and B-110-NC.

Descriptors: *Aquatic environment, *Lotic environment, *Wetlands, Phosphorus, Cycling nutrients, Streams, Creeping swamp, North Carolina, Flood plains, Runoff, Hydrologic regime.

The fluxes and retention of filterable reactive phosphorous (FRP), filterable unreactive phosphorus (FUP), and particulate phosphorus (PP) in a floodplain swamp in eastern North Carolina varied in response to the seasonality of inundation and yearly variations in runoff from the upstream watershed. During the cool season flooded period, the floodplain forest floor had a high adsorption capacity for runoff-derived FRP that was both temperature and water FRP concentration dependent. The FUP, on the other hand, was released from the forest floor in approximate proportion to the volume of floodwaters. During the warm season, when decomposition rates were faster and standing water concentrations of phosphorus were relatively high, little or no runoff occurred; thus there was no significant loss of phosphorus from the ecosystem. Overall, 30 to 56% of total phosphorus inputs were retained by the swamp ecosystem during the 2 years of study. (Author)
W86-03386

NITRATE-NITROGEN MASS BALANCES FOR TWO ONTARIO RIVERS,

York Univ., Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W86-03396

2I. Water In Plants

VEGETATION AND CLIMATES OF THE LAST 45,000 YEARS IN THE VICINITY OF THE NEVADA TEST SITE, SOUTH-CENTRAL NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
W. G. Spaulding.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-535, 1983. 199 p, 25 fig, 25 tab, 115 ref.

Descriptors: . *Great Basin Desert, Middens, *Mojave, *Nevada, Test site, Packrats, *Paleoclimates, Paleoclimatology, Quaternary, *Vegetation, History, Semi-arid lands.

Paleoclimatic reconstructions for the Nevada Test Site, spanning the last 45,000 years, are based on plant macrofossil assemblages from radiocarbonated packrat (Neotoma spp) middens from south-central Nevada. The temperature regime during the Wisconsin glacial age, from before about 45,000 years ago until about 12,000 years ago, was characterized by lower temperatures during all seasons. Wisconsin maximum (about 18,000 years before present) winter temperatures were at least 6 deg. Celsius below those of the present, and the relative decrease in summer temperature was as much as 8 deg. Celsius. The data provide evidence for a precipitation regime drier than that proposed by many studies. The maximum estimated increase in average annual precipitation during the full-glacial period is 40 percent above current precipitation. The increase in temperature signaling the end of the Wisconsin glacial age may have begun as early as about 16,000 years ago. The oldest record of desert scrub vegetation from the Nevada Test Site area dates to about 15,000 years ago. By 10,000 years before present, average annual temperatures may have approximated present values, although seasonal temperature and precipitation regimes probably differed from those of today. Climate changes during the last 10,000 years have been relatively minor variations in a warm, dry climatic regime. Probably future climatic changes include a brief but pronounced warm period within the next 500 years, followed by a protracted transition to the next glacial age during the next 10,000 years. (USGS)
W86-03168

EFFECTS OF DECREASED WATERING ON WHEAT AND BARLEY YIELDS,
New Mexico Water Resources Research Inst., Las Cruces.
For primary bibliographic entry see Field 3F.
W86-03289

PRIMARY PRODUCTION AND DECOMPOSITION OF SUBMERGENT AND EMERGENT AQUATIC PLANTS OF TWO APPALACHIAN RIVERS,
North Texas State Univ., Denton. Inst. of Applied Sciences.
For primary bibliographic entry see Field 5C.
W86-03389

2J. Erosion and Sedimentation

STREAMFLOW AND WATER QUALITY OF ONION RIVER, WISCONSIN–AN ASSESSMENT OF NONPOINT-SOURCE DISCHARGES,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02932

PHYSICAL BASIS AND POTENTIAL ESTIMATION TECHNIQUES FOR SOIL EROSION PARAMETERS IN THE PRECIPITATION RUNOFF MODELING SYSTEM (PRMS),
Geological Survey, Nashville, TN. Water Resources Div.
W. P. Carey, and A. Simon.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4218, 1984. 32 p, 8 fig, 2 tab, 69 ref.

Descriptors: *Soil erosion, *Watershed models, Physical properties, *Simulation analysis, Hydraulic detachment(Soil), *Model studies.

Simulation of upland-soil erosion by the Precipitation-Runoff Modeling System currently requires the user to estimate two rainfall detachment parameters and three hydraulic detachmment paramenters. One rainfall detachment parameter can be estimated from rainfall simulator tests. A reformulation of the rainfall detachment equation allows the second parameter to be computed directly. The three hydraulic detachment parameters consist of one exponent and two coefficients. The initial value of the exponent is generally set equal to 1.5. The two coefficients are functions of the soil's resistance to erosion and one of the two also accounts for sediment delivery processes not simulated in the model. Initial estimates of these parameters can be derived from other modeling studies or from published empirical relations. (USGS)
W86-02943

SEDIMENT AND WATER-QUALITY FOR THE WEST BRANCH SHADE AND EAST BRANCH SHADE RIVER BASINS, OHIO, 1983 WATER YEAR,
Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress, and R. L. Jones.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-187, 1985. 16 p, 4 fig, 3 tab, 12 ref.

Descriptors: *Sedimentation, *Water quality, Hydrologic data collections, Cross-sections, Strip mines, Land reclamation, West Shade River Basin, *Ohio.

Sedimentation in and flooding of the West Branch Shade River and its tributaries have been major concerns of residents and State and local officials. The area was extensively surface-mined for coal between the mid-1940's and the early 1960's. Reclamation efforts immediately after mining were unsuccessful. The results have been elevated sediment loads and the subsequent loss of channel conveyance. Two sediment and stream-gaging stations were established on the West Branch Shade River and one station was established on the East Branch Shade River. The data will help to evaluate the effectiveness of current reclamation activities on reducing sediment loads. From June through September 1983, suspended-sediment yield was 18 times higher in West Branch (218 tons per square mile) than East Branch Shade River (12 tons per square mile). In addition, acidity is higher, pH is lower, and concentrations of dissolved sulfate and metals are higher in the West Branch Shade river basin than in the East Branch Shade river basin. (USGS)
W86-02947

COMPUTER PROGRAM FOR THE COMPUTATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE,
Geological Survey, Lakewood, CO. Water Resources Div.
H. H. Stevens.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4047, 1985. 14 p, 8 ref, 10 append.

Descriptors: *Computer programs, Data processing, Rivers, Sediment transport, *Sediment load, *Modified Einstein procedure, Total sediment discharge.

Two versions of a computer program to compute total sediment discharge by the modified Einstein procedure are presented. The FORTRAN 77 language version is for use on the PRIME computer, and the BASIC language version is for use on most microcomputers. The program contains built-in limitations and input-output options that closely follow the original modified Einstein procedure. Program documentation and listings of both versions of the program are included. (USGS)
W86-02964

CORRELATION OF PALEOSTRUCTURE AND SEDIMENT DEPOSITION IN THE MADISON LIMESTONE AND ASSOCIATED ROCKS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, WYOMING, AND NEBRASKA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02977

CHANGES IN CHANNEL GEOMORPHOLOGY OF SIX ERUPTION-AFFECTED TRIBUTARIES OF THE LEWIS RIVER, 1980-82, MOUNT ST. HELENS, WASHINGTON,
Geological Survey, Vancouver, WA. Water Resources Div.
H. Martinson, S. Finneran, and L. J. Topinka.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-1984. 113 p, 17 fig, 6 tab, 14 ref.

Descriptors: *Cross-sections, *Channel erosion, *Geomorphology, *Channel accretion, Volcanoes, *Mount St. Helens, *Washington, Lewis River, Pine Creek, Muddy Creek, Smith Creek, Swift Creek, Bean Creek, Clearwater Creek, Channel geometry, Channel aggradation.

The May 18, 1980, eruption of Mount St. Helens generated a lateral blast, lahars and tephra deposits that altered tributary channels in the Lewis River drainage basin. In order to assess potential flood hazards, study channel adjustments, and construct a sediment budget for the perturbed drainages on the east and southeast flanks of the volcano, channel cross sections were monumented and surveyed on Pine Creek, Muddy River, and Smith Creek during September and October of 1980. Additional cross sections were monumented and surveyed on Swift Creek, Bean Creek, and Clearwater Creek during the summer of 1981. The network of 88 channel cross sections has been resurveyed annually. Selected cross sections have been surveyed more frequently, following periods of higher flow. The repetitive cross-section surveys provide measurements of bank erosion or accretion and of channel erosion or aggradation. The report presents channel cross-section profiles constructed from the survey data collected during water years 1980-82. (USGS)
W86-02979

MEASURING THE SURFACE AREA OF SEDIMENT-PARTICLES,
Geological Survey, Minneapolis, MN. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03007

IMPACT OF AN OUTBURST OF SPIRIT LAKE ON THE COLUMBIA RIVER,
Geological Survey, Tacoma, WA. Water Resources Div.
W. G. Sikonia.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4054, 1985. 55 p, 40 fig, 3 tab, 13 ref.

Descriptors: *Floods, Flood crest, Flood hydrographs, *Sediment transport, Deposition, Computer models, Hydraulic models, *Mudflows, *Columbia River, *Mount St. Helens, Spirit Lake, *Washington.

A one-dimensional sediment-transport computer model was used to study the effects of an outburst of Spirit Lake on the Columbia River. According to the model, flood sediment discharge to the Columbia from the Cowlitz would form a blockage to a height of 44 feet above the current streambed of the Columbia River, corresponding to a new

streambed elevation of -3 feet, that would impound the waters of the Columbia River. For an average flow of 233,000 cubic feet in that river, water surface elevations would continue to increase for 16 days after the blockage had been formed. The river elevation at the Trojan nuclear power plant, 5 miles upstream of the Cowlitz River, would rise to 32 feet, compared to a critical elevation of 45 feet, above which the plant would be flooded. For comparison, the Columbia River at average flow without the blockage has an elevation at this location of 6 feet. Correspondingly high water surface elevations would occur along the river to Bonneville Dam, with that at Portland, Oregon, for example, rising also to 32 feet, compared to 10 feet without the blockage. (USGS)
W86-03008

SURVEY OF FENA RESERVOIR, ISLAND OF GUAM: LIMNOLOGICAL RECONNAISSANCE,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2H.
W86-03018

HYDROLOGY AND SEDIMENT TRANSPORT MOANALUA VALLEY, OAHU, HAWAII,

Geological Survey, Honolulu, HI. Water Resources Div.
P. J. Shade.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-41 56. 1984. 54 p, 14 fig, 14 tab, 56 ref.

Descriptors: *Rainfall-runoff relationship, *Model studies, *Sediment transport, Calibration, Suspended sediment, Recharge, *Hawaii, Moanalua Valley, Oahu.

The rainfall-runoff relationship and sediment transport were analyzed for Moanalua Valley, Oahu, an undeveloped watershed in Hawaii. Rainfall, streamflow, and evaporation data were input to the Dawdy, Schaake, and Alley distributed routing rainfall-runoff model (DSA). The model was calibrated and verified for this rural tropical watershed indicating that on an event basis the average estimate of runoff is 35 percent of rainfall. A basin water balance computer using calibrated model parameter values, indicates an average of 7 million gallons per day groundwater recharge. Sediment transport was determined from daily and intermittent suspended-sediment samples collected at two sites, and from debris basin surveys. The estimated mean annual sediment yield ranges between 500 and 1,000 tons/mi2/yr. (USGS)
W86-03034

STREAMFLOW AND SUSPENDED-SEDIMENT DISCHARGE FROM TWO SMALL WATERSHEDS IN SOUTHWESTERN WYOMING AND NORTHEASTERN UTAH, 1984,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03066

CALCULATING SEDIMENT DISCHARGE FROM A HIGHWAY CONSTRUCTION SITE IN CENTRAL PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-03102

RECONNAISSANCE STUDY OF STREAM SEDIMENTAION, SOUTHERN GUAM,

Geological Survey, Honolulu, HI. Water Resources Div.
P. J. Shade.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4212, 1983. 33 p, 13 fig, 9 tab, 10 ref.

Descriptors: *Sediment yield, Basins, *Flow duration, *Sedimentation, *Suspended sediment, Reservoir, *Survey, *Guam, Talofofo, Ylig, Ugum, Fena.

This study uses limited available data to estimate sediment yields for three basins in southern Guam. The flow-duration sediment-rating curve method, reservoir survey data, and Pacific southwest Inter-Agency Committee (PSIAC) formula were used. Daily suspended-sediment samples were collected at USGS gaging stations on the Ylig and Ugum Rivers for one year. Intermittent samples were collected from the Talofofo River for six months. Although limited, these data are used in the flow-duration sediment-rating-curve method to estimate mean suspended-sediment yields. Fena Reservoir sedimentation data are used to test the applicability of the PSIAC formula in the three basins. Estimates of suspended-sediment yields are 467 to 845, 678 to 977, and 634 to 855 tons per year per square mile for the Talofofo, Ylig, and Ugum basins, respectively. PSIAC estimates of total sediment yield are 1,200 tons/yr/mi2 for the Talofofo, 1,385 tons/yr/mi2 for the Ylig, and 1,210 tons/yr/mi2 for the Ugum basins. These values are comparable to estimates of sediment yields from several similar basins on Oahu, Hawaii. It appears that the PSIAC method can be a useful tool in estimating sediment yields in some tropical areas. (USGS)
W86-03112

ESTIMATES OF LONG-TERM SUSPENDED-SEDIMENT LOADS IN BAY CREEK AT NEBO, PIKE COUNTY, ILLINOIS, 1940-80,

Geological Survey, Urbana, IL. Water Resources Div.
T. R. Lazaro, K. K. Fitzgerald, and L. R. Frost.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4003, 1984. 22 p, 9 fig, 5 tab, 7 ref.

Descriptors: *Suspended sediments, *Sediment load, *Sediment transport, *Illinois, Pike County, Bay Creek.

Five years of daily suspended-sediment discharges (1968, 1969, 1975, 1976, and 1980) for Bay Creek at Nebo, Illinois, computed from once- or twice-weekly samples (more often during storm events), were used to develop transport equations that can be used to estimate long-term suspended-sediment discharges from long-term water-discharge records. Discharge was divided into three groups based on changes in slope on a graph of logarithms of water discharge versus suspended-sediment discharge. Two subgroups were formed within each of the three groups by determining whether the flow was steady or increasing, or was decreasing. Seasonality was accounted for by introducing day of the year in sine and cosine functions. The suspended-sediment load estimated from the equations for the 5 years was 77.3 percent of that computed from daily sediment- and water-discharge records for those years. The mean annual suspended-sediment load for 41 years of estimated loads was 359,500 tons, which represents a yield of about 3.5 tons per acre from the Bay Creek drainage basin. (USGS)
W86-03138

RELATIONS OF SUSPENDED SEDIMENT TO STREAMFLOW IN THE GREEN RIVER, WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
B. H. Ringen.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4026, 1984. 14 p, 4 fig, 3 tab, 6 ref.

Descriptors: *Sediment concentration, *Sediment discharge, *Regression analysis, Streamflow, Statistical methods, *Temporal-concentration graph, *Sediment-transport curve, *Wyoming, Green River basin, Correlation.

The relation of suspended-sediment concentration to water discharge was computed using regression analysis for 33 stations and 2 miscellaneous sites in the Green River basin, Wyoming. These relations show that suspended-sediment concentrations vary in direct proportion to streamflow. The number of coincident instantaneous suspended-sediment concentration and water-discharge values available for each regression analysis ranged from 6 to 98. Standard error of estimates for 35 relationships were usually large and correlation were relatively small. Large standard errors and small correlations are expected because of the complexity of the fluvial system. The effects of other factors, such as geology, topography, climate, soils, vegetation, and land use were not evaluated. Daily suspended-sediment discharges for four stations were computed by the 'sediment-transport-curve' method described in this report, and compared with values computed by the traditional 'temporal-concentration-graph' method. Annual sediment yields in tons per square mile drainage area, were compared in like manner. For those stations examined, values computed by the 'sediment-transport-curve' method were within 58 percent of those computed by the temporal-concentration-graph' method when only one year of record was used, but were within 12 to 21 percent when 2 to 4 years of record were averaged. (USGS)
W86-03174

MORPHOLOGICAL MODELLING FOR RIVERS WITH NON-UNIFORM SEDIMENT,

Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
J. S. Ribberink.
Internal Report No 1-80, 1982, 144 p, 32 fig, 12 tab, 23 ref, 1 append.

Descriptors: *Channel morphology, *Mathematical models, *Sediment transport, *Mathematical equations, *Rivers, Models, Model studies, Prediction, Mathematical studies, Fluvial sediments, Flow velocity.

The mathematical prediction of morphological changes in rivers due to natural causes or human interference has received much attention during the last two decades. The existing mathematical model for morphological computations in rivers consists of two water-equations and two sediment-equations. In principle these equations are a continuity equation and an equation of motion for both phases. This study attempts to reduce the complexity of the analysis by assuming the presence of nearly uniform sediment. A quasi-steady flow, constant bed roughness and local transport as a function of local conditions are also assumed. The derivation of the equations needed for the new model is presented. To gain insight into the workings of the new model, a restriction of only two sediment fractions is used. Specific calculations are carried out of the characteristic directions and relations. The influence of two possible concepts for a transport formula per fraction is studied. Four simple applications of the mathematical model for two sediment fractions are created. The water motion is simplified to enable manual calculations. The equation of motion of the sediment is a sediment transport formula which implies a direct relationship between sediment transport and the depth-averaged water velocity. (Geiger-PTT)
W86-03269

DETERMINATION OF TURBIDITY PATTERNS IN LAKE CHICOT FROM LANDSAT MSS IMAGERY,

Kentron International, Inc., Hampton, VA. Technical Center.
S. R. LeCroy.
Available from the National Technical Information Service, Springfield, VA 22161 as N82-32788, Price codes: A03 in paper copy, A01 in microfiche. Report No. CP-32-04237, January 1982. 42 p, 23 fig, 18 ref.

Descriptors: *Sedimentation, *Satellite technology, *Remote sensing, *Turbidity, *Lakes, *Sediment transport, *Spectroscopy, *Turbidity flow, Lake sediments, Erosion, Infrared imagery, Aerial photography, *Arkansas, Lake Chicot.

A historical analysis of all applicable Landsat imagery was conducted on the turbidity patterns of

Lake Chicot, located in the Southeastern corner of Arkansas. By examining the seasonal and regional turbidity patterns, a record of sediment dynamics and possible disposition can be obtained. Sketches were generated from the suitable imagery, displaying different intensities of brightness observed in bands 5 and 7 of Landsat's multispectral scanner data. Differences in and between band 5 and 7 indicate variances in the levels of surface sediment concentrations. High sediment loads are revealed when distinct patterns appear in the band 7 imagery. Additionally, the upwelled signal is exponential in nature and saturates in band 5 at low wavelengths for large concentrations of suspended solids. (Author)
W86-03291

ENGINEERING GEOLOGY AND GEOMORPHOLOGY OF STREAMBANK EROSION: REPORT 4, SUPPLEMENTAL UPDATE TO REPORT 3: THE APPLICATION OF WATERBORNE GEOPHYSICAL TECHNIQUES IN FLUVIAL ENVIRONMENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
J. R. May.
Technical Report GL-79-7, September 1982. 11 p, 3 ref.

Descriptors: *Bank erosion, *Sediment erosion, *Soil erosion, *Stream degradation, Errors, *Wave action, Flood waves, Rivers, Erosion, Wind erosion, Ohio River, Navigable rivers.

This supplementary report addresses portions of Report 3 in the series 'Engineering Geology and Geomorphology of Streambank Erosion' to restate certain paragraphs that contain significant errors. In addition, this supplement provides a data-based explanation of causation of streambank failure and erosion observed at the Ohio Rivery survey sites. Supplemental data resulting from studies conducted by the U.S. Army Corp of Engineers along the Ohio River show that wind-generated wave action has a negligible effect on Ohio River banks due to low wave heights and short fetch lengths. Principal sites where traffic-generated waves and turbulence may result in bank erosion are limited to areas of the bank line located at locking and docking facilities and fleeting and staging areas. Bank failures most often occur within short time periods in response to storms and floods. Bank erosion has been historically persistent along the entire length of the Ohio River but evidence indicates that this erosion has not been caused by the construction or operation of the navigation structures. Soil composing the banks has been eroded (rather than stripped) and carried into the river.
W86-03320

THEODORE ROOSEVELT LAKE: 1981 SEDIMENTATION SURVEY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. M. Lara.
Available from Engineering and Research Center, Denver, CO. Report No REC-ERC-82-18, September 1982. 89 p, 66 fig, 3 tab.

Descriptors: *Reservoir capacity, *Surveys, Capacity, *Reservoir silting, *Reservoir storage, *Lake sediments, *Sounding, *Sonar, Reservoirs, Sediments, Silting, Water storage, Storage, Lakes, Hydrographs, Water depth, Arizona, Theodore Roosevelt Lake.

Theodore Roosevelt Lake was surveyed in 1981 to compile field data needed to compute the reservoir capacity. The data were also used to compute the volume of sediments that had accumulated in the reservoir since the gates of the dam were closed in 1909. Twenty-eight sediment samples from reservoir deposits were collected from various reservoir ranges throughout the lake. Sonic depth recording equipment interfaced with an automated survey system was used to run the hydrographic survey. Reservoir capacity was computed based on surface areas determined by a width-ratio method. The capacity of the reservoir is now 1.65 x 10 to the 9th power cu m (1,336,734 acre-ft), and the reservoir has a surface area of 7016 hectares (17,337 acres). Since 1909, 2.39 x 10 to the 8th power cu m (193,765 acre-ft) of sediment accumulation have resulted in about a 13 percent loss of capacity. (Author)
W86-03331

2K. Chemical Processes

EVALUATION OF ENVIRONMENTAL FACTORS AFFECTING MAJOR DISSOLVED-ION YIELDS OF STREAMS IN THE UNITED STATES,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02923

WATER QUALITY OF A STREAM-AQUIFER SYSTEM, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
J. T. de Roche, and A. C. Razem.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4238, 1984. 44 p, 8 fig, 7 tab, 20 ref.

Descriptors: *Glacial aquifers, *Induced infiltration, *Geochemistry, Geohydrology, Chemical composition, Mass transfer, *Surface-groundwater relationships, *Ohio, Franklin County.

The water resources in the Scioto River valley south of Columbus, Ohio were evaluated as a potential water supply, based on data collected from 74 wells and 4 surface-water sites. A very hard calcium bicarbonate water high in dissolved solids is characteristics of the area. Mean pH of the ground water is 7.3 and concentrations of bicarbonate range from 238 to 530 milligrams per liter (mg/L). Concentrations of dissolved iron in water samples (0.01 to 3.9 mg/L) frequently exceed the Ohio Environmental Protection Agency's recommended limit of 0.3 mg/L. The chemical quality of local streams closely parallels the ground-water quality, except for higher levels of sodium, chloride, and sulfate in the surface water. Microbiological testing of ground water from several wells indicated high concentrations of fecal coliform and fecal streptococci bacteria. The contamination was probably due to infiltration of surface waters through improperly sealed wells during a recent flood. Mass-balance calculations on the chemical data indicate that pH is buffered primarily by the carbonate system, and that areas of different chemical environments exist within the aquifer. (USGS)
W86-02931

SEDIMENT AND WATER-QUALITY FOR THE WEST BRANCH SHADE AND EAST BRANCH SHADE RIVER BASINS, OHIO, 1983 WATER YEAR,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02947

SELECTED TRACE-ELEMENT DATA FOR STREAMS IN THE SOUTHERN YAMPA RIVER BASIN, NORTHWESTERN, CO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02967

QUANTITATIVE ANALYSIS OF THE HYDROTHERMAL SYSTEM IN LASSEN VOLCANIC NATIONAL PARK AND LASSEN KGRA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02994

INDEX OF GROUND-WATER QUALITY DATA FOR FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03002

RESULTS OF THE U.S. GEOLOGICAL SURVEY'S SECOND INTERNATIONAL INTERLABORATORY ANALYTICAL COMPARISON STUDY--STANDARD-REFERENCE WATER SAMPLES M-86 (MAJOR CONSTITUENTS), T-87 (TRACE CONSTITUENTS), AND P-5 (PRECIPITATION SNOWMELT),
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03013

GROUND-WATER-QUALITY DATA FROM THE SOUTHERN POWDER RIVER BASIN, NORTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
L. R. Larson, and R. L. Daddow.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-939, 1984. 56 p, 2 fig, 3 tab, 3 ref.

Descriptors: Wqter quality, *Chemical analysis, *Trace elements, *Radiochemical analysis, Wells, Springs, Aquifers, *Coal mine effects, *Southern Powder River basin, *Wyoming, Northern Great Plains RASA, *Coal hydrology.

Water-quality data for wells and springs in the Powder River basin in northeastern Wyoming are presented in three tables. The first table lists results of analyses of common constituents for 748 ground-water sites. The second table presents dissolved-trace-metal data for 220 ground-water sites. Radiochemical data are listed in the third table for 65 ground-water sites. The locations of the sites listed in the tables are shown on a map of the area. (USGS)
W86-03014

RECORDS OF WELLS, DRILLERS' LOGS, WATER-LEVEL MEASUREMENTS, AND CHEMICAL ANALYSES OF GROUND WATER IN HARRIS AND GALVESTON, COS., TEXAS, 1975-79,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03045

WATER-RESOURCES MONITORING IN THE COTTONWOOD CREEK AREA, SHASTA AND TEHAMA COUNTIES, CALIFORNIA, 1982-83,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03054

DATA FROM A SOLUTE TRANSPORT EXPERIMENT IN THE LEVIATHAN MINE DRAINAGE, ALPINE COUNTY, CALIFORNIA, OCTOBER 1982,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03055

FIELD GUIDELINES FOR COLLECTION, TREATMENT, AND ANALYSIS OF WATER SAMPLES, MONTANA DISTRICT,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03060

FILTRATION AND COLUMN-ADSORPTION SYSTEM FOR ONSITE CONCENTRATION AND FRACTIONATION OF ORGANIC SUBSTANCES FROM LARGE VOLUMES OF WATER,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-03065

PREPARATION OF POLYETHYLENE SACKS FOR COLLECTION OF SAMPLES FOR CHEMICAL ANALYSIS,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-03072

SURFACE-WATER QUANTITY AND QUALITY IN THE LOWER KENAI PENINSULA, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03076

APPARENT WATER RESISTIVITY, POROSITY, AND WATER TEMPERATURE OF THE MADISON LIMESTONE AND UNDERLYING ROCKS IN PARTS OF MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03081

SELECTED HYDROLOGIC DATA FOR THE POWELL RIVER BASIN IN WISE COUNTY, VIRGINIA,

Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03103

SELENIUM CONCENTRATIONS IN WATERS TRIBUTARY TO AND IN THE VICINITY OF THE KESTERSON NATIONAL WILDLIFE REFUGE, FRESNO AND MERCED COUNTIES, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-03124

ATMOSPHERIC DEPOSITION OF SELECTED CHEMICALS AND THEIR EFFECT ON NONPOINT-SOURCE POLLUTION IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03125

TEMPORAL TRENDS IN THE ACIDITY OF PRECIPITATION AND SURFACE WATERS IN NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03135

EVALUATION OF GROUND-WATER QUALITY DATA FROM KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
C. L. Sprinkle, R. W. Davis, and D. S. Mull.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4240, 1983. 65 p, 33 fig, 4 tab, 34 ref.

Descriptors: *Water quality, *Groundwater, *Statistical analysis, Geochemistry, Groundwater pollution, Saline water, *Kentucky.

The report reviews and summarizes 10,578 chemical analyses, from 2,362 wells and springs in Kentucky. These water-quality data were collected prior to September 30, 1981, and are available in computer files of the U.S. Geological Survey. The principal water-bearing rocks in Kentucky were combined into 10 major groups to aid in data summary preparation and general description of the ground-water quality of the State. Ground water in Kentucky is generally fresh near the outcrop of the rocks comprising the aquifer. Slightly saline to briny water occurs at variable depths beneath the freshwater. Preparation of quadrilinear diagrams revealed three principal geochemical processes in the aquifers of Kentucky: (1) mixing of freshwater and saline water in an interface zone; (2) dedolomitization of the Devonian and Silurian and Lower Mississippian carbonate rocks; (3) sodium for calcium exchange in the freshwater sections of many of the sandstone-shale aquifers. A number of errors and deficiencies were found in the data base. The principal deficiencies were: (1) very few complete analyses which included important field measurements; (2) inadequate definition of the chemistry of the freshwater-saline water interface zone throughout much of the State; (3) no analyses of stable isotopes and dissolved gases; (4) fewer than 10 analyses of most trace metals, radionuclides, and man-made organic chemicals; and (5) no data on bacteria in ground water from any aquifer in the State. (USGS)
W86-03142

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTHEASTERN MISSISSIPPI, AUGUST 1983,

Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-62, 1984. 21p, 5 fig, 3 tab, 7 ref.

Descriptors: *Water quality, Lignite, *Sediment load, *Cross-sections, *Low flow, *Mississippi, Calhoun County, Webster County, Montgomery County.

Hydrologic data were collected at 15 stream sites draining potential lignite areas in Calhoun, Montgomery, and Webster Counties during a period of low streamflow. The total dissolved solids ranged from 25 to 14.9 mg/L and most major ion concentrations were less and suspended sediment concentrations were less than 30 mg/L. The pH ranged from 6.7 to 9.1 units. Aluminum concentrations ranged from less than 100 to 500 micrograms per liter. Chromium and zinc concentrations ranged from 1 to 10 micrograms per gram and mercury concentrations ranged from 0.01 to 0.04 micrograms per gram in bottom material. (USGS)
W86-03162

CHEMICAL AND BIOLOGICAL QUALITY OF STREAMS AT THE INDIANA DUNES NATIONAL LAKESHORE, INDIANA, 1978-80,

Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03163

RECONNAISSANCE OF BENTHIC INVERTEBRATES FROM TRIBUTARY STREAMS OF THE YAMPA AND NORTH PLATTE RIVER BASINS, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-03167

DATA FROM PUMPING AND INJECTION TESTS AND CHEMICAL SAMPLING IN THE GEOTHERMAL AQUIFER AT KLAMATH FALLS, OREGON,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03169

GEOHYDROLOGY OF THE NORTHERN PART OF THE TOWN OF BROOKHAVEN, SUFFOLK COUNTY, NEW YORK,

Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03173

UNDERGROUND RESIDENCE TIMES AND CHEMICAL QUALITY OF BASAL GROUNDWATER IN PEARL HARBOR AND HONOLULU AQUIFERS, O'AHU, HAWAII,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2F.
W86-03290

HYDROGEN AND OXYGEN ISOTOPE GEOCHEMISTRY OF COLD AND WARM SPRINGS FROM THE TUSCARORA, NEVADA THERMAL AREA,

Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
J. R. Bowman, and D. Cole.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019920, Price codes: A02 in paper copy, A01 in microfiche. DOE/ID/12079-70, June, 1982. 14 p. 6 fig, 1 tab, 16 ref.

Descriptors: *Cold springs, *Hot springs, *Deuterium, *Oxygen isotopes, *Water chemistry, Water recharge, Bicarbonates, Temperature, Geochemistry, Topography, Evaporation, *Thermal Springs, *Nevada.

Eighteen cold and warm spring water samples from the Tuscarora, Nevada thermal area were analyzed for hydrogen and oxygen isotope composition and fluid chemistry. Warm springs have delta D values (-128 to -137 permil) significantly lower than those of cold springs to the north and east of the area, but similar to the delta D values of cold springs to the west and south (-131 to -135 permil). The recharge area for the warm springs is unlikely to be to the immediate north, which is the local topographic highland in the area. The hydrogen isotope data would permit recharge from areas to the southwest or from high elevations to the southeast (Independence Mountains), a sector consistent with electrical resistivity evidence of fluid flow. Warm springs are HC03(-)-rich waters, enriched by a factor of 3 to 10 in Na, HC03(-) and Si02 relative to local cold springs. Average quartz (no steam loss) and Na/K/Ca geothermometer estimates suggest subsurface temperatures of 145 C and 196 C, respectivley. The warm springs exhibit poor correlations between either hydrogen or oxygen isotope composition and water temperature or chemistry. The absence of such correlations suggests that there is no single coherent pattern of cold water mixing or evaporation in the thermal spring system.
W86-03308

INFLUENCE OF HUMIC-ACID COMPLEXING ON THE MOBILITY OF AMERICIUM IN THE SOIL AQUATIC ENVIRONMENT,

Washington State Univ., Pullman. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W86-03315

CHARACTERIZATION OF GLENWOOD SPRINGS AND DOTSERO SPRINGS WATERS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer.
Available from Engineering and Research Center, Denver, CO. Report No REC-ERC-83-10, October 1983. 52p, 10 fig, 14 tab.

Descriptors: *Salinity, *Colorado River, *Colorado, *Mineral springs, *Saline water, *Chemical properties, Springs, Physical properties, *Fate of pollutant, *Pollutant identification, *Trace elements, Path of pollutants, Water analysis, Water temperature, Aquifers, Hydrogen ion concentration, Cations, Anions, Radioactivity, Trace metals, Glenwood Springs.

The Bureau of Reclamation is endeavoring to find disposal methods for preventing high salinity water from 16 identified sources from entering the Colorado River. The Glen Dot (Glenwood Springs-Dotsero Springs) is one source that contributes 10% of the identified salt load or 227,000 metric tons annually. Data on the physical and chemical properties of the Glen-Dot waters were collected from 1972 to 1982 to aid in determining disposal methods and characterizing the aquifers for major constituents, trace metals, trace anions, radioactivity, and organic compounds. The Dotsero Springs, located in the Leadville limestone strata, had a combined flow rate for 11 identified springs of 0.220 cu m/sec. Temperatures of these waters ranged from 23 to 32 degrees. The pH ranged from 7.2 to 7.7 and total dissolved solids were 9.954 mg/L. The content of Na, Mg, Ca, K, Cl, sulfate and bicarbonate was 82, 10, 7, 1, 84.5, 8.7 and 6.8%, respectively. The Glenwood Springs, located in the Leadville limestone strata, had a combined flow rate for 14 identified springs of 0.296 cu m/sec. Temperatures of these waters ranged from 25 to 51 degrees. The pH ranged from 6.6 to 7.6 and total dissolved solids were 18,780 mg/L. The content of Na, Ca, K, Mg, Cl, sulfate and bicarbonate was 90, 7, 2, 1, 83.9, 10.2 and 6.0%, respectively. Lime treatment was recommended to reduce the Ca levels of the Glen-Dot waters.
W86-03333

WATER ANALYSIS, VOLUME III: ORGANIC SPECIES,

For primary bibliographic entry see Field 5A.
W86-03406

2L. Estuaries

DATA ON DISTRIBUTION AND ABUNDANCE OF SUBMERSED AQUATIC VEGETATION IN THE TIDAL POTOMAC RIVER AND TRANSITION ZONE OF THE POTOMAC ESTUARY, 1983 AND 1984,

Geological Survey, Reston, VA. Water Resources Div.
V. Carter, N. B. Rybicki, R. T. Anderson, T. J. Trombley, and G. L. Zynjuk.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-82, 1985. 61 p, 28 fig, 24 tab, 13 ref.

Descriptors: *Submersed aquatic vegetation, Vegetation maps, Aquatic weeds, Estuaries, *Tidal Potomac River, *Potomac River Estuary, *Maryland, *Virginia.

Data on the distribution and abundance of submerged aquatic vegetation were collected in the tidal Potomac River and transition zone of the Potomac Estuary during 1983 and 1984. Plant species were identifed on transects. Water-quality characteristics measured include temperature, specific conductance, and Secchi depth. Maps were made of the distribution of individual species based on transect samples and a complete shoreline survey. (USGS)
W86-02944

WATER SURFACE ELEVATIONS FOR THE HIGH TIDE OF DECEMBER 15, 1977, IN THE PUGET SOUND REGION, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
L. M. Nelson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4293, 1985. 15 p, 8 fig, 1 tab, 5 ref.

Descriptors: *Water surface profiles, *Tidal effects, Tidal floods, Tides, *Puget Sound, *Washington, High-tide elevations.

An unusually high oceanic tide on December 15, 1977, caused flooding of lowlying, nearshore parts of western Washington, including several areas in the Puget Sound region. At Seattle, the December 15 high tide of 14.8 feet above MLLW (mean lower low water datum; 8.55 feet above the National Geodetic Vertical Daltum of 1929, or NGVD) was 0.1 foot higher than the 100-year high tide. At Neah Bay, near the western end of the Straits of Juan de Fuca, however, the high tide of 8.77 feet MLLW (4.55 feet NGVD) on that date was 3.2 feet lower than the 100-year high tide. This study has identified the observed December 15 high-tide elevations at many locations in the Puget Sound region. The observed high tide then was much higher than predicted in most of the Puget Sound region, primarily as the result of a very low barametric pressure. Little damage from wind waves was reported. Elevation profiles for the predicted and observed high tides on December 15 and for several other selected tide levels indicate an increase in the maximum height in the inland direction, except near Port Angeles, and show abrupt changes in tidal elevations at three constrictions - Admiralty Inlet, Tacoma Narrows, and Deception Pass. (USGS)
W86-02953

WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY - AN OVERVIEW,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02975

WATER QUALITY OF THE TIDAL POTOMAC RIVER AND ESTUARY HYDROLOGIC DATA REPORTS SUPPLEMENT 1979 THROUGH 1981 WATER YEARS,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-02997

PRIMARY PRODUCTIVITY IN THE POTOMAC TIDAL RIVER, MARYLAND, MAY 1980 TO AUGUST 1981,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03000

EFFECT OF EUSTATIC SEA-LEVEL CHANGES ON SALTWATER-FRESHWATER RELATIONS IN THE NORTHERN ATLANTIC COASTAL PLAIN,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03010

DISTRIBUTION AND ABUNDANCE OF SUBMERSED AQUATIC VEGETATION IN THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA,

Geological Survey, Reston, VA. Water Resources Div.
V. Carter, J. E. Paschal, and N. Bartow.
Available from Dist Branch, USGS 604 S. Pickett St. Alexandria, VA 22034. USGS Water-Supply Paper 2234-A, 1985. 46 p, 20 fig, 20 tab, 86 ref.

Descriptors: Aquatic Plants, Nutrients, Plant growth, *Submersed aquatic plants, Aquatic habitats, Substrate, Estuaries, *Potomac River Estuary, Tidal Potomac River, *Maryland, *Virginia, District of Columbia.

The distribution and abundance of submersed aquatic vegetation in the tidal Potomac River and Estuary were studied from 1978 through 1982. Sixteen species of submersed aquatic plants were identified--fourteen vascular plants and two species of the algae Chara. Most of the plants were located in the transition zone of the Potomac River and Wicomico River tributary, with a few isolated populations in the tidal river and estuary. Vallisneria americana, Zannichellia palustris, Ruppia maritima and Potamogeton perfoliatus were the most abundant and widespread species. The present distribution differs considerably from that in the early 1900's when flats in the tidal river were covered with lush vegetation such as Vallisneria and Potamogeton spp., and the estuary had an abundance of Zostera marina. The factors responsible for the decline of submersed aquatic vegetation in the tidal Potomac River and Estuary are varied and may include storm damage in the 1930's; increasing nutrient enrichment with a shift in the relationship between submersed aquatic plants and phytoplankton, a change in light availability; and grazing by turtles, fish, muskrat, or waterfowl. Salinity dynamics may account for the presence of abundant vegetation and the diversity of species in the transition zone. (USGS)
W86-03012

SEASONAL PATTERNS OF ALKALINITY IN THE SAN FRANCISCO BAY, CALIFORNIA, ESTUARINE SYSTEM DURING 1980,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03059

SALINITY, ALKALINITY, AND DISSOLVED AND PARTICULATE ORGANIC CARBON IN THE SACRAMENTO RIVER WATER AT RIO VISTA, CALIFORNIA, AND AT OTHER LOCATIONS IN THE SACRAMENTO-SAN JOAQUIN DELTA, 1980,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03063

FRESHWATER RUNOFF AND SALINITY DISTRIBUTION IN THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA, 1980-82,

Geological Survey, Tallahassee, FL. Water Resources Div.
G. M. Russell, and B. F. McPherson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4244, 1984. 36 p, 21 fig, 4 tab, 15 ref.

Descriptors: *Salinity, Rivers, Canals, *Estuaries, Water release, *Runoff, Loxahatchee River estuary, Canal 18, Jupiter Inlet, *Florida.

Freshwater mixed with seawater over a distance of 5 to 10 river miles in the Loxahatchee River estuary during a recent study. Large freshwater inflows vertically stratified the estuary and shifted the mixing zone seaward. In the northwest fork of the estuary, the saltwater-freshwater interface moved daily about 0.5 to 1.5 river miles as a result of tides, and annually about 3 to 5 miles as a result of seasonal changes in freshwater inflow. In the southwest fork, saltwater movement upstream was blocked by a gate and dam structure in Canal-18, 4.7 miles upstream from the Atlantic Ocean. Although Canal-18 discharged about one-third of the total freshwater tributary inflow to the estuary, the effects of canal discharge on salinity were limited to relatively brief periods. Much of the time, no freshwater was discharged. (USGS)
W86-03118

THEORETICAL AND OBSERVED PROFILES OF TIDAL CURRENTS AT TWO SITES ON THE SOUTHEASTERN BERING SEA SHELF,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
H. O. Mofjeld, J. D. Schumacher, and D. J. Pashinski.
NOAA Technical Memorandum ERL PMEL-62, October 1984. 60 p, 10 fig, 11 tab, 26 ref.

Descriptors: *Theoretical analysis, *Tidal currents, *Tidal hydraulics, *Hydraulic models, *Continental shelf, Models, Model studies, Tides, Eddies, Waves, Wave propagation, Wave action, Hydraulic similitude.

A semi-analytic theory for vertical profiles of tidal currents on the continental shelf is presented in which the vertical eddy viscosity is obtained with a high-resolution, Level II turbulence closure model. Each tidal constituent is assumed to be free shallow water wave propagating on an unstratified shelf on constant depth. The eddy viscosity is a time-dependent composite of contributions from the major tidal constituents. The theoretical profiles were fit to M2 and K1 current harmonic constants observed at two sites on the Southeastern Bering Sea Shelf. The fit of M2 and K1 theoretical profiles reproduced the general features of the tidal currents (rectilinear with Kelvin wave regime) at the coastal station BBL1 off the Alaska Peninsula. At the mid-shelf currents, the fit to the thin boundary layers observed for M2 and K1 revealed a small apparent bottom roughness (0.001 cm), possibly due to calm weather and/or the lack of bedforms. The theory overestimates slightly the width of the M2 ellipses but predicts the K1 width and perpendicular orientation of the M2 and K1 ellipses. The model provides estimates of residual tidal currents under very restrictive assumptions. For the coastal Kelvin waves, the residual tidal current is due almost entirely to Stokes drift, while for the Sverdrup waves, the magnitudes of the theoretical residual currents are a factor of 1/20 smaller than the coastal currents. (Geiger-PTT)
W86-03237

DATA FROM THE SALSX CRUISES: MAY 1978-JULY 1980,
Delaware Univ., Newark. Sea Grant Coll. Program.
C. H. Culberson, J. H. Sharp, T. M. Church, and B. W. Lee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-117085, Price codes: A04 in paper copy, A01 in microfiche. University of Delaware Oceanographic Data Report Number 2. February 1982. 53 p, 7 fig, 7 tab.

Descriptors: *Data acquisition, *Estuaries, Salinity, Water temperature, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Phosphates, Nitrates, Nitrites, Delaware River, Trace metals, Organic carbon, Phosphorus, Ammonium.

Chemical and physical data collected during six cruises in the Delaware River and Bay from May 1978 to July 1980 are reported. These cruises, designated Salsx, covered the entire salinity gradient in the estuary from freshwater in the river near Philadephia to seawater at the entrance of the bay. During Salsx-2 and Salsx-4, stations were also occupied in the coastal waters off Delaware and New Jersey. In addition during Salsx-4 and Salsx-6, sampling in the freshwater portion of the estuary was extended from Philadelphia to Trenton, the head of the estuary. The following parameters were measured on board during the cruise: temperature, salinity, oxygen and pH. Total alkalinity, phosphate, nitrate, nitrite, ammonium, dissolved organic carbon and phosphorus, and particulate organic carbon were analyzed ashore for all cruises. Station positions were charted for all cruises. Trace metals were determined ashore for selected positions in cruises 2-6.
W86-03298

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

USE OF NON-CONVENTIONAL WATER RESOURCE IN DEVELOPING COUNTRIES,
United Nations, New York. Dept. of Technical Co-operation for Development.
Natural Resource/Water Series No. 14, ST/ESA/149, 1985. 278 p, 9 fig, 26 tab, 208 ref, 2 append.

Descriptors: *Desalination, *Water reuse, *Developing countries, *Icebergs, *Water supply development, *Water transport, Water resources development, Wastewater renovation, Reverse osmosis, Membrane processes, Distillation, Electrodialysis, Rural areas, Cost analysis, Weather modification, Evaporation control.

Twenty years after the United Nations issued a series of publications on water desalination prospects in developing countries, the use of non-conventional water resources in developing countries was reviewed. The progress made over the past 20 years in the use of desalination, transport of water, water reuse and enhancement of existing supplies or sources is reported. The development of brackish and sea-water sources through distillation methods, electrodialysis, and reverse osmosis is considered. Supply and demand evaluations, energy considerations, and factors related to process selection are economic aspects of desalination that are examined. Small-scale desalination units in rural areas, and the combination of desalination efforts with renewable energy sources are also discussed. The transport of water by tankers or in the form of icebergs is examined in relation to recent technological advances and applications in developing countries. Wastewater reuse is considered as a form of non-conventional water reuse. The enhancement of existing supplies or sources by weather modification and evaporation suppression is reviewed. Future prospects for all the methods examined in this publication are outlined. Annexes to the main text discuss the technical background of distillation, electrodialysis, and reverse osmosis. A list of United Nations publications on water resources development topics is given. (Geiger-PTT)
W86-03240

AUTOMATED PLUGGING FACTOR MONITOR: SPECIFICATIONS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer, and S. C. Stitt.
Available from Engineering and Research Center, Denver, CO. Report No. REC-ERC-83-4, October 1983. 44 p, 6 fig, 1 app, 2 ref.

Descriptors: *Automation, Electronic equipment, *Monitoring, *Control systems, *Reverse osmosis, *Membrane processes, *Desalination, *Hydraulic equipment, Sampling, Membranes, Suspended soilds, Hydraulic machinery.

Efficient and economical control of a reverse osmosis membrane water desalting process is dependent on rapid but precise monitoring of the feed water parameter known as the plugging factor. The plugging factor measures the amount of microscopic organic and inorganic particulate matter within the size range measured which is suspended in the water. A totally automatic plugging factor monitor (PFM) test assembly was designed by and tested by government engineers. The PFM electronic controller drives the PFM tester to obtain the necessary data for calculating a plugging factor for a sample of water the PFM-SPSBP draws continuous flow samples of test water for 1-(6) reselected sources. The SPSBP flow operation is schematically diagramed. Other PFM-tester unit function and hardware specifications are also included along with engineer drawings of the mechanisms.
W86-03325

CATION EXCHANGE PRETREATMENT STUDIES FOR HIGH RECOVERY: YUMA DESALTING PLANT,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. W. Kaakinen, and P. E. Laverty.
Available from Engineering and Research Center, Denver, CO. Report No REC-ERC-82-11, October 1983. 295 p, 34 fig, 15 tab, 9 app, 33 ref.

Descriptors: *Desalination, *Desalination plants, *Cation echange, *Sulfates, *Water softening, *Gypsum, Pretreatment standards, Calcium sulfate, Ion exchange, Brines, Scaling, Resins, Demineralization, Adsorption, Yuma Desalting Plant.

The main purpose of the High Recovery Test Program was to obtain feasibility design data for cation exchange softening to allow a greater fractional recovery of desalted product water at the YDP (Yuma Desalting Plant). Compared to the original YDP design with 70% desalting recovery, additional removal of calcium in the sesalting feed would allow recoveries over 90%. The sole chemical regeneration solution for the IX (ion exchange) process during steady-state operation would be the sodium-rich brine from the desalting equipment. Pilot plant equipment to test this process was operated at the YDTF (Yuma Desalting Test Facility) and consisted of an IX unit and an electrodialyzer to supply reject-brine regenerant for the IX experiments. Because the reject-brine contained major concentrations of sulfate, gypsum scale occurred in the resin bed under certain IX operating conditions. Scaling occurred especially when the water temperatures were about 30 C in the summer. Scaling did not occur with water tempertures of 15 C in the winter. Gypsum scale buildup in the resin bed could be avoided by regeneration with a high upward flow rate causing a fluidized bed. Reuse of regenerant was also beneficial. Multiple regression analysis of the IX data delineated the importance of several control variables in the IX experiments, including regeneration concentration, flow rate, volume, and temperature. The major response variable was the specific calcium resin capacity divided by the IX cycle duration. This number is inversely proportional to the design resin requirement. Results show that the ion exchange high recovery pretreatment process is highly feasible, and that it is technically possible to achieve high recovery in the YDP. Numerous recommendations for a plant design are given and future studies are noted.
W86-03335

3B. Water Yield Improvement

USE OF NON-CONVENTIONAL WATER RESOURCE IN DEVELOPING COUNTRIES,
United Nations, New York. Dept. of Technical Co-operation for Development.
For primary bibliographic entry see Field 3A.
W86-03240

3C. Use Of Water Of Impaired Quality

MULTIPLE WATER REUSE IN POULTRY PROCESSING: CASE STUDY IN EGYPT,
Alexandria Univ. (Egypt). Higher Inst. of Public Health.
A. Hamza.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-156760, Price codes: A05 in paper copy, A01 in microfiche. EPA-600/2-83-005, January 1983. 96 p, 21 fig, 30 tab, 22 ref. 3-542-2.

Descriptors: *Reclaimed water, *Water reuse, Water treatment, Chlorination, Water use, Impaired water use, Wastewater, Wastewater management, Wastewater treatment, Wastewater renovation, Food processing industry.

An industrial-scale multiple water reuse system was under investigation for a period of four years at a modern poultry processing plant in Alexandria, Egypt. The system involved: chlorination of cooling water from the compressor; reuse of this water in the chiller; successive transfer of an equivalent amount of water from the chiller to the prechiller, from the prechiller to the wash tank, and finally, from the wash tank to the scalder. Process waters in the prechiller and wash tank were alternately purified by diatomaceous earth filtration. Long-term studies at the plant indicated successful utilization of a multiple reuse system with chlorinated water (20 mg/l input) and a water makeup rate of 20 cu m/day. Build-up of contaminants (total aerobic and coliform counts) and pollutants (Grease, suspended residue, BOD and COD) in the immersion tanks were compared to normal operation. (Author)
W86-03274

3D. Conservation In Domestic and Municipal Use

EVALUATION OF THE ADSORPTION PROPERTIES OF SILICALITE FOR POTENTIAL APPLICATION TO ISOLATING POLAR LOW-MOLECULAR-WEIGHT ORGANICS FROM DRINKING WATER,
Ames Lab., IA.
For primary bibliographic entry see Field 5F.
W86-03266

3F. Conservation In Agriculture

ENERGY AND U.S. AGRICULTURE: IRRIGATION PUMPING, 1974-1980,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
G. Sloggett.
Agricultural Economic Report No. 495, December 1982. 36 p, 1 fig, 9 tab, 18 ref, 3 append.

Descriptors: *Irrigation, *Economic aspects, *Groundwater, Irrigation efficiency, Irrigation engineering, Water potentials, Irrigation practices, Irrigation wells, Pump wells.

Data on a variety of aspects of pump-irrigation fuel costs are presented. Pump irrigators can reduce energy costs by irrigating more efficiently. U.S. farmers increased onfarm pump irrigation by 21 percent from 1974 to 1980, adding 7.5 million pump-irrigated acres. Farmers irrigated 42.6 million acres in 1980 with onfarm pumps, and pump energy accounted for 23 percent of total energy used onfarm for crop production. Most irrigation pumps used electricity, followed in descending order by natural gas, diesel, liquefied petroleum gas (LPG), and gasoline. Diesel fuel use about doubled, but the use of gasoline and LPG for pumping irrigation water declined. Pump irrigators can reduce energy costs by irrigating more efficiently. Tail-water recovery for surface-water irrigation systems is becoming very popular and can reduce energy use by 10 to 30 percent. Also, low-pressure center pivot sprinkler systems saved United States farmers an estimated $42 million in energy costs during 1980. (Halterman-PTT)
W86-03233

CROP-WATER PRODUCTION FUNCTIONS AND ECONOMIC IMPLICATIONS FOR THE TEXAS HIGH PLAINS REGION,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
P. G. Hoyt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-149690, Price codes: A03 in paper copy, A01 in microfiche. ERS Staff Report No. AGES820405, April 1982. 30 p, 16 tab, 12 ref.

Descriptors: *Irrigation efficiency, *Irrigation practices, *Water conservation, Water costs, *Cost analysis, Irrigation water, Irrigation requirements, Economic aspects, Corn, Sorghum, Wheat, Aquifer, Crop production, Decision making, Profit.

Crop-water production functions are estimated by growth stage for the major crops of corn, sorghum and wheat grown in the Texas High Plains region. An economic analysis of these production functions provides useful information for making farm-level irrigation decisions to increase profits and conserve water in the Ogallala Aquifer. Results of this study show that irrigators can both save water and increase profits for corn by applying water to maximize profits rather than yields when water prices (costs) are high. Profit maximizing quantities of irrigation water change very little in response to changes in crop or water prices, under conventional delivery and application efficiencies. Increasing irrigation application efficiency decreases water pumped at all water prices, while crop profits are only affected at medium and high water prices. A reduction in well yields of up to 20% has no significant effect on crop profits per acre for corn and wheat, assuming normal precipitation. Profit maximization with well yield reductions of 40% or less will result in lower irrigation application levels and not less land under irrigation, assuming normal precipitation. (Geiger-PTT)
W86-03255

WATER CONSERVATION ALTERNATIVES FOR CALIFORNIA AGRICULTURE: A MICROECONOMIC ANALYSIS,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
S. Kelly, and H. Ayer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-149708, Price codes: A02 in paper copy, A01 in microfiche. ERS Staff Report No. AGES820417, April 1982. 28 p, 11 tab, 11 ref.

Descriptors: *Irrigation efficiency, *Irrigation practices, *Water conservation, *Water costs, *Cost analysis, Irrigation water, Irrigation requirements, Economic aspects, Corn, Cotton, Tomatoes, Crop production, Decision making, Profit, Pricing.

Crop-water production functions for corn, cotton, and tomatoes grown in California are estimated to determine the effects on water use and farm profits of alternative water application levels, changes in irrigation delivery and field efficiencies, and quantity restrictions and changes in water cost on water applications. The production functions show that short run profits are sharply increased if irrigation field efficiences are increased. Education efforts to reduce irrigation levels will be profitable where the cost of water is medium or high; profits can be increased and water saved if water is medium or high; profts can be increased and water saved if water applications are cut below common practice or the yield maximizing levels. The magnitude of cost savings varies widely based on the source of surface water and the lift depth of pumped water. Educational and management services can encourage farmers to improve field and delivery efficiencies by providing technical and economic data which shows the profitability of efficiency improvement. Improved delivery efficiencies show substantial increases in short run profits in areas of medium to high water prices. The production functions can determine the profit reduction from a 10 or 20% cut in water applications on crops. When very low water prices are increased several fold, water application is reduced by a meaningful amount. (Geiger-PTT)
W86-03256

EFFECTS OF DECREASED WATERING ON WHEAT AND BARLEY YIELDS,
New Mexico Water Resources Research Inst., Las Cruces.
T. W. Sammis, and D. Smeal.
WRRI Report No. 179, January 1983. 72 p, 12 fig, 31 tab, 11 ref, 2 append. 1-4-23652.

Descriptors: *Soil-water-plant relationships, *Water conservation, *Irrigation efficiency, *Water use efficiency, Barley, Wheat, Crop yield, Evapotranspiration, Sprinkler irrigation, Grain crops, Water stress, Stress, Clovis, New Mexico, Agricultural hydrology.

Water resource planners use a water-production function, which is the relationship between yield and evapotranspiration (E) to determine the economic impact of various water allocation decisions. Wheat and barley were irrigated with a range of water levels using a sprinkler-line source to determine yield and evapotranspiration under deficit irrigation. The water-production functions for spring and winter barley were different and varied under different levels of fertilizer. However, expressing the data in terms of relative yield and relative evapotranspiration produced a common water production function. The grain water-production functions for the winter wheat under non-nitrogen stress conditions were the same over years. The average wheat water-production function at Covis, New Mexico, was statistically different from a derived wheat water-production function in Yuma, Arizona. However, when the water-production functions were again expressed in relative yield and relative E terms, the production functions became statistically the same and transferable to either site. The transferability of a water-production function from location to location can be accomplished, when expressed in relative terms, under varying climate conditions and varying fertilizer levels. Water stress also affects the physiological development rate and physiological characteristics of both barley and wheat. The changes in the physiological characteristics of the crops can be used to estimate the resulting decrease in yield caused by moisture stress. (Author)
W86-03289

ADVANCES IN IRRIGATION,
Volume I. Academic Press, New York. 1982, Edited by Daniel Hillel. 302 p.

Descriptors: *Irrigation, *Irrigation practices, *Irrigation programs, *Irrigation efficiency, *Crop production, Models, Irrigation requirements, Water stress, Trickle irrigation, Irrigation water, Drip irrigation, Salt balance, Conjunctive use, Irrigation design, Irrigation canals, Soil moisture meters, Semiarid lands.

This volume is the first of a new serial publication entitled 'Advances in Irrigation'. The new serial is aimed at fulfilling a perceived global need for periodically updated, comprehensive elucidations of the various topics of contemporary interest and importance, related to the rapidly advancing science and engineering practice of irrigation. The contributions used in the serial will include, but not be limited to, state-of-the-art reports, critiques of current practices, economic analyses, case studies of irrigation in difference locations, changing concepts of irrigation, and water-use efficiency. Considerations will be given to such topics as energy and irrigation, controlled-environment crop production, conjuctive use of rainfall and irrigation, and the precise role of irrigation in regional and global food production. Contributions of this first volume cover the following topics: conjunctive use of rainfall and irrigation in semiarid regions, irrigation scheduling using soil moisture measurements(theory and practice), canopy temperature and crop water stress, use of solute transport models to estimate salt balance below irrigated cropland, level-basin irrigation, flow measurement flumes(applications to irrigation), (water management), and principles, practices, and potentialities of trickle (drip) irrigation. (Geiger-PTT)
W86-03398

CONJUNCTIVE USE OF RAINFALL AND IRRIGATION IN SEMIARID REGIONS,
Agricultural Research Service, Bushland, TX. Conservation and Production Research Lab.
B. A. Stewart, and J. T. Musick.
IN: Advances in Irrigation, Volume 1, 1982. 1-24 p, 9 fig, 4 tab, 24 ref.

Descriptors: *Irrigation practices, *Irrigation programs, *Irrigation efficiency, *Conjunctive use, *Semiarid lands, Irrigation, Irrigation requirements, Crop production, Irrigation water, Rainfall, Precipitation, Economic aspects, Soil water, Evapotranspiration, Crop yield.

The conjunctive use of rainfall and irrigation offers considerable potential for increasing water-use efficiency and reducing energy needs for pumping in semiarid regions. Rainfall distributions in semiarid areas of the Central and Southern Great Plains regions of the United States are given. The management strategy of limited irrigation is to optimize production per unit of applied water, rather than to maximize yield per unit of land. Limited irrigation warrants serious consideration as a means of increasing efficient use of water resources for drought-tolerant crops such as sorghum, wheat, cotton, sunflower, and sugar beet. The water-use efficiency is frequently defined as yield per unit amount of evapotranspiration of crops. The conjunctive use of irrigation water and rainfall can be improved indirectly by conservation tillage which decreases runoff, increases infiltration, and reduces evaporation by leaving more crop residues on the soil surface. Specific systems for the conjunctive use of rainfall and irrigation are examined. These

include limited-irrigation-dryland farming, low-energy precision-application, alternating strips of grain sorghum with wheat, tensiometer systems, runoff pits, snow management, crop breeding, antitranspirants, and irrigated-dryland crop rotations. Management systems used for limited irrigation must be carefully planned to ensure that increased gains in yield due to higher water-use efficiency are not offset by increased production costs in other areas. (Geiger-PTT)
W86-03399

IRRIGATION SCHEDULING USING SOIL MOISTURE MEASUREMENTS: THEORY AND PRACTICE,

Washington State Univ., Pullman. Dept. of Agronomy and Soils.
G. S. Campbell, and M. D. Campbell.
IN: Advances in Irrigation, Volume 1, 1982. p 25-42, 5 fig, 22 ref.

Descriptors: *Irrigation requirements, *Irrigation programs, Irrigation efficiency, *Soil water, *Soil moisture meters, Irrigation, Crop production, Irrigation water, Evapotranspiration, Tensiometers, Monitoring, Models.

The measurement of soil moisture content is probably the oldest method of determining irrigation schedules. Recognition of the fact that the soil water system is dynamic is of fundamental importance in irrigation scheduling. When the soil water content is maintained at values above field capacity, drainage from the profile is rapid, and both water and nutrients are lost. This transition from negligible drainage to appreciable drainage occurs over a narrow range of water contents. The actual water content at which this transition occurs depends on the particular soil. The irrigator must control soil water content so that drainage remains at the value required to meet the objectives of the irrigation. Models were used to calculate soil full and refill points, and the effects of environmental factors on these two points. To schedule irrigation using soil moisture measurements, a site for monitoring soil moisture must be selected, a device for determining the soil water content or potential must be chosen, full and refill points must be set for the particular soil being monitored, and a record-keeping scheme must be established which will show when irrigation is needed and whether overirrigation has occurred. Calibration and recalibration of the neutron probes are described. The soil moisture method of irrigation may be integrated with evapotranspiration and pan evaporation methods to assure that cumulative errors in the climatological scheduling method did not lead to either crop stress or overirrigation. (Geiger-PTT)
W86-03400

CANOPY TEMPERATURE AND CROP WATER STRESS,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson.
IN: Advances in Irrigation, Volume 1, 1982. p 43-85, 17 fig, 120 ref.

Descriptors: *Infrared radiation, *Water stress, *Irrigation efficiency, *Temperature, *Canopy, Infrared imagery, Irrigation requirements, Plant water potential, Air temperature, Evapotranspiration.

During the first half of the twentieth century, it was suggested that leaf temperatures are always warmer than the air. However, it is now accepted that leaf temperatures and canopy temperatures may be either warmer or cooler than the air, depending upon environmental factors that can for the most part be specified. In the arid areas where irrigation is practiced, temperature techniques work best to predict crop water stress. All temperature-based stress indices assume that only vegetation temperatures are measured. With infrared (IR) thermometry, care must be taken to avoid the complication of the soil background, especially when sparse vegetation is being measured. Critical values of the temperature indices need to be established for various crops. As the development of temperature-based indices progresses, several management factors that need to be considered for certain crops are presented. Advances in IR technology during the past few years have allowed the production of lightweight hand-held IR thermometers that can be used to measure plant canopy temperatures rapidly. Data accumulated so far suggests success in predicting the timing of irrigations to prevent water stress in crops. (Geiger-PTT)
W86-03401

USE OF SOLUTE TRANSPORT MODELS TO ESTIMATE SALT BALANCE BELOW IRRIGATED CROPLAND,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury.
IN: Advances in Irrigation, Volume 1, 1982. p 87-104, 4 fig, 3 tab, 51 ref.

Descriptors: *Models, *Solute tranport, *Irrigation efficiency, *Salt balance, *Drainage water, Model studies, Irrigation requirements, Plant water potential, Crop production, Irrigation.

The state of the art of solute tranport modeling is reviewed and the uses and limitations of models of varying degrees of complexity are discussed in some detail. Solute transport models are useful in describing the movement of salt through the soil, because such in situ field experiments are not feasible due to their time requirements. Solute tranport models differ greatly in complexity and utility, ranging from simple steady-state models which ignore chemical reactions, to complex dynamic models which include all major soil-solution reactions. Three types of solute transport models were applied to the calculation of drainage water composition - the proportional model, the steady-state chemistry model, and the dynamic solute transport model with chemical reactions. In many cases the steady-state assumption will be in error because of the persistence of exchange reactions. During the transitional period or even in steady state, precipitation or dissolution reactions may have an appreciable influence on the salt balance of the drainage water, and calculations based on simple models may be greatly in error. The usefulness of solute transport models to make predictions in field conditions is limited by the inadequacy of water transport models in describing the spatial and temporal distribution of water flow. The solute transport model has its greatest utility as a tool for predicting relative behavior of different irrigation waters, different soil types, or different water management strategies when a scenario for drainage ion composition is produced. (Geiger-PTT)
W86-03402

LEVEL-BASIN IRRIGATION,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. R. Dedrick, L. J. Erie, and A. J. Clemmens.
IN: Advances in Irrigation, Volume 1, 1982. p 105-145, 24 fig, 3 tab, 34 ref, 1 append.

Descriptors: *Irrigation, *Basin irrigation, *Irrigation practices, *Irrigation design, *Irrigation engineering, Models, Irrigation requirements, Irrigation efficiency, Irrigation programs, Drainage patterns, Infiltration.

In level-basin irrigation, a controlled amount of water is applied to a level soil surface, generally over a short time. Since irregularities in soil infiltration rates or general soil type and land elevation differences may result in uneven distribution of irrigation water, several land preparation measures must be taken. The topsoil should be as uniform as possible. Land grading should include rough grading followed by precision finishing with laser-controlled equipment. The cost of leveling will depend on the amount of soil that must be moved, which is turn is related to field slope and basin size. Design of level basins involves sizing the basins so that a desired distribution uniformity is met for the particular volume of water to be applied (depth of application). The distribution uniformity of a level basin can be functionally described by the Manning equation. When designing level basins a form of the Manning equation has commonly been used. In the Soil Conservation Service design manual for border irrigation, a series of design charts are presented for level basins which relate unit flow rate, basin length, depth of flow, and time of application to distribution uniformity. Theoretical models, such as the zero-inertia model have been developed to predict border irrigation advance and recession. Performance, maintenance and irrigation water delivery systems of border irrigation systems are considered. (Geiger-PTT)
W86-03403

FLOW MEASUREMENT FLUMES: APPLICATIONS TO IRRIGATION WATER MANAGEMENT,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 8B.
W86-03404

PRINCIPLES, PRACTICES, AND POTENTIALITIES OF TRICKLE (DRIP) IRRIGATION,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. A. Bucks, F. S. Nakayama, and A. W. Warrick.
IN: Advances in Irrigation, Volume 1, 1982. 219-298 p, 35 fig, 11 tab, 200 ref.

Descriptors: *Trickle irrigation, *Drip irrigation, *Irrigation design, *Irrigation operation, Irrigation, Irrigation efficiency, Irrigation practices, Salt balance, Irrigation programs, Hydraulics, Spray irrigation.

Trickle or drip irrigation represents one of the latest innovations in irrigation technology. It was first used in Germany in 1860. Modern trickle irrigation technology dates back to 1964. Trickle irrigation offers more beneficial use of available water, enhanced plant growth and yield, reduced salinity hazard to plants, improved fertilizer and other chemical applications, limited weed growth, reduced operation labor, decreased energy requirements, and improved cultural practices. Potential disadvantages of trickle irrigation include persistent maintenance requirements, salt accumulation near plants, restricted soil water distribution and plant root development, and other economic and technical limitations. Advances in emitters have been made in the trickle, subsurface trickle, bubbler, spray, mechanical move and pulse irrigation systems. Advances in the distribution lines and fittings, system control, water measurement, and automation systems are described. The principles of soil water modeling in relation to trickle irrigation systems are presented. The hydraulics, emission uniformity, and emitter variability of trickle systems are considered. The causes of emitter clogging and preventive maintenance practices are listed. The application of fertilizer and water amendments, irrigation scheduling and crop response, salinity management, water placement and plant rooting, and adaption of cultural practices are examined. Future developments and research in trickle irrigation are discussed. (Geiger-PTT)
W86-03405

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

METHOD OF ESTIMATING FLOOD VOLUMES IN WESTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4164, 1984. 18 p, 2 fig, 4 tab, 2 ref.

Descriptors: Flood discharge, Flood flows, *Volumetric analysis, *Estimating flood volume, Forecasting, *Regression analysis, *Kansas, Crest-stage-indicator gages, *Flood volume.

Relationships between flood volume and peak discharge in western Kansas were developed considering basin and climatic characteristics in order to evaluate the availability of surface water in the area. Multiple-regression analyses revealed a relationship between flood volume, peak discharge, channel slope, and storm duration for basins smaller than 1,503 square miles. The equation VOL=0.536 PEAK1.71 SLOPE-0.85 DUR0.24, had a correlation coefficient of R=0.94 and a standard error of 0.33 log units (-53 and +113 percent). A better relationship for basins smaller than 228 square miles resulted in the equation VOL=0.483 PEAK0.98 SLOPE-0.74 AREA0.30, which had a correlation coefficient of R=0.90 and a standard error of 0.23 log units (-41 and +70 percent). (USGS)
W86-02922

PEAK FLOW, VOLUME, AND FREQUENCY OF THE JANUARY 1982 FLOOD, SANTA CRUZ MOUNTAINS AND VICINITY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Blodgett, and K. R. Poeschel.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-583, 1984. 22 p, 6 fig, 5 tab, 7 ref.

Descriptors: *Flood frequency, Flood discharge, Precipitation intensity, Rainfall distribution, *Rainfall-runoff relations, Historic floods, *Peak flow, *California, Santa Cruz Mountains, San Lorenzo River, Santa Cruz.

The areal distribution of precipitation and flooding during the January 1982 storm in the Santa Cruz Mountains and vicinity was influenced by the orographic effect of the Santa Cruz Mountains. Precipitation depths ranged from 12.2 inches in 1 day on the west side to 1.33 inches on the east side. Unit peak discharge ranged from 626 cubic feet per second per square mile on the west side to 83 cubic feet per second per square mile on the east side. The median recurrence interval of peak flow on the west side is 22 years, whereas on the east side it is 6.8 years. Development of a relation between rainfall at Ben Lomond and runoff on the San Lorenzo River at Big Trees shows that the significant climatic factors that describe the flood hydrology of the basin are (1) precipitation for the 3 consecutive days including the day of peak flows and (2) precipitation for a 60-day duration prior to the peak. A study of historical floods and precipitation characterisitics in the San Lorenzo River basin suggests that major floods in the area are the product of (1) greater-than-normal antecedent precipitation for up to 60 days prior to the flood and (2) subsequent intense frontal-type storms immediately prior to the peak. (USGS)
W86-02935

PREDICTIVE SIMULATIONS OF ALTERNATIVES FOR MANAGING THE WATER RESOURCES OF NORTH FORK SOLOMON RIVER VALLEY BETWEEN KIRWIN DAM AND WACONDA LAKE, NORTH-CENTRAL KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2A.
W86-02941

FLOOD-DISCHARGE PROFILES OF SELECTED STREAMS IN ROCKLAND COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02960

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--COASTAL RIVER BASINS OF THE SOUTH SHORE AND BUZZARDS BAY,

Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and M. A. Morgan.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4288, 1985. 30 p, 5 fig, 5 tab, 35 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, South Shore coastal river basins, Buzzards Bay coastal river basins.

The coastal river basins include the minor river basins draining into Massachusetts Bay along the South Shore or into Buzzards Bay. The larger of these basins are the North, South, Jones, Wareham, Weweantic, Mattapoisett, Acushnet, and Slocums River basins. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for data collection sites. Statistics on streamflow characteristics computed with a new data base are presented for six gaged streams. Daily-flow records through 1982 were used to compute annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 49 partial-record sites and procedures used to determine the hydrologic characteristics of the basin are summarized. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for goveramental agencies and the engineering and planning communities. (USGS)
W86-02962

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--THAMES RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and J. A. LeBlanc.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4287, 1984. 27 p, 5 fig, 5 tab, 30 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Quinebaug River basin, French River basin.

The Thames River basin includes streams draining the Quinebaug River (141 square miles), French River (99.5 square miles), and Middle River (about 6 square miles) basins in south central Massachusetts. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for the first time for streams draining more than 3 square miles and were recomputed for data-collection sites. Streamflow characteristics at seven sites, were calculated using a new data base with daily flow records through 1980. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10 year recurrence intervals. Seven-day low-flow statistics are presented for 32 partial-record sites, and the procedures used to determine the hydrologic characteristics of the basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are provided for seven gaged streams. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02963

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--BLACKSTONE RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and A. F. Phipps.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4286, 1985. 26 p, 5 fig, 5 tab, 30 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Blackstone River basin.

The Blackstone River basin encompasses 335 square miles in south-central Massachusetts, including parts of Bristol, Middlesex, Norfolk, and Worcester Counties. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for the first time for streams draining more than 3 square miles and were recomputed for data-collection sites. Streamflow characteristics, were calculated using a new data base with records through 1980. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. The 7-day, 10-year low-flow values are presented for 31 partial-record sites and the procedures used to determine the hydrologic characteristics of the basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for the six gaged streams in the Blackstone River basin. This gazetteer will aid in the planning and siting of water-resources-related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02965

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS--HOUSATONIC RIVER BASIN,

Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and R. G. Lippert.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4285, 1984. 30 p, 5 fig, 5 tab, 30 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Housatonic River basin.

The Housatonic River basin includes streams that drain 504 square miles in western Massachusetts and 30.5 square miles in eastern New York. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for the first time for streams draining more than 3 square miles and were recomputed for data-collection sites. Streamflow characteristics for four gaged streams were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 52 partial-record sites, and the procedures used to determine the hydrologic characteristics of the basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are provided for selected gaging stations. This gazetteer will aid in the planning and siting of water-resources related activities and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02966

FLOODS OF MAY 1978 IN SOUTHEASTERN MONTANA AND NORTHEASTERN WYOMING,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02971

STREAMFLOW CHARACTERISTICS OF MOUNTAIN STREAMS IN WESTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.

For primary bibliographic entry see Field 2E.
W86-02972

GAZETTEER OF HYDROLOGIC CHARACTERISTICS OF STREAMS IN MASSACHUSETTS–TAUNTON AND TENMILE RIVER BASINS AND COASTAL RIVER BASINS OF MOUNT HOPE BAY, NARRAGANSETT BAY, AND RHODE ISLAND SOUND,

Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle, and G. R. Keezer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4283, 1984. 35 p, 5 fig, 5 tab, 30 ref.

Descriptors: *Drainage area, *Flow duration, *Low flow, *Frequency analysis, Flow characteristics, Streamflow, Surface water, *Massachusetts, Taunton River basin, Tenmile River basin, Mount Hope Bay coastal basins, Narragansett Bay coastal basins, Rhode Island Sound coastal basins.

The study area includes streams draining the Taunton River (562 square miles), the Tenmile River (53.1 square miles), and the minor streams flowing into Mount Hope Bay, Narraganset Bay, and Rhode Island Sound in southern Massachusetts, and adjacent areas of Rhode Island. Drainage areas, using the latest available 1:24,000 scale topographic maps, were computed for the first time for streams draining more than 3 square miles and were re-computed for data-collection sites. Streamflow characteristics, at 10 gaging stations were calculated using a new data base with daily flow records through 1981. These characteristics include annual and monthly flow statistics, duration of daily flow values, and the annual 7-day mean low flow at the 2-year and 10-year recurrence intervals. Seven-day low-flow statistics are presented for 44 partial-record sites and the procedures used to determine the hydrologic characteristics of a basin are summarized. Basin characteristics representing 14 commonly used indices to estimate various streamflows are presented for selected gaged streams. This gazetteer will aid in the planning and managing of water-resources related activities, and will provide a common data base for governmental agencies and the engineering and planning communities. (USGS)
W86-02976

MAXIMUM KNOWN STAGES AND DISCHARGES OF NEW YORK STREAMS THROUGH SEPTEMBER 1981,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03038

WATER BUDGET FOR MAJOR STREAMS IN THE CENTRAL VALLEY, CALIFORNIA, 1961-77,

Geological Survey, Tahoe City, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03050

DATA COLLECTION FOR A TIME-OF-TRAVEL AND DISPERSION STUDY ON THE COOSA RIVER NEAR CHILDERSBURG, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03052

IMPACTS OF THE TAMPA BYPASS CANAL SYSTEM ON THE AREAL HYDROLOGY, HILLSBOROUGH COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
R. L. Knutilla, and M. A. Corral.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4222, 1984. 65 p, 32 fig, 7 tab, 32 ref.

Descriptors: Hydrologic systems, Groundwater levels, *Canal construction, Water quality, Streamflow, Springs, *Surface-groundwater relationships, Hillsborough County, *Florida, Tampa Bypass Canal.

Construction of the Tampa Bypass Canal, Florida has resulted in an increase in streamflow from the canal area. Base-flow discharge is more than twice preconstruction amounts. Discharge from springs has decreased by one half or more. Ground-water levels show an increase of up to 4 feet near structure S-160 due to impoundment of water. Elsewhere, levels have generally decreased by 2 to 4 feet. Some minor changes in water quality have occurred. Some of the changes, however, may be attributed to factors other than canal construction. (USGS)
W86-03056

SIMULATED EFFECTS OF PROPOSED RESERVOIR-DEVELOPMENT ALTERNATIVES ON STREAMFLOW QUANTITY IN THE WHITE RIVER, COLORADO AND UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
G. Kuhn, and S. R. Ellis.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4297, 1984. 59 p, 18 fig, 6 tab, 13 ref.

Descriptors: *Reservoirs, Streamflow depletion, Hydraulic models, *Reservoir effects, *Water resources development, Minimum flow, Simulation analysis, White River, Avery Reservoir, Powell Park Reservoir, Taylor Draw Reservoir, White River Reservoir, *Colorado, *Utah.

Numerous reservoirs have been proposed for the White River basin in Colorado and Utah, primarily to provide water for oil-shale development. A multireservoir-flow model was used to simulate the effects of streamflow withdrawal at four of the proposed reservoirs using historical streamflow data from the 1932-81 water years. The proposed reservoirs considered in the study were Avery, Powell Park, Taylor Draw, and White River Reservoirs; construction of Taylor Draw Dam was completed during the study. Annual streamflow depletions from the White River ranging from about 93,000 to 226,000 acre-feet were simulated for the 50 year period. Simulated streamflow throughout the year generally became smaller and more constant as streamflow throughout the year generally became smaller and more constant as streamflow depletion increased. Minimum streamflow requirements would not have been met for a maximum of 13 years and water-use requirements associated with the proposed reservoirs would not have been met for a maximum of 3 years. The current water-use pattern, which depletes about 40,000 acre-feet per year and is dominated by irrigation of hay meadows and pastureland, was maintained in the simulation. Relations between reservoir active capacity and yield applicable to the White River also were developed. These relations show that reservoir storage of about 400,000 acre-feet is the maximum practicable for the White River. (USGS)
W86-03061

PRELIMINARY INVESTIGATION OF FLOW CHARACTERISTICS OF THE ALABAMA RIVER UPSTREAM FROM SELMA, ALABAMA,

Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03077

FLOOD FREQUENCY AND STORM RUNOFF OF URBAN AREAS OF MEMPHIS AND SHELBY COUNTY, TENNESSEE,

Geological Survey, Memphis, TN. Water Resources Div.
B. L. Neely.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4110, 1984. 51 p, 10 fig, 7 tab, 13 ref.

Descriptors: *Floods, *Regional floods, *Regression analysis, *Peak discharge, *Tennessee, Gaging stations, Hydraulic design, Flood frequency, Flood hydrographs, *Memphis, Shelby County, *Rainfall-runoff model.

Techniques are presented for estimating the magnitude and frequency of peak discharges and storm runoff on stream in urban areas of Memphis, Tennessee. Comprehensive analyses were made in which physical characteristics of streams are related to synthetic flood characteristics at gaging stations. Equations derived from analyses provide estimates of peak discharges with recurrence intervals of 2 to 100 years on streams that have drainage areas less than 20 square miles. The regression analyses indicated that size of drainage area and condition of channel (paved or unpaved) are the most significant basin characteristics affecting the magnitude and frequency of floods in urban streams. Data from 27 gaging stations with 8 years of record were used in the analyses. Flood frequency at each gaging station was computed from calibrated parameters in a rainfall-runoff model. Techniques are also presented for estimating discharge hydrographs for individual floods by using the unit hydrograph, lag time, and rainfall excess. (USGS)
W86-03078

FLOODING IN NORTHWESTERN HILLSBOROUGH AND SOUTHERN PASCO COUNTIES, FLORIDA, IN 1979,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03109

FRESHWATER RUNOFF AND SALINITY DISTRIBUTION IN THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA, 1980-82,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2L.
W86-03118

EVALUATION OF THE EFFECTS OF LAKE AUDUBON ON GROUND- AND SURFACE-WATER LEVELS IN THE LAKE NETTIE AREA, EASTERN MCLEAN COUNTY, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03140

GENERALIZED SKEW COEFFICIENT FOR FLOOD FREQUENCY COMPUTATIONS FOR THE STATE OF HAWAII,

Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03143

STORAGE ANALYSIS FOR EPHEMERAL STREAMS IN SEMIARID REGIONS,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03171

WATER RESOURCES DATA, TEXAS, WATER YEAR 1982, VOLUME 3; COLORADO RIVER, LAVACA RIVER, GUADALUPE RIVER, NUECES RIVER, RIO GRANDE BASINS AND INTERVENING COASTAL BASINS,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03208

WATER RESOURCES DATA, OKLAHOMA WATER YEAR 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03217

WEATHERING TESTS CONDUCTED ON SOIL STABILIZERS: INTERIM REPORT,
Bureau of Reclamation, Denver, CO.
W. R. Morrison, and Z. D. Fedotova.
A Water Resource Technical Publication, U.S./U.S.S.R. Joint Studies on Plastic Films and Soil Stabilizers, December 1984. 83 p, 55 fig, 14 tab.

Descriptors: *Erosion control, *Erosion, *Vegetation establishment, Bank erosion, Soil erosion, Soil stability, Weathering, Revegetation, Vegetation regrowth, Vegetation, Soil stabilization.

Studies on soil stabilizer specimens in the form of crusts or films formed as a result of treatment of sandy slopes of a drainage canal are described. The joint U.S. and U.S.S.R. program involved testing a means of stabilizing slopes or reclamation (drainage) canals by direct sowing of perennial grass (without emplacement of a fertile layer of soil and raking in of seeds), accompanied by application of polycomplexes to the surfaces of sands, sandy, and sandy-loam soils. the coatings retain their protective qualities under the effects of alternating wetting and drying; they do not soften or fail, are resistant to torrential rains, spring floods and wind velocities of 24 to 30 m/s. The grass seeds grow freely in the first year, with an average shoot density of 3600 to 4100/sq m. The economic aspects of the reclamation of canal banks is discussed. (Halterman-PTT)
W86-03247

HERBICIDAL RESIDUES AND ENVIRONMENTAL EFFECTS FROM THE EXPERIMENTAL APPLICATION OF TWO 2,4-D FORMULATIONS TO CONTROL EURASIAN WATERMILFOIL,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
N. E. Otto, J. C. Pringle, and D. Sisneros.
Available from Engineering and Research Center, Denver, CO. Report No. REC-ERC-83-1, July 1983. 97 p, 24 fig, 27 tab, 2 app, 15 ref.

Descriptors: *Herbicide residues, *Environmental effects, *Weed control, *Aquatic weed control, *Toxicity, Eurasian Watermilfoil, Water analysis, Chemical analysis, Water quality, Limnology, Bioaccumulation, Oklahoma.

In response to the need for an effective and environmentally acceptable herbicide to control erosian watermilfoil, a serious aquatic weed problem, an interagency research study was initiated involving the USBR (Bureau of Reclamation) and the COE (U.S. Army Corps of Engineers). This document reports the tolerance and label amendment efforts done by the USBR. Experimental small-plot applications of 2,4-D dimethylamine (DMA) and butoxyethanol ester (BEE) at rates of 20 and 40 lb/acre (22.5 and 45 kg/ha) were made at Banks Lake, Washington and Fort Cobb Reservoir, Oklahoma with subsequent water, hydrosoil, invertebrate organism, and dish flesh sample collection and analysis for residues, through 56-days posttreatment. The temporary potable water tolerance of 0.1 mg/L (0.1 p/m) was exceeded in three 1-day posttreatment samples (of 1680 water samples analyzed) or 0.18% of the total samples. No dichlorophenols were found in water, but dimethylnitrosamines in the microgram/L range were detected in a few pretreatment and posttreatment samples from both sites. Hydrosoil 2,4-D residues were low, with concentrations ranging from 0 to 0.316 micrograms/g in DMA treated areas and a maximum of 37 micrograms/g of soil resulting from a 45 kg/ha (40 lb/acrea) BEE application. Trace amounts of 2,4-D dichlorophenol in the microgram/L range were found in some hydrosoil pretreatment and posttreatment samples. Herbicide residues in fish flesh were well within the 1 mg/L (1 p/m) food additive tolerance, with no evidence of bioaccumulation.
W86-03327

4B. Groundwater Management

SIMULATED GROUND-WATER FLOW IN THE POTOMAC AQUIFERS, NEW CASTLE COUNTY, DELAWARE,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02920

WATER-SUPPLY POTENTIAL OF THE FLORIDAN AQUIFER IN OSCEOLA, EASTERN ORANGE, AND SOUTHWESTERN BREVARD COUNTIES, FLORIDA,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02924

ESTIMATION OF VERTICAL HYDRAULIC CONDUCTIVITY OF THE CLAY LAYER BETWEEN THE EUTAW AND GORDO AQUIFERS IN THE VICINITY OF FAUNSDALE, MARENGO COUNTY, ALABAMA,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02925

MODEL PROJECTIONS, 1980-99, FOR ARKANSAS RIVER VALLEY, HAMILTON AND KEARNY COUNTIES, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02928

WATER QUALITY OF A STREAM-AQUIFER SYSTEM, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02931

HYDROGEOLOGIC DATA FROM A TEST WELL IN EAST-CENTRAL DUVAL COUNTY, FLORIDA,
Geological Survey, Jacksonville, FL. Water Resources Div.
D. P. Brown, R. A. Johnson, and R. A. Broxton.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-802, 1985. 61 p, 18 fig, 3 tab, 4 ref.

Descriptors: Observation wells, Groundwater, *Subsurface investigations, Saline-water intrusion, Confined aquifers, *Hydrogeology, Well logging, *Test wells, *Florida, Duval County, Jacksonville, Floridan aquifer system.

A 2,112-foot test well was drilled in east-central Duval County, Florida, to obtain geologic, hydrologic, and water chemistry data. Drill cuttings and water samples were collected, and water-level measurements and lithologic and geophysical logs were made. Deposits to a depth of 575 feet consist of sand, clayey sand, phosphatic sandy clay, coquina, sandy limestone, and dolostone. Below 575 feet, the deposits consist of fragmented and granular limestone, dolomitic limestone, and massive to finely crystalline dolostone, which comprise the Floridan aquifer system in the area. Water levels were measured near or at the bottom of the drill hole through the drill stem and in the annular space between the drilled hole and drill stem at the well head as drilling progressed from 770 to 2,112 feet in depth. Water levels measured through the drill stem ranged from 1.17 feet above land surface at a depth of 2,107 feet to 15.0 feet above land surface at a depth of 1,574 feet. Water levels measured in the annular space ranged from 7.5 feet above land surface at a depth of 770 feet to 14.9 feet at various depths from 1,574 to 1,721 feet. Chloride concentrations of water sampled through the drill stem from a depth of 711 to 1,616 feet ranged from 22 to 150 milligrams per liter at 1,648 feet. Chloride concentrations then ranged from 345 to about 800 milligrams per liter to a depth of 2,071 feet and then increased to a maximum of 5,450 milligrams per liter at 2,107 feet. (USGS)
W86-02938

SURFICIAL AQUIFER IN PINELLAS COUNTY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02946

GROUND-WATER SYSTEM AND SIMULATED EFFECTS OF GROUND-WATER WITHDRAWALS IN NORTHERN UTAH VALLEY, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02948

FEASIBILITY OF ARTIFICIAL RECHARGE IN THE COASTAL PLAIN NEAR ATLANTIC CITY, NEW JERSEY, WITH EMPHASIS ON THE 800-FOOT SAND OF THE KIRKWOOD FORMATION,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02949

PROJECTED WATER-LEVEL DECLINES IN THE OGALLALA AQUIFER IN LEA COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02952

APPLICATION OF THE CONJUGATE-GRADIENT METHOD TO GROUND-WATER MODELS,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02954

REGIONAL GEOHYDROLOGY OF THE NORTHERN LOUISIANA SALT-DOME BASIN, PART II, GEOHYDROLOGIC MAPS OF THE TERTIARY AQUIFERS AND RELATED CONFINING LAYERS,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02956

AVAILABILITY OF GROUND WATER IN THE OUTWASH AQUIFER, MARION COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02958

ALTITUDE AND CONFIGURATION OF THE WATER TABLE IN THE HIGH PLAINS AQUIFER IN KANSAS, 1970,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02970

HYDROGEOLOGY OF THE CLAYTON AQUIFER OF SOUTHWEST GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02995

GEOCHEMICAL SURVEY TO DETERMINE WATER-QUALITY CHARACTERISTICS OF THE BIG SIOUX AQUIFER IN EASTERN SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03019

GEOHYDROLOGY OF ROCKS PENETRATED BY TEST WELL UE-25PNO1, YUCCA MOUNTAIN AREA, NYE COUNTY, NEVADA,

Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03024

EFFECTS OF ARTIFICIAL RECHARGE ON AN ALLUVIAL AQUIFER, OGALLALA FORMATION, TEXAS,

Geological Survey, Lakewood, CO. Water Resources Div.
R. F. Brown, and W. S. Keys.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2251, 1985. 56 p, 67 fig, 7 tab, 26 ref.

Descriptors: *Artificial recharge, *Aquifer characteristics, *Hydrogeology, Borehold geophysics, Well logging, Groundwater movement, *Ogallala Formation, *Texas.

Four recharge tests were conducted by injecting water from playa lakes through wells into the Ogallala Formation. Injection was by both gravity flow and pumping under pressure. At one site, 34-acre feet of water was injected by gravity which produced a significant increase in yield of the well. At a second site, gravity injection of only 0.58 acre-foot caused a significant decrease in permeability due to plugging of the aquifer by suspended sediment. At two other sites, injection by pumping 6 and 14 acre-feet respectively, resulting in discharge of water at the surface and in perching of water above the water table. Difference in success of recharge were largely due to: lithology and, therefore, the type of permeability; the concentration of suspended solids in the recharge water; and the injection technique. The injection technique can be controlled and the concentration of suspended solids can be minimized by treatment, but the site for well recharge will accept water most rapidly if it is selected on the basis of a favorable geohydrologic environment. Geophysical logs were used to study the effect of aquifer lithology on recharge and to understand the movement of injected water. Temperature logs were particularly useful in tracing the movement of recharged water. Natural-gamma, gamma-gamma, and neutron logs provided important data on lithology and porosity in the aquifer and changes in porosity and water distribution resulting from recharge. Effective recharge of the Ogallala Formation, using water from playa lakes, is possible where geohydrologic conditions are favorable and the recharge system is properly constructed. (USGS)
W86-03032

PRINCIPLE OF SUPERPOSITION AND ITS APPLICATION IN GROUND-WATER HYDRAULICS,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03040

GROUND-WATER LEVELS IN WYOMING, 1974 THROUGH 1983,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03046

PROPOSED ARTIFICIAL RECHARGE STUDIES IN NORTHERN QATAR,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03058

TEST WELLS IN CENTRAL WASHINGTON, 1977-79: DESCRIPTION AND RESULTS,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03062

SELECTED HYDROGEOLOGIC DATA FOR THE BIG MUDDY CREEK VALLEY NEAR PLENTYWOOD, NORTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-406, 1985. 22 p, 3 fig, 5 tab.

Descriptors: *Groundwater, *Water quality, Well logs, *Hydrologic data, Data collections, *Montana, Plentywood.

Selected hydrogeologic data have been compiled for the Big Muddy Creek valley near Plentywood. The data pertain to most of the known municipal, commercial, and domestic wells drilled in the valley. The data include records of 59 wells and 19 test holes, 21 chemical analyses of water samples, and 40 logs describing lithology penetrated during drilling operations. (USGS)
W86-03068

HYDROGEOLOGIC APPRAISAL OF FIVE SELECTED AQUIFERS IN ERIE COUNTY, NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03084

GEOHYDROLOGY OF THE AQUIFER IN THE SANTA FE GROUP, NORTHERN WEST MESA OF THE MESILLA BASIN NEAR LAS CRUCES, NEW MEXICO,

Geological Survey, Las Cruces, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03088

TEST WELLS T27 AND T28 WHITE SANDS MISSILE RANGE, DONA ANA COUNTY, NEW MEXICO,

Geological Survey, Las Cruces, NM. Water Resources Div.
R. G. Myers, and K. M. Pinckley.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-809, 1985. 19 p, 3 fig, 5 tab, 2 ref.

Descriptors: *Observation wells, *Groundwater data, Borehole geophysical logs, Lithologic logs, Driller's logs, *New Mexico, Dona Ana County, Tularosa Basin, White Sands Missile Range.

Two test wells, T27 and T28, were drilled at White Sands Missile Range in south-central New Mexico as part of a joint military training program sponsored by the U.S. Army in February and March 1983. Test wells T27 and T28 were drilled as observation wells in the vicinity of the Liquid Propellant Storage Area. Information obtained from these wells includes lithologic logs, driller's logs, and borehole-geophysical logs from the cased wells. (USGS)
W86-03089

TEST WELLS T23, T29, AND T30, WHITE SANDS MISSILE RANGE AND FORT BLISS MILITARY RESERVATION, DONA ANA COUNTY, NM,

Geological Survey, Las Cruces, NM. Water Resources Div.
R. G. Myers, and K. M. Pinckley.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-805, 1985. 23 p, 3 fig, 4 tab, 3 ref.

Descriptors: *Observation wells, *Test holes, *Groundwater data, Borehole geophysical logs, Lithologic logs, *New Mexico, Dona Ana County, Tularosa Basin, Fort Bliss Military Reservation, White Sands Missile Range.

Three test wells, T23, T29, and T30, were drilled in south-central New Mexico as part of a joint military training program sponsored by the U.S. Army in November 1982. Test well T23 was drilled as an exploratory and monitoring well in the proposed Soledad well field at the Fort Bliss Military Reservation. Test wells T29 and T30 were drilled at White Sands Missile Range. Test well T29 was drilled as an observation well in the vicinity of the outfall channel from the sewage treatment plant. Test well T30 was drilled as an observation well for a landfill south of the well site. Information obtained from these wells includes lithologic logs for all wells and borehole-geophysical logs from the cased wells for test wells T29 and T30. (USGS)
W86-03090

GROUNDWATER LEVELS IN NEBRASKA, 1983,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03094

TEST WELL DO-CE 88 AT CAMBRIDGE, DORCHESTER COUNTY, MARYLAND,

Geological Survey, Trenton, NJ. Water Resources Div.
H. Trapp, L. L. Knobel, H. Meisler, and P. P. Leahy.
Available from Dist Branch, USGS, 604 S. Pickett St., Alexandria, VA 22034. USGS Water-Supply Paper 2229, 1984. 48 p, 13 fig, 20 tab, 36 ref.

Descriptors: *Test wells, *Coastal aquifers, Saline-freshwater interfaces, Piezometric head, Well logs, Water quality, *Aquifer testing, Hydraulic properties, *Groundwater, Clay minerals, Geologic formations, Dinoflagellates, Foraminifers, Palynology, Core logging, Well drilling, Geothermal studies, Groundwater movement, Minerals, Cation exchange, Aquifer characteristics, Specific capacity, Temperature effects, Tidal effects, Chemical analysis, *Maryland, Dorchester County, Maryland, Atlantic Coastal Plain, Core squeezing.

The test well DO-CE at Cambridge, M, penetrated 3,299 feet of unconsolidate Quaternary, Tertiary and Cretaceous sediments and bottomed in quartz monzonite gneiss. It provides data for a study of the aquifer system of the northern Atlantic Coastal Plain. Twenty-one cores were collected. Six sand zones were tested for aquifer properties and their waters sampled. Heads measured at seven depths indicate upward flow. A temperature log showed a maximum temperature of 41.9 degrees Celsius and a mean temperature gradient of 27.5 degrees Celsius/kilometer. Water analyses delineated the freshwater-saltwater transition zone between 2,650 and 3,100 feet. The ground water changes progressively downward from a sodium bicarbonate to a sodium chloride character. Clays in the analyzed core samples belong to the montmorillonite and kaolinite groups, and mean cation exchange capacity ranged from 8.3 to 38.9 milliequivalens/100 grams. Vertical and horizontal hydraulic conductivities measured in sediment cores ranged from 0.0000015 to 1.3 feet/day and from 0.0000073 to 1.3 feet/day, respectively. Porosity ranged from 22.4 to 41 percent. From aquifer tests, transmissivities ranged from 25 to 850 feet squared/day and horizontal hydraulic conductivities ranged from 2.5 to 85 feet/day. Fossils in core samples include palynomorphs, dinoflagellates, and foraminifers. (USGS)
W86-03098

HYDROGRAPHS FROM SELECTED OBSERVATION WELLS AND TOTAL ANNUAL

PUMPAGE FROM MUNICIPAL SUPPLY WELLS, 1950-83, SANTA FE, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03101

DEVELOPMENT OF A TWO-DIMENSIONAL DIGITAL MODEL FOR THE ANALYSIS OF THE GROUND-WATER FLOW SYSTEM IN THE SAN ANTONIO CREEK VALLEY, SANTA BARBARA COUNTY, CALIFORNIA,
Geological Survey, Laguna Niguel, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03108

POTENTIAL GROUND-WATER LEVEL CHANGES IN THE MISSISSIPPI RIVER ALLUVIAL AQUIFER IN RESPONSE TO PROPOSED NAVIGATION IMPROVEMENTS ON THE YAZOO RIVER IN MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03122

HYDROLOGY OF THE OGALLALA AQUIFER IN FORD COUNTY, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03128

GROUND-WATER-LEVEL TRENDS IN IDAHO, 1971-82,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03129

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1982,
Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03204

REHABILITATION OF A CALCIUM CARBONATE CLOGGED DRAINAGE SYSTEM USING SULFAMIC ACID,
Bureau of Reclamation, Billings, MT. Upper Missouri Region.
G. M. Walker.
REC-ERC-85-2, October 1984, 9 p, 3 fig, 4 tab, 6 ref, 1 append.

Descriptors: *Scaling, *Subsurface drains, *Acids, Cleaning, *Clogging, Cost analysis, Calcium carbonate, Drains, Drainage systems, Drainage engineering, Subsurface drainage, Irrigation engineering.

The restoration of subsurface irrigation drains is a problem when drain water has deposited calcium carbonate scale. Methods for restoration of these drains such as mechanical routing and sulfur dioxide gas treatment are expensive and dangerous. A technique was developed for cleaning drains in which the drains are flooded with a 10% sulfamic acid-sodium chloride solution. The present method costs less than a fifth of the replacement cost. The cost of treating a severely plugged 240-mm drainage pipe would range between $3 and $6 per meter. Sulfamic acid is not considered to be a hazardous material when neutralized before disposal, and is available in granular form, making it safe to transport and use. The ease of use and lower costs of the sulfamic acid-sodium chloride method should make this method an attractive option for drainage systems of projects of the Bureau of Reclamation. (Geiger-PTT)
W86-03268

4C. Effects On Water Of Man's Non-Water Activities

RELATIONS OF URBAN LAND-USE AND DRY-WEATHER STORM AND SNOWMELT FLOW CHARACTERTISTICS TO STREAM-WATER QUALITY, SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
L. M. Pope, and H. E. Bevans.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-750, 1984. 64 p, 12 fig, 11 tab, 21 ref.

Descriptors: *Water quality, *Urban runoff, *Storm runoff, *Land use, Urbanization, Streamflow, Trace metals, Nutrients, Rainfall, Rainfall intensity, *Kansas, Topeka, Shunganunga Creek.

Water-quality characteristics of streams draining Topeka, Kansas, and the Shunganunga Creek basin were investigated from October, 1979, through November 1981, to determine the effects of runoff from urban areas. Characteristics were determined at six sites and summarized statistically for three streamflow conditions-dry weather, storm, and snowmelt. Median concentrations of trace metals and nutrients were greater in storm streamflow than in dry-weather streamflow. Regression equations were developed to estimate median concentrations of total lead and zinc in storm streamflow from the percentage of drainage area in residential plus commercial land-use areas and from street density. Median concentrations of dissolved sodium, chloride, and solids were considerably greater in snowmelt streamflow than in dry-weather streamflow. Regression equations were also developed to estimate median concentrations of dissolved sodium, chloride, and solids from the summation of percentages of the drainage area in residential, commercial, and industrial land-use areas and from street density. Multiple-regression analysis relating storm-runoff volumes and average constituent concentrations to land-use and storm characterstics produced significant relations for storm-runoff volume, total lead, total zinc, and suspended sediment. (USGS)
W86-02926

RAINFALL-RUNOFF DATA IN THE ALBUQUERQUE, NEW MEXICO, METROPOLITAN AREA, 1976-83,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02933

HYDROLOGY OF AREA 61 NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, COLORADO AND NEW MEXICO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02934

HYDROLOGY OF AREA 45, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, MONTANA AND NORTH DAKOTA,
Geological Survey, Helena, MT. Water Resources Div.
S. E. Slagle.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Open File Report 83-527, 1984. 90 p, 44 fig, 11 tab, 169 ref.

Descriptors: Groundwater, Surface water, Coal, Coal mines, *Strip mines, Spoil banks, *Coal mine effects, *Water quality, *Groundwater quality, Hydrogeology, *Montana, *North Dakota, Northern Great Plains, Williston Basin, Fort Union Formation.

Area 45 encompasses about 14,300 square miles in east-central Montana and west-central North Dakota and is drained by the Missouri, Yellowstone, and Redwater Rivers and their tributaries. During low-flow intervals, the water in streams generally is of the sodium sulfate type with dissolved-solids concentrations of 1,000 to 3,000 mg/L. During direct-runoff periods, the relative proportions of calcium and bicarbonate increase and dissolved-solids concentration typically is 150 to 600 mg/L. These high dissolved concentrations in streams of this area are naturally occuring and not ordinarily a result of coal mining. Principal water-yielding units are the Fox Hills-lower Hell Creek, Tullock, Tongue River, and alluvial aquifers. Wells completed in the Fox Hills-lower Hell Creek aquifer may yield as much as 400 gal/min. Wells in other bedrock aquifers commonly yield 8 to 15 gal/min. Yields to wells in alluvial aquifers commonly are 30 gal/min or less but may be several hundred gallons per minute along major streams. Water from aquifers less than about 200 feet deep is generally of the sodium sulfate type. Dissolved-solids concentration averages about 1,700 mg/L. Water from the Fox Hills-lower Hell Creek aquifer generally is of the sodium bicarbonate type and has an average dissolved-solids concentration of about 1,200 mg/L. (USGS)
W86-02959

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE HORSE CREEK AREA, SHERIDAN AND MOORHEAD COAL FIELDS, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
N. E. McClymonds.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4239, 1985. 61 p, 14 fig, 8 tab, 29 ref.

Descriptors: Hydrology, Coal mines, Reclamation, *Coal mining, Environmental impact, Water development effects, Hydrogeology, *Montana, *Powder River Basin.

The Horse Creek area of the Sheridan and Moorhead coal fields, 16 miles east of the Decker Coal Mines near the Tongue River, contains large reserves of Federally owned coal that have been identified for potential lease sale. A hydrologic study was conducted in the area to describe existing hydrologic systems and to assess potential impacts of surface coal mining on local water resources. Hydrologic data collected from private wells, observation wells, test holes, and springs indicate that the aquifers are primarily coal and sandstone beds in the upper part of the Tongue River Member of the Fort Union Formation (Paleocene age) and sand and gravel of valley alluvium (Pleistocene and Holocene age). Surface-water resources are mostly limited to a few stock ponds receiving discharge from springs in the higher ports of the area. Two stock wells, one spring, and three stock ponds receiving discharge from springs supply most of the water used within the Horse Creek basin; the only use is watering of livestock. Mining of the Anderson and Dietz coal beds would destroy one stock well and two ponds receiving discharge from springs, and would lower the potentiometric surface within the coal and sandstone aquifers. Although mining would alter existing hydrologic systems, alternative deeper water supplies are available. (USGS)
W86-02968

FLOODFLOW CHARACTERISTICS OF FILBIN CREEK AT PROPOSED INTERSTATE HIGHWAY 526, NORTH CHARLESTON, SC,
Geological Survey, Columbia, SC. Water Resources Div.
L. R. Bohman.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4323, 1984. 20 p, 7 fig, 4 tab, 7 ref.

Descriptors: *Flood profiles, *Highway effects, Reservoir routing, Hydrologic models, Model studies, *South Carolina, North Charleston, Filbin Creek.

A study to determine the impact of two alternative construction plans for proposed interchange between the existing Interstate Highway 26 and Interstate Highway 526 in the Filbin Creek drainage basin near North Charleston, South Carolina was performed by the U.S. Geological Survey, in cooperation with the South Carolina Department of Highways and Public Transportation. A computerized reservoir routing technique was used to route synthetic flood hydrographs through the basin system. Simulation results indicate that the new roadway will cause little or no change in water-surface elevations downstream of Interstate Highway 26. Upstream of Interstate Highway 26, approximately 0.5 foot of backwater will be created by either alternative during a 100-year flood as a result of the Interstate Highway 526 embankments and structures. (USGS)
W86-02969

USE OF SELECTED BASIN CHARACTERISTICS TO ESTIMATE MEAN ANNUAL RUNOFF AND PEAK DISCHARGES FOR UNGAGED STREAMS IN DRAINAGE BASINS CONTAINING STRIPPABLE COAL RESOURCES, NORTHWESTERN NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
H. R. Hejl.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4260, 1984. 17 p, 2 fig, 2 tab, 12 ref.

Descriptors: Annual runoff, Flood peak, *Flood frequency, Flood recurrence interval, *Flow characteristics, Regression analysis, Statistical methods, *Basin charateristics, *Coal mining, *New Mexico, San Juan Basin.

Equations in this report can be used to estimate mean annual runoff and peak discharges for 2-, 5-, 10-, 25-, and 100-year recurrence intervals for ungaged streams in drainage basins containing strippable coal resources in northwestern New Mexico. These streamflow characteristics are related to basin characteristics that were found to be significant, using regression techniques. Mean annual runoff for ephemeral streams is related to drainage area, active-channel width, main-channel slope, basin slope, and silt-clay percentage in active-channel banks. Peak discharges for ephemeral, intermittent, and perennial streams are related to drainage area, active-channel width, main-channel length, basin slope, and silt-clay percentage in active-channel banks. (USGS)
W86-02978

GROUND-WATER-QUALITY DATA FROM THE SOUTHERN POWDER RIVER BASIN, NORTHEASTERN WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-03014

STORM RUNOFF AS RELATED TO URBANIZATION BASED ON DATA COLLECTED IN SALEM, AND PORTLAND, AND GENERALIZED FOR THE WILLAMETTE VALLEY, OREGON,

Geological Survey, Portland, OR. Water Resources Div.
A. Laenen.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4143, 1983. 88 p, 16 fig, 16 tab, 19 ref.

Descriptors: *Rainfall, Runoff, *Urbanization, *Storm runoff, Basin characteristics, Salem, *Urban hydrology, *Urban runoff, Willamette Valley, *Oregon.

Storm runoff as related to urbanization is defined by a series of regression equations for Salem and for the Willamette Valley, Oregon. In addition to data from 17 basins monitored in the Salem area, data from 24 basins gaged in a previous study in Portland, Oregon - Vancouver, Washington were used defining the Willamette Valley equations. Basins used to define equations ranged in size from 0.2 to 26 square miles. Rainfall intensity varied from 1.8 to 2.2 inches for the 6 hour, 0.2 exceedence probability. Sensitivity analyses of equations indicate that urbanization of an undeveloped basin can increase peak discharge more than three times and almost double runoff volume. Much of Portland and Vancouver are located on porous river terraces where dry wells are used to shunt runoff. Much of East Salem is located on previously farmed land where drain tiles used to dewater soils still connect directly to streams. (USGS)
W86-03015

WATER RESOURCES AND POTENTIAL HYDROLOGIC EFFECTS OF OIL-SHALE DEVELOPMENT IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
K. L. Lindskov, and B. A. Kimball.
Dist Branch, USGS, 604 S. Pickett St., Alexandria, VA 22034. USGS Professional Paper 1307, 1984. 32 p, 20 fig, 3 tab, 55 ref.

Descriptors: Water resources, *Oil shale, *Water quality, *Salinity, Colorado River compact, *Mining effects, *Colorado, Uinta Basin, Green River Formation,Synfuels, Upper Colorado River Region.

Normal annual precipitation varies with altitude from less than 8 inches at altitudes below 5,000 feet to more than 20 inches where altitudes exceed 9,000 feet. In areas where precipitation is less than 10 inches, streams are ephemeral. Mean annual runoff is about 28,000 acre-feet and varies from less than 0.1 to 1.6 inches. Runoff varies yearly and seasonally, and potentially evapotranspiration exceeds precipitation. The White and Green Rivers convey an average flow of 4.3 million acre-feet per year from an outside drainage of 34,000 squqre miles, more than 150 times the flow originating in the area. Total recoverable groundwater in storage is about 18 million acre-feet. Yields of individual wells and interference between wells cound limit withdrawals to about 15,000 acre-feet per year. A 400,000-barrel-per-day oil-shale industry would require a water supply of 70,000 acre-feet per year. Other sources of water supply discussed are diversion from the White River, a proposed reservoir on the White River, diversion from the White River combined with proposed off-stream storage, diversion from the Green River, and conjunctive use of ground and surface water. Leachate water from retorted-shale piles has large concentrations of sodium and sulfates, and retort waters contain much organic carbon and nutrients. Without proper disposal of these water, the natural waters of the area could be contaminated and the salinity of downstream waters in the Colorado River Basin could be increased. (USGS)
W86-03021

FLOOD-PROFILE ANALYSIS, BIG DARBY CREEK AT STATE ROUTE 762, ORIENT, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
W. P. Barlett, and J. M. Sherwood.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4276, 1984. 12 p, 4 fig, 3 tab, 5 ref.

Descriptors: *Flood profiles, *Bridge construction, Backwater, *Big Darby Creek, *Ohio, Backwater.

The U.S. Geological Survey, in cooperation with the Ohio Department of Transportation, made a hydraulic analysis of the 25- and 100-year floods on Big Darby Creek where State Route 762 crosses the stream at Orient, Ohio. Two proposed bridge plans were analyzed to determine the effects of placing a new deck bridge upstream of the existing State Route 762 bridge. In plan 1, the bridge is set at sufficient elevation to pass the 100-year flood below it. In plan 2, the elevations are 3 feet lower than in plan 1, which would result in partial submergence of the bridge during the 100-year flood. This analysis shows that the 25-year flood upstream of the new bridge would increase by 0.4 foot if plan 1 is adopted and by 0.3 foot if plan 2 is adopted. The profiles for the 100-year flood would increase by 0.6 foot for plan 1 and 1.1 feet for plan 2. This additional backwater affects profiles up to 5,750 feet upstream, where the plan 1 profile is 0.1 foot higher than for present conditions and the plan 2 profile is 0.2 foot higher than profiles for present conditions. (USGS)
W86-03027

SYNTHESIZED FLOOD FREQUENCY FOR SMALL URBAN STREAMS IN TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03037

DETERMINING THE EFFECTIVENESS OF HIGHWAY DRAINAGE SYSTEMS IN PREVENTING SALT CONTAMINATION OF GROUND WATER,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W86-03044

STREAMFLOW IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03064

CLASSIFICATION OF STREAM BASINS IN SOUTHEASTERN OHIO ACCORDING TO EXTENT OF SURFACE COAL MINING,

Geological Survey, Columbus, OH. Water Resources Div.
C. J. O. Childress.
Available from Dist Branch, USGS, 604 S. Pickett St. Alexandria, VA 22034. USGS Water-Resources Investigations Report 84-4212, 1985. 83 p, 7 fig, 8 tab, 26 ref.

Descriptors: Water quality, *Coal mines, *Mine drainage, *Land reclamation, Land use, Surface water, Analysis of variance, Mine water, Coal mining effects, *Ohio, Discriminant function analysis, Surface coal mining.

Water-quality data were collected to rank streams draining 35 basins in the southeastern Ohio coal region according to severity of impact from acid mine drainage. The area is underlain by rocks of Pennsylvania age, the most important coal-producing formations being the Allegheny and the Monongahela. Water and bed-material samples were collected at 276 sites; each site was sampled four times over a 3-year period. By means of land-use maps, each site was classified as 'mined-abandoned,' 'mined-relcaimed,' 'unmined,' or 'mixed.' Streams draining the carbonate-bearing Monongahela Formation have a significantly greater buffering capacity than streams draining the Allegheny Formation. There were significant differences in specific conductance, pH, alkalinity, acidity, hardness, total and dissolved iron, manganese, and aluminum; dissolved nickel, zinc, and sulfate; and dissolved solids among mining disturbance types in the Allegheny Formation. However, in streams draining the more calcareous Monongahela Formation, only dissolved solids, hardness, sulfate, and dissolved manganese were significantly different among mining-disturbance types. Discriminant-function analysis of water-quality data was used to classify each mixed site into one of 10 categories ranging from strongly characteristic of abandoned-mine areas to strongly characteristic of unmined areas. (USGS)
W86-03071

URBAN WATER-QUALITY DATA AND STATISTICAL SUMMARIES FOR SELECTED SITES IN THE SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03099

CALCULATING SEDIMENT DISCHARGE FROM A HIGHWAY CONSTRUCTION SITE IN CENTRAL PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
L. A Reed, J. R. Ward, and K. L. Wetzel.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4216, 1985. 12 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Road construction, *Sediment discharge, Sediment prediction, Sediment modeling, Rainfall, Soil erosion, *Pennsylvania, *Highway construction, Discharge, Sediment yield.

Two methods used by the Pennsylvania Department of Transportation to compute the quantity of sediment discharged from an area of highway construction--the Universal Soil Loss Equation and the Younkin Sediment Prediction Equation--were evaluated. Data used in the analysis included the total rainfall, kinetic energy, and the erosive index (EI) of the precipitation, and highway construction data including the area disturbed by clearing and grubbing, the area in cuts and fills, the average depth of cuts and fills, the area seeded and mulched, and the area paved. Sediment yields, calculated using the two equations, were compared to the actual measured values, and standard errors of estimate and coefficients of correlation were calculated. Using the USLE, the standard error of estimate was 0.40, (about 105 percent), and the coefficient of correlation was 0.79. Using the Younkin Equation, the standard error of estimate was 0.42 (about 110 percent), and the coefficient of correlation was 0.77. (USGS)
W86-03102

HYDROLOGIC DATA FOR URBAN STUDIES IN THE HOUSTON, TEXAS, METROPOLITAN AREA, 1982,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03106

HYDROLOGY OF AREA 29, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03111

EFFECTS OF HYDRAULIC BOREHOLE MINING ON GROUND WATER AT A TEST SITE IN NORTHEAST ST. JOHNS COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
P. S. Hampson.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4149, 1984. 29 p, 12 fig, 10 tab, 3 ref.

Descriptors: *Hydraulic mining, *Ground water, *Injection wells, *Mining engineering, Phosphates, *Hydraulic borehole mining, Phosphate mining.

An experimental mining project was conducted in northeast St. Johns County, Florida, to determine the feasibility of extracting deeply buried phosphate ore by hydraulic borehole mining techniques. The phosphate zone is between 232 and 250 feet below land surface and consists of approximately equal proportions of fine-grained phosphate, sand, and clay. Six wells were constructed at the test site to monitor effects of the mining operation on the ground-water resources of the area. One well penetrated the Floridan aquifer beneath the phosphate zone, another was completed in the phosphate zone, and the other four were finished in water-bearing zones above the phosphate zone. The mining project consisted of three separate tests in which different mining methods were used. Changes in water levels, other than in the mined zone, were detected only in the overlying monitored zone during the first two tests as a result of roof failures in cavities formed by the mining operation. Water-quality changes were observed only in the mined zone and resulted from the injection of water from the deeper Floridan aquifer as part of the mining operation. (USGS)
W86-03116

POTENTIAL HYDROLOGIC IMPACTS OF A TARSAND INDUSTRY IN 11 SPECIAL TAR SAND AREAS IN EASTERN UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 6D.
W86-03141

WYCOALGAS COAL GASIFICATION PROJECT: PRELIMINARY DRAFT ENVIRONMENTAL IMPACT STATEMENT, VOLUME 1,
Woodward-Clyde Consultants, San Francisco, CA.
For primary bibliographic entry see Field 5C.
W86-03271

4D. Watershed Protection

RECONNAISSANCE STUDY OF STREAM SEDIMENTAION, SOUTHERN GUAM,
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-03112

ESTIMATES OF LONG-TERM SUSPENDED-SEDIMENT LOADS IN BAY CREEK AT NEBO, PIKE COUNTY, ILLINOIS, 1940-80,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-03138

WEATHERING TESTS CONDUCTED ON SOIL STABILIZERS: INTERIM REPORT,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 4A.
W86-03247

HANDBOOK FOR PROTECTION OF FISH AND WILDLIFE FROM CONSTRUCTION OF FARM AND FOREST ROADS,
Center for Natural Areas, South Gardiner, ME.
For primary bibliographic entry see Field 6B.
W86-03257

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

WATER-QUALITY RECONNAISSANCE AND STATISTICAL ANALYSIS FOR SELECTED WATER-SUPPLY LAKES IN EASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
L. M. Pope, J. A. Arruda, and A. E. Vahsholtz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4058, 1985. 47 p, 1 fig, 9 tab, 16 ref.

Descriptors: *Lakes, *Water quality, *Land use, Lake morphology, Watersheds, Nutrients, Nitrates, Total organic carbon, Chlorophyll a, Statistical analysis, *Kansas, Pollutant identification.

Data collected for 19 public water-supply lakes in eastern Kansas during spring-fall 1983 were statistically analyzed to describe relationships between water-quality constituents and lake and watershed physical characteristics. A large range was observed in mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a and in lake and watershed physical characteristics, such as age, surface area, watershed area, watershed-to-lake surface-area ratio, and average maximum depth. Pesticides were detected in 8 of the 19 lakes. Atrazine and Alachlor were the most commonly detected pesticides. Spearman rank-order correlation analyses showed possible relationships between mean concentrations of total nitrite plus nitrate nitrogen, total ammonia nitrogen, total phosphorus, total organic carbon, and chlorophyll a, and certain lake and watershed physical characteristics. Multiple-regression analysis produced significant relations between mean concentrations of total nitrite plus nitrate nitrogen and percentage of watershed in protected cropland and age of lake (0.62 coefficient of determination), and between mean concentrations of total organic carbon and lake average maximum depth, lake-surface area, age of lake, and watershed-to-lake surface-area ratio (0.76 coefficient of determination). (USGS)
W86-02927

WATER QUALITY OF A STREAM-AQUIFER SYSTEM, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-02931

HYDROLOGIC EFFECTS OF IMPOUNDMENTS IN SHERBURNE NATIONAL WILDLIFE REFUGE, MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02939

HYDROLOGY OF AREA 45, NORTHERN GREAT PLAINS AND ROCKY MOUNTAIN COAL PROVINCES, MONTANA AND NORTH DAKOTA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02959

WATER QUALITY OF THE TIDAL POTOMAC RIVER AND ESTUARY HYDROLOGIC DATA REPORTS SUPPLEMENT 1979 THROUGH 1981 WATER YEARS,
Geological Survey, Reston, VA. Water Resources Div.
R. H. Coupe, and W. F. Webb.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-132, 1984. 66 p, 4 fig, 9 tab, 29 ref.

Descriptors: *Biochemical oxygen demand, *Fecal coliforms, *Fecal streptococci, *Sewage treatment plants, Incident light, Light attenuation, *Potomac River, *Potomac Estuary, Pollutant identification.

This report is a companion report to the U.S. Geological Survey 1979, 1980, and 1981 Hydrologic Data Reports of the tidal Potomac River and Estuary. It contains values of biochemical oxygen demand and specific rate constants, incident light and light attenuation measurements; numbers of phytoplankton, fecal coliform and fecal streptococci, cross-sectional averages from field measurements of dissolved oxygen, pH, specific conductance, and temperature data; and cross-sectional averages of chlorophyll data. Sewage treatment plant loads are also included. (USGS)
W86-02997

INDEX OF GROUND-WATER QUALITY DATA FOR FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03002

RESULTS OF THE U.S. GEOLOGICAL SURVEY'S SECOND INTERNATIONAL INTERLABORATORY ANALYTICAL COMPARISON STUDY–STANDARD-REFERENCE WATER SAMPLES M-86 (MAJOR CONSTITUENTS), T-87 (TRACE CONSTITUENTS), AND P-5 (PRECIPITATION SNOWMELT),

Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03013

GROUND-WATER-QUALITY DATA FROM THE SOUTHERN POWDER RIVER BASIN, NORTHEASTERN WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-03014

COMPILATION OF GROUND WATER QUALITY DATA IN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03026

WATER-RESOURCES MONITORING IN THE COTTONWOOD CREEK AREA, SHASTA AND TEHAMA COUNTIES, CALIFORNIA, 1982-83,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03054

FIELD GUIDELINES FOR COLLECTION, TREATMENT, AND ANALYSIS OF WATER SAMPLES, MONTANA DISTRICT,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-03060

FILTRATION AND COLUMN-ADSORPTION SYSTEM FOR ONSITE CONCENTRATION AND FRACTIONATION OF ORGANIC SUBSTANCES FROM LARGE VOLUMES OF WATER,

Geological Survey, Lakewood, CO. Water Resources Div.
J. A. Leenheer, and T. I. Noyes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Supply Paper 2230, 1984. 15 p, 4 fig, 1 tab, 12 ref.

Descriptors: *Organic matter, Fulvic acids, *Water analysis, Adsorption, Separation techniques, Filtration, *Chemical analysis, *Analytical methods, Dissolved organic carbon fractionation, Organic solute isolation techniques.

A portable filtration and column-adsorption system was developed, which can concentrate suspended sediment and dissolved-aqueous organic substances onsite. Organic solutes also are fractionated into hydrophobic- and hydrophilic-acid, base, and neutral fractions. Subsequent isolation of organic solutes from fraction concentrates and extraction of organic constituents in suspended sediment entrained on filter tubes is performed by a variety of procedures in the laboratory. Three surface-water samples and one ground-water sample ranging in volume from 300 to 1,000 liters were processed through the filtration and column-adsorption system, yielding from about 0.8 to 3.0 grams of recovered organic carbon per sample. (USGS)
W86-03065

PREPARATION OF POLYETHLENE SACKS FOR COLLECTION OF SAMPLES FOR CHEMICAL ANALYSIS,

Geological Survey, Lakewood, CO. Water Resources Div.
L. J. Schroder, and A. W. Bricker.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4067, 1985. 9 p, 4 tab, 11 ref.

Descriptors: *Adsorption, Atomic absorption, *Spectroscopy, Specific conductance, *Sampling, *Water analysis, Iron, Lead, Zinc, Hydrogen ion concentration.

Polyethylene sacks are used to collect precipitation samples. Washing polyethylene with acetone, hexane, methanol, or nitric acid can change the adsorptive characteristics of the polyethylene. In this study, simulated precipitation at pH 4.5 was in contact with the polyethylene sacks for 21 days; subsamples were removed for chemical analysis at 7, 14, and 21 days after intitial contact. Sacks washed with acetone adsorbed iron and lithium; sacks washed with hexane adsorbed barium, iron, and lithium; sacks washed with methanol adsorbed calcium and iron; and sacks washed with 0.30 N nitric acid adsorbed iron. Leaching the plastic sacks with 0.15 N nitric acid did not result in 100-percent recovery of any of the adsorbed metals. Washing polyethylene sacks with dilute nitric acid caused the pH of the simulated precipitation to be decreased by 0.2 pH unit after 1 week of contact with the polyethylene. The specific conductance increased by 10 microsiemens per centimeter. Contamination of precipitation samples by lead was determined to be about 0.1 microgram per liter from contact with precleaned polyethylene sacks. No measurable contamination of precipitation samples by zinc occurred. (USGS)
W86-03072

GROUND-WATER QUALITY APPRAISAL OF SURFICIAL SAND-PLAIN AQUIFERS IN HUBBARD, MORRISON, OTTER TAIL, AND WADENA COUNTIES, MINNESOTA,

Geological Survey, Grand Rapids, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03080

SELENIUM CONCENTRATIONS IN WATERS TRIBUTARY TO AND IN THE VICINITY OF THE KESTERSON NATIONAL WILDLIFE REFUGE, FRESNO AND MERCED COUNTIES, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
T. S. Presser, and I. Barnes.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4122, 1984. 26 p, 4 fig, 3 tab, 21 ref.

Descriptors: *Water pollution sources, *Pollutant identification, *Wildlife, *Selenium, *California, *Water analysis, *Sodium sulfate, *Thenardite, Kesterson National Wildlife Refuge.

Analyses were made for selenium in waters and other materials of the Kesterson National Wildlife Refuge. Analyses were also made of source agricultural drainage waters from the San Luis Drain discharged into the refuge, and surrounding irrigation supply and return waters. Selenium concentrations range from 140 to 1,400 micrograms per liter (microgram/L) in irrigation drain waters supplied to the San Luis Drain. The selenium supplied to the Kesterson National Wildlife Refuge is to a small extent precipitated in sodium sulfate (thenardite) but a higher concentration was found in an alagal mat. Most other waters of the area contain less than detectable < 2 micrograms per liter concentrations of selenium. Oxidation of organic matter and reduction of selenate to selenite were found to be necessary for a quantitative analysis of total selenium. (USGS)
W86-03124

DATA COMPILATION OF BENTHIC INVERTEBRATES FROM TRIBUTARY STREAMS OF THE YAMPA AND NORTH PLATTE RIVER BASINS, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-03126

EVALUATION OF GROUND-WATER QUALITY DATA FROM KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-03142

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN NORTHEASTERN MISSISSIPPI, AUGUST 1983,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-03162

RECONNAISSANCE OF BENTHIC INVERTEBRATES FROM TRIBUTARY STREAMS OF THE YAMPA AND NORTH PLATTE RIVER BASINS, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
L. J. Britton.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4191, 1983. 73 p, 20 fig, 25 tab, 31 ref.

Descriptors: *Water quality, *Coal-mining, Aquatic insects, *Benthic invertebrates, *Biological water quality statistical relationships, Pollutant identification, *Colorado, Yampa River Basin, North Platte River Basin.

Benthic invertebrates were collected from tributaries of the Yampa River in Routt and Moffat Counties, and tributaries of the North Platte River in Jackson County. Field water-quality measurements of water temperature, specific conductance, pH, dissolved oxygen, and bed material size were also made to aid in assessing stream water-quality conditions. The purpose of the study was to describe and quantify the benthic invertebrate communities in selected streams in coal mining areas. Stream sampling sites were located upstream and downstream from potential, existing, or historical coal mining areas. Sampling was conducted on a near bimonthly basis throughout the growing season, beginning in April and May 1980, and continuing through September 1981. The density of benthic invertebrates generally increased downstream in all streams sampled. Most of the variation in densities and taxa among the stream sites was associated with sampling date differences. There were also some strong correlations of benthic invertebrate densities with measured water-quality constituents and properties. However, a larger sample size (greater frequency of sampling) may influence this relation. (USGS)
W86-03167

OVERVIEW OF GROUND-WATER QUALITY DATA IN WISCONSIN,

Geological Survey, Madison, WI. Water Resources Div.
P. A. Kammerer.
USGS Water-Resources Investigation Report 83-4239, 1984. 58 p, 16 ref.

Descriptors: *Groundwater, *Water quality, *Groundwater pollution, *Waste disposal, *Wastewater lagoons, Landfills, Evaluation, Geohydrologic units, Groundwater quality appraisal, *Wisconsin, Contamination, Data evaluation.

This report contains a summary of ground-water-quality data for Wisconsin and an evaluation of the adequacy of these data for assessing the impact of land disposal of wastes on ground-water quality. Chemical analyses used in data summaries were limited to those stored in the USGS computer

system (WATSTORE). Information on documented instances of ground-water contamination and sources of potential contamination from land disposal of wastes was provided by the Wisconsin Department of Natural Resources. Available data provide an overview of ground water quality but may be insufficient for assessment of ground-water contamination from land disposal of wastes. Many sources of potential ground-water contamination (landfills, surface waste-storage impoundments, and buried tanks) are known. Some of these are probably causing local ground-water contamination that is not apparent from available regional data. Information needs for assessment of ground-water contamination from land disposal of wastes include improved understanding of both ground-water hydrology and the chemical behavior of specific contaminants in the environment. (USGS)
W86-03177

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1982,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-03204

NEW INSTRUMENTATION FOR AIRBORNE ACID-RAIN RESEARCH,

Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 7B.
W86-03242

PRESENCE OF PATHOGENIC MICROORGANISMS IN POWER PLANT COOLING WATERS: REPORT FOR OCTOBER 1, 1979, TO SEPTEMBER 30, 1981,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W86-03243

MONITORING AND ANALYSIS OF HAZARDOUS ORGANICS IN MUNICIPAL WASTEWATER - A STUDY OF TWENTY-FIVE TREATMENT PLANTS,

Municipal Environmental Research Lab., Cincinnati, OH.
S. A. Hannah, and L. Rossman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-155613, Price codes: A03 in paper copy, A01 in microfiche. EPA-600/D-82-376, November 1982, 32 p, 10 fig, 8 tab, 12 ref.

Descriptors: *Water pollution, *Wastewater treatment, *Wastewater, *Wastewater analysis, Wastewater composition, Wastewater facilities, Treatment plants, Organic wastes, Organic compounds, Hazardous materials, Toxicity, Sludge.

A discussion is presented of a research program with the following objectives: (1) to develop sensitive analytical methods capable of analyzing municipal wastewater and sludges for 114 organic priority pollutants and (2) to survey 25 publicly owned treatment works for the toxic organics. Development of the analytical methods and results of the survey are discussed. Plant selection criteria included plant size and type, geographical location and industrial contributions to the municipal wastewater. Raw wastewaters, primary effluents, final discharges and sludges were sampled. The majority of the plants were found to have between 20 and 50 priority organics in their raw influents and 10 to 30 priority organics in their final discharges. Only 15 compounds were found at concentrations above 1 microgram/l in wastewaters (or 1 mg/kg in sludge) at least 80 percent of the time in raw wastewaters and at least 50 percent of the time in final plant discharges and sludges. Significance of the findings as related to proposed Water Quality Criteria for both toxic organics and metals are addressed. (Author)
W86-03262

DEVELOPMENT OF A SYSTEM FOR THE IDENTIFICATION OF OIL SPILLS,

Sentralinstitutt for Industriell Forskning, Oslo (Norway).
R. G. Lichtenthaler, P. E. Paus, I. Andresen, H. Guthenberg, and T. Haegh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132597, Price codes: A03 in paper copy, A01 in microfiche. 77 12 09-3, Technical Report, August 31, 1982. 39 p, 1 fig, 1 tab, 7 ref. 77 12 09.

Descriptors: *Pollutant identification, *Oil pollution, *Oil spills, *Gas chromatography, *Spectroscopy, Infrared spectroscopy, X-ray spectroscopy, Nickel, Vanadium, Sampling, Atomic absorption spectroscopy, Heavy metals.

A system for the identification of oil spilled at sea is proposed. The system includes oil sampling procedures and analytical methods. Hydrocarbon compounds are studied by ultraviolet or ultraviolet-fluorescence-spectroscopy, low resolutions gas chromatography, high resolution gas chromatography and infrared-spectroscopy; the contents of Ni and V are determined by atomic absorption spectroscopy; the contents of S are determined by X-ray-fluorescence spectroscopy or by combustion and titration. Criteria for the evaluation of results and standardized reporting are presented. (Author)
W86-03286

DETECTION OF POLLUTION AT DRINKING WATER INTAKES,

Water Research Centre, Medmenham (England). Medmenham Lab.
G. P. Evans, and D. Johnson.
IN: Environmental Protection: Standards, Compliance, and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 239-254 p, 3 fig, 2 tab, 26 ref.

Descriptors: *Aquatic environment, *Environmental protection, *Public health, Toxicity, Monitoring, Environmental management, Drinking water, Potable water, Fish, Bioassay.

It is predicted that by the end of this century, 60% of the water supplied in the United Kingdom will be provided by lowland river intakes. At present, there are about 100 annual drinking water intake closures due to pollution incidents in the supplying rivers. The pollutants involved are fuel oils 40% of the time, 10% farm wastes, 10% sewage, 5% plating effluent, 5% phenols, and 30% of the incidents are due to other chemicals from industry and road accidents. The purpose of this paper is to discuss early detection of pollution incidents which will allow managers of water treatment plants to make appropriate decisions in order to safeguard both the consumer and the plant. Conventional pollutant monitoring of such parameters as dissolved oxygen, temperature, pH, ammonia, nitrate, organic matter and turbidity can be on a continuous basis, and fed directly into micro-computer systems. The use of captive fish as a broad-based monitor, whole cell and enzyme systems, oil slick indicator instruments and system integration are also available for detection of non-conventional, non-specific pollutant monitoring. (Halterman-PTT)
W86-03359

WATER ANALYSIS, VOLUME III: ORGANIC SPECIES,

Academic Press, Inc., Orlando, FL. 1984. Edited by Roger A. Minear and Lawrence H. Keith. 456 p.

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Organic compounds, Oxygen demand, Sample preparation, Chromatography, Mass spectrometry, Infrared spectroscopy.

Many techniques are available for determining the organic constituents of water and wastewater. Useful nonspecific determinations include BOD, COD, total organic carbon. In addition to bottle tests, laboratories use respirometers, carbon analyzers, spectrophotometry, and electrochemical methods. Concentration, partitioning, and isolation techniques may involve solvent extraction, sorption from water, solvent evaporation, distillation and evaporation, freeze concentration, membrane techniques, adsorption, ultrafiltration, precipitatin, and bubble concentration. For the purpose of concentration, compounds are roughly divided into volatile, semivolatile, low molecular weight nonvolatile, and high molecular weight. For complex unknown mixtures several systemmatic isolation and concentration schemes have been developed. Gas chromatography is a popular and fast-advancing method for complex mixture analysis. Mass spectrometry is most often used to identify unknown organic compounds in environmental samples. High performance liquid chromatography is the most valuable technique for separation and analysis of nonvolatile organic constituents in water. Theoretical and practical aspects of infrared spectrophotometry for water analysis are discussed. (Cassar-PTT)
W86-03406

WASTE STRENGTH AND WATER POLLUTION PARAMETERS,

Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
J. C. Young.
IN: Water Analysis, Volume III: Organic Species, 1984. 1-39 p, 12 fig, 4 tab, 90 ref.

Descriptors: *Pollutant identificaiton, *Wastewater analysis, *Organic compounds, *Biochemical oxygen demand, *Oxygen demand, Organic matter, Mathematical models, Model studies, Nitrification, Dilution, Aeration, Respirometers, Warburg respirometer, Barcroft respirometer, Sampling, Sample preservation, Dissolved oxygen, Nutrients, Hydrogen ion concentration.

Nonspecific or indirect tests for the gross amount of organic matter in wastewater are essential for wastewater management. Although the BOD test is time consuming and relatively imprecise, it is the only parameter that distinguishes between biodegradable and nonbiodegradable organic matter. The 5-day BOD test is widely recognized as the standard BOD. During the first 5-7 days the carbonaceous material is degraded, followed by oxidation of nitrogenous compounds (nitrogen demand). The ultimate oxygen demand is the sum of carbonaceous and nitrogen demand. A plateau and a lag may be evident in the BOD test. The plateau may be a result of endogenous respiration of bacteria and other processes; the lag may occur when insufficient acclimated microorganisms are present. The BOD reaction has been modeled by first- or second-order equations, nitrification reactions, and other models. BOD test methods have several forms: standard dilution test, reaeration technique, short-term total biochemical oxygen demand test, respirometers (Warburg, Barcroft, other modified manometric type, oxygen-depletion, and electrolytic), and rapid or alternative. Many factors affect BOD test data: sampling procedure, sample storage and preservation, sample characteristics, mixing, seeding, dilution, dilution technique, dilution water quality, pH, mineral nutrients, method of dissolved oxygen measurement, dissolved oxygen concentration, toxicity, and nitrification. Accuracy and precision vary widely. Lowest coefficients of variability are obtained with respirometers. (Cassar-PTT)
W86-03407

CHEMICAL NONSPECIFIC ORGANICS ANALYSIS,

Florida International Univ., Miami. Drinking Water Research Center.
W. J. Cooper, and J. C. Young.
IN: Water Analysis, Volume III: Organic Species, 1984. p 41-82, 6 fig, 10 tab, 52 ref.

Descriptors: *Pollutant analysis, *Water analysis, *Wastewater analysis, *Organic compounds, *Chemical oxygen demand, Organic carbon, Dissolved organic carbon, Total organic carbon, Volatile organic carbon, Monitoring, Automation, Amines, Carbohydrates, Halogens, Oxygen demand, Spectrophotometry, Electrochemistry.

Nonspecific methods for determining the organics content of aqueous solutions are suitable as screening procedures to minimize use of more complex analyses. Total organic carbon may be determined

as total organic carbon (TOC), dissolved organic carbon (DOC), particulate organic carbon (POC), and volatile organic carbon (VOC). Three techniques are used for this purpose: wet oxidation, dry combustion, and direct injection, high-temperature oxidation. A table lists some commercial carbon analyzers and their characteristics. Sources of error are inorganic salts and acids, loss or volatile organics during acidification, heavy metals, and instrument variations. Organic halogens are determined by several techniques, including instrumental methods. The chemical oxygen demand test uses an oxidant such as potassium dichromate. Reagent remaining after oxidation is titrated, and the amount of carbon is calculated. COD tests have been developed into rapid forms and automated forms. The main sources of error in COD tests are incomplete oxidation of the organic compounds, vaporization of compounds, insufficient reflux or heating time, unsuitable sample size and preparation, and interference from chlorides and other inorganics. Total oxygen demand methods more nearly approximate the theoretical oxygen demand of a sample. spectrophotometric methods and electrochemical methods are also available for measuring organics in water. Specific reagent systems are available to determine amines and carbohydrates. Carbon and total oxygen demand analyzers are also adaptable to on-line monitoring. (Cassar-PTT)
W86-03408

CONCENTRATION, PARTITIONING, AND ISOLATION TECHNIQUES,

Geological Survey, Denver, CO. Water Resources Div.
J. A. Leenheer.
IN: Water Analysis, Volume III: Organic Species, 1984. p 83-166, 19 fig, 4 tab, 260 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Wastewater analysis, Sample preparation, Ion exchange, Sorption, Membrane processes, Solvent extractions, Evaporation, Distillation, Freezing, Reverse osmosis, Dialysis, Bubbles, Chemical precipitation, Adsorption, Ultrafiltration, Gel filtration, Filtration, Activated carbon.

The most significant developments in concentration, partitioning, and isolation techniques for organic constituents of water include (1) the sparge-and-trap technique for volatile analyses, (2) the development and use of synthetic resin adsorbents, and (3) applications of high performance liquid chromatography to sample concentration, fractionation, and cleanup. Important aspects of determining analytes at very low levels involve selection of organic-free equipment, sample handling to prevent organic contamination, and preparation of organic-free reagent water, chemical reagents, sorbents, and membranes. Techniques are described for volatiles, semivolatiles, low molecular weight nonvolatiles, and high molecular weight constituents. The techniques of sparge-and-trap, solvent extraction, and sorption from water are applied to volatiles concentration. For semivolatiles, the following may be used for sample concentration: solvent extraction, sorption from water (ion exchange), water distillation and evaporation, freezing, membranes, adsorptive bubble separation, and vacuum sublimation. Practical concentration techniques for low molecular weight nonvolatiles include sorption (ion exchange), adsorptive bubble separation, solvent extraction, water evaporation, reverse osmosis, precipitation, and freezing. Although high molecular weight compounds (e.g., humic and fulvic acids) are least characterized at the structural level, they abound in dissolved and colloidal organic fractions. Concentration methods involve adsorption, ultrafiltration and gel filtration, precipitation and coprecipitation, and water evaporation. Comprehensive and systematic schemes for concentrating, partitioning, and isolating constituents from a complex mixture are described. (Cassar-PTT)
W86-03409

GAS CHROMATOGRAPHY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
R. P. Schwarzenbach, W. Giger, and K. Grob.
IN: Water Analysis, Volume III: Organic Species, 1984. p 167-251, 25 fig, 5 tab, 226 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Chromatography, Gas chromatography, Surfactants, Pesticides, Hydrocarbons, Trihalomethanes, Chlorinated hydrocarbons, Aromatic hydrocarbons, Phenols.

Gas chromatography is the most important analytical technique for determination of individual organic compounds in the aquatic environment. Many variations in equipment and techniques are available for adaptation to the analyst's needs. Capillary gas chromatography requires more skill in operation than packed-column chromatography, but it is more sensitive and selective. Three types of injection techniques are available: vaporizing, cold (introduced as a liquid), and cold introduction with ballistic heating. Injection methods and their problems are discussed: the syringe needle, split injection, splitless injection, and cold on-column injection. Capillary columns are discussed in detail: problems, column qualities and tests, stationary phases, carrier gases, end-piece treatment, and diagnosis of defects. Detector systems include flame ionization, electron capture, alkali flame ionization, flame photometric, thermal conductivity, electrochemical, photoionization, microwave plasma emission, and mass spectrometer. Substances which can be detected qualitatively or quantitatively in aqueous systems are volatile halogenated hydrocarbons, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, phenols, pesticides, triglycerides, low-molecular weight acids, surfactants, and complex mixtures. (Cassar-PTT)
W86-03410

ORGANIC MASS SPECTROMETRY,

National Inst. of Environmental Health Sciences, Research Triangle Park, NC.
J. R. Hass, and D. L. Norwood.
IN: Water Analysis, Volume III: Organic Species, 1984. p 253-316, 20 fig, 106 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Spectrometry, Mass spectrometry, Chromatography, Gas chromatography.

This chapter reviews the basic principles of organic mass spectrometry, instrumentation, and data interpretation and describes recent developments in the field. Ionization may take place by electron impact or chemical means. Low-volatility samples present special problems in ionization; techniques used are (1 chemical derivatization to form a more volatile substance or (2) methods such as field desorption and surface ionization. Several mass analyzers are available. Quadropole mass filters are most widely used. Others include magnetic sectors and double-focusing mass analyzers. The time-of-flight mass spectrometer uses a pulse of ions accelerated through a source-voltage difference. Electron multipliers detect the ions; these come in two varieties, venetian blind and continuous dynode. Mass spectrometry combined with either gas or liquid chromatography has been a powerful tool in organics analysis. For detection of single components in complex mixtures (e.g., dioxin in environmental samples), tandem mass spectrometry, also known as mass spectrometry/mass spectrometry, is used. Qualitative analysis of unknown mixtures involves a series of steps; this process has been somewhat simplified by computers and spectrum library files. Gas chromatography has decreased the use of mass spectrometry in quantitative analysis. However, coupling the two methods is receiving more attention. Some applications in the field of water analysis include detection of trace organic pollutants and the substances adsorbed by activated carbon filters. (Cassar-PTT)
W86-03411

USE OF HPLC FOR WATER ANALYSIS,

Radian Corp., Austin, TX.
K. J. Bombaugh.
IN: Water Analysis, Volume III: Organic Species, 1984. p 317-379, 11 fig, 7 tab, 65 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Chromatography, Liquid chromatography, High performance liquid chromatography.

High pressure/performance liquid chromatography (HPLC), valuable for analyzing nonvolatile substances, has great potential for water analysis. The equipment consists of several components: carrier delivery systems (pumps), carrier gradient systems (mixing), sample inlet systems (injection), and column hardware and housing. Many detectors are available for use with HPLC: photometric, spectrophotometric, refractive index, fluorometric, photoconductivity, electrical conductivity, and electrochemical. Two basic problems in HPLC are solute band retention and spreading of the bands. Resolution, the extent to which chromatographic peaks are separated, can be optimized by increasing relative retention (column selectivity) and retention (capacity factor) and by reducing band spreading (column efficiency). HPLC systems can be classified into several types: normal-phase (porous sorbent with nonpolar carrier), reversed-phase (polar mobile phase and nonpolar stationary phase), paired-ion (conversion of ionic substances to lipophilic liquid that distribute between conventional LC phases), ion-exchange (pH-controlled aqueous carriers and ionically charged packings), and size-exclusion (separated according to molecule size). Directions are given for making a separation and optimizing it. (Cassar-PTT)
W86-03412

INFRARED SPECTROPHOTOMETRY OF POLLUTANTS IN WATER SYSTEMS,

Breidenbach Environmental Research Center, Cincinnati, OH.
F. K. Kawahara.
IN: Water Analysis, Volume III: Organic Species, 1984. p 381-443, 12 fig, 9 tab, 99 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Spectroscopy, *Infrared spectroscopy, Hydrocarbons, Aromatic compounds, Amines, Amino acids, Nitrogen compounds, Nitrates, Nitrites, Chlorinated hydrocarbons, Fluorine compounds, Organophosphorus compounds, Sulfur compounds, Sulfides, Pesticides, Phenols, Oil spills, Statistical analysis.

Infrared spectroscopy relies on the interaction of infrared light of known frequency and intensity with molecules. This paper discusses the theoretical aspects, considering molecular spectra, band positions, types of vibrations, and interactions. Conditions necessary for interpreting spectra are described. Spectra may be compared with spectra of known functional groups. Types of bands and spectra are covered under alkanes (methyl and methylene groups), branched-chain hydrocarbons, olefins (carbon-carbon double bonds and carbon-hydrogen bonds), aromatics (carbon hydrogen bonds and ring carbon-carbon bonds), alcohols and phenols (oxygen-hydrogen bond, carbon-oxygen bond, and hydroxyl group), ethers, epoxides, peroxides, carbonyl compounds (aldehydes, ketones, carboxylic acids and salts, esters, acyl and aroyl halides, amides, anhydrides, lactams, and lactones), amines (nitrogen-hydrogen bonds and carbon-nitrogen bonds), amine salts, amino acids and salts, nitriles and isonitriles, nitro compounds, nitrates, nitrites, organohalogens (carbon-fluorine and carbon-chlorine), organophosphorus compounds, and organosulfur compounds. Detailed information is given for infrared analysis of pesticides, phenol, and petroleum products, in particular, oil spills. Statistical analysis has been applied to infrared analysis in linear discriminant function analysis. Fourier transform infrared spectroscopy has permitted higher sensitivity and/or greater speed in analysis of trace water pollutants. (Cassar-PTT)
W86-03413

5B. Sources Of Pollution

GEOHYDROLOGY OF THE MADISON AND ASSOCIATED AQUIFERS IN PARTS OF MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02921

EVALUATION OF ENVIRONMENTAL FACTORS AFFECTING MAJOR DISSOLVED-ION YIELDS OF STREAMS IN THE UNITED STATES,

Geological Survey, Doraville, GA. Water Resources Div.
N. E. Peters.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Supply Paper 2228, 1984. 39 p, 18 fig, 9 tab, 88 ref.

Descriptors: *Multivariate analysis, *Denudation, Streams, *Weathering, Crystalline rocks, Carbonate rocks, Sandstones, Atmospheric precipitation, *Geochemistry, Population density, *Dissolved solids, *Ions, Chemical transport, *Ion transport.

The seven dissolved major ions in streams (sodium, potassium, magnesium, calcium, chloride, sulfate, and bicarbonate) and their sum dissolved solids, from 56 basins in the conterminous United States and Hawaii were correlated with bedrock type, annual precipitation, population density, and average stream temperature of their respective basins through multiple linear regression equations to predict annual yields. Yields from basins underlain by limestone, sandstone, or crystalline rock ranged from about 10 to 100,000 kilograms per square kilometer. Predicted yields were within 1 order of magnitude of measured yields. The most important factor in yield prediction was annual precipitation, which accounted for 58 to 71 percent of all yields. Rock type was second in importance. Population density was ineffective indicator of all constituents except sodium and chloride, for which it accounted for 13 and 20 percent of the annual yield, respectively. Furthermore, average ion contributions from atmospheric deposition accounted for 30 percent of the sodium and chloride and 60 percent of the sulfate in annual yields. (USGS)
W86-02923

RELATIONS OF URBAN LAND-USE AND DRY-WEATHER STORM AND SNOWMELT FLOW CHARACTERTISTICS TO STREAM-WATER QUALITY, SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02926

WASTEWATER APPLICATION BY SPRAY IRRIGATION ON A FIELD SOUTHEAST OF TALLAHASSEE, FLORIDA: EFFECTS ON GROUND-WATER QUALITY AND QUANTITY, 1980-82,

Geological Survey, Tallahassee, FL. Water Resources Div.
J. F. Elder, J. D. Hunn, and C. W. Calhoun.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4006, 1985. 41 p, 20 fig, 5 tab, 40 ref.

Descriptors: Municipal wastewater, Wastewater management, *Wastewater irrigation, *Spray irrigation, *Groundwater pollution, Groundwater level, Water quality, *Florida, Tallahassee.

A field southeast of Tallahassee, Florida, used for land application of wastewater by spray irrigation was the site of a ground-water monitoring study to determine effects of spray irrigation on water-table elevations and ground-water quality. The study was conducted during 1980-82 in cooperation with the City of Tallahassee. The wastewater has relatively high concentrations of chloride, nitrogen, phosphorus, organic carbon, coliform bacteria, sodium, and potassium. These substances are usually attenuated before they can impact the ground water. However, increases in chloride and nitrate-nitrogen were evident in ground water in some of the monitoring wells during the study. Chloride concentrations increased five-fold or more in some wells directly affected by spray irrigation, and nitrate-nitrogen concentrations increased eight-fold or more. Ground-water levels in the area of the spray field fluctuated over a range of several feet. These fluctuations were affected somewhat by spray irrigation, but the primary control on water levels was rainfall. As of December 1982, constituents introduced to the system by spray irrigation of effluent had not exceeded drinking water standard in the ground water. However, the system had not yet stabilized and more changes in ground-water quality could be expected. (USGS)
W86-02929

RECONNAISSANCE OF WATER QUALITY AT A U.S. DEPARTMENT OF ENERGY SITE, PINELLAS COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
M. Fernandez.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4062, 1985. 49 p, 10 fig, 7 tab, 44 ref.

Descriptors: Water pollution control, Water quality, *Water pollution sources, Environmental quality, Ponds, *Spray irrigation, *Waste disposal ponds, *Florida, Pinellas County.

Sanitary and industrial wastes at the Pinellas Plant of the U.S. Department of Energy, prior to December 1982, were combined, treated, and disposed of by ponding and spray irrigation on a 10-acre tract within the plant site. Prior to 1972, the treated wastes were released to surface drainage features. An electromagnetic survey for ground conductivity was made to identify changes in the ground conductivity that may be due to the spray irrigation disposal operations. Water samples from four test wells drilled into the surficial aquifer and the two disposal ponds and bottom material from the ponds were analyzed for priority and nonpriority pollutants, total organic carbon, volatile organic carbon, herbicides, insecticides, trace metals, nutrients, and major constituents. Overall, concentrations of constituents in the water samples were (1) less than the detection limits, (2) within U.S. Environmental Protection Agency quality criteria for water, or (3) within the range of results for a designated background water-quality site. Concentrations of 12 priority pollutants were found to be considerably above detection limits. Concentrations of these compounds, mostly coal-tar derivatives, ranged from 220 to 5,500 micrograms per kilogram; the detection limit for these compounds is 10 micrograms per kilogram. Included in these compounds were anthracene, pyrenes, and chrysene. (USGS)
W86-02930

STREAMFLOW AND WATER QUALITY OF ONION RIVER, WISCONSIN--AN ASSESSMENT OF NONPOINT-SOURCE DISCHARGES,

Geological Survey, Madison, WI. Water Resources Div.
S. J. Field, and R. A. Lidwin.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resouces Investigations Report 84-4066, 1984. 78 p, 12 fig, 6 tab, 31 ref.

Descriptors: *Small watersheds, *Water quality, Hydrology, *Wisconsin, Water temperature, Dissolved solids, Sediment yield, Onion River, *Nonpoint-source discharge, Suspended-sediment yield, Total nitrogen load, Total phosphorus laod.

The Onion River in eastern Wisconsin was monitored during the 1979 and 1980 water years to define the relationship between water quality, streamflow, and nonpoint-source discharges. Nonpoint-source discharges in the lower part of the Onion River are suspected of contributing significantly to degradation of water quality. Two streamflow water-quality monitoring stations were established on the Onion River, one at Hingham upstream of the affected area, and one near Sheboygan Falls downstream of the affected area. The 1979 streamflow was 60 percent greater than average, whereas the 1980 streamflow was about 5 percent less than average. Suspended-sediment yields and, probably, phosphorus yields were slightly above average for both years because of greater than normal precipitation, and because stream discharges were greater than normal in 1979 and near normal in 1980. A population of bottom-dwelling carp resuspends the bottom sediments during late spring and early summer, possibly causing high concentrations of suspended sediment and phosphorus during these periods. Suspended sediment and nutrient yields, and loading rates, were highest downstream of Hingham. Nonpoint-source contribution of phosphorus amounted to 362 pounds per square mile downstream of Hingham compared to 272 pounds per square mile upstream of Hingham in the 1979 water year. (USGS)
W86-02932

RECONNAISSANCE STUDY OF SALTWATER CONTAMINATION IN THE EL DORADO AQUIFER, UNION COUNTY, ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
M. E. Broom, T. F. Kraemer, and W. V. Bush.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4012, 1984. 47 p, 24 fig, 6 tab, 18 ref.

Descriptors: *Chlorides, *Aquifers, Geochemistry, Geohydrology, Geologic fractures, Water quality, *Arkansas, Union County, Sparta sand, Graben.

Since 1960 chloride concentrations in the El Dorado aquifer have increased near El Dorado, Arkansas. The aquifer is a major source for municipal and industrial water supply in Union County. Greatest withdrawal occurs near El Dorado. Because of this withdrawal, the potentiometric surface at El Dorado has been lowered more than 300 feet. Geologic, hydrologic, and chemical data indicate that water from a graben south and east of El Dorado is the source of contamination from salt within the El Dorado aquifer. The data indicates that surface brines and deeper aquifers are not the sources of chloride contamination. Lowering the potentiometric surface near El Dorado has caused water to move out of the graben toward El Dorado. Estimates based on interpretation of electric logs for two wells in the graben indicate chloride equivalents may be as high as 2,500 milligrams per liter in the aquifer. Concentrations outside the graben range from 130 to 650 milligrams per liter at the west end of the graben and from 25 to 150 milligrams per liter farther west and north. (USGS)
W86-02936

HISTORICAL WATER-QUALITY DATA FOR THE CLARK FORK (RIVER) AND THE MOUTHS OF SELECTED TRIBUTARIES, WESTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
T. M. Brosten, and M. A. Jacobson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-168, 1985. 89 p, 1 fig, 2 tab, 3 ref.

Descriptors: *Water quality, Sediment concentration, *Data collections, Trace metals, Sediment discharge, Clark Fork River, *Montana.

The Clark Fork, occupying a major drainage area in western Montana, leaves the state of Montana's largest river. This report is a compilation of recent historical water-quality data collected by the U.S. Geological Survey on the Clark Fork and near the mouths of major tributaries. Included in the report are water-quality data collected during various time intervals since 1969 at 18 surface-water stations. Because of the large amount of streamflow and water-temperature data collected at these 18 stations and at other sites in the study area, the data are not included in the report. However, station numbers and corresponding periods of record are listed and the availability of the data is identified. (USGS)

W86-02937

HYDROLOGIC BENCH-MARK PROGRAM AS A STANDARD TO COMPARE AND EVALUATE TIME-SERIES TRENDS IN SELECTED WATER-QUALITY CONSTITUENTS FOR STREAMS IN GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02940

QUALITY OF IRRIGATION-RETURN FLOWS IN THE LOWER ARKANSAS RIVER VALLEY, COLORADO,

Geolcgical Survey, Pueblo, CO. Water Resources Div.
D. Cain.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4273, 1985. 85 p, 20 fig, 19 tab, 21 ref.

Descriptors: *Return flow, Nutrients, Bacteria, *Water quality, Tailwater, Water budget, Salt budget, *Colorado, *Arkansas River.

Irrigation-return flows in the lower Arkansas River valley of Colorado were investigated using one-time data at 59 sites, monthly data at 4 sites, and intensive data in a small irrigated area. Specific conductance of return flows increased downstream, paralleling specific conductance of irrigation water. During July 1977, Arkansas River streamflow below Manzanola was mostly irrigation-return flow. A similar situation existed during periods of little precipitation in the early and late irrigation seasons during 1974 to 1978. Irrigation-return flows had a large effect on Arkansas River water quality during these times. (USGS)
W86-02942

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE RED OAK AREA, LATIMER COUNTY, OKLAHOMA,

Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, D. L. Bergman, J. D. Stoner, and S. P. Blumer.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4116, 1983. 44 p, 13 fig, 17 tab, 15 ref.

Descriptors: Strip mines, *Strip mine wastes, *Mine drainage, *Water pollution sources, *Coal mines, Water quality, *Oklahoma, Latimer County, Red Oak, Brazil Creek, Rock Creek.

In the Red Oak area, Oklahoma, water in shale bedrock occurs in bedding planes and fractures and is confined. Wells probably yield less than 5 gallons per minute. Ground water is a sodium or mixed cation carbonate/bicarbonate type with dissolved-solids concentrations ranging from about 300 to 700 milligrams per liter. No relationship between water chemistry and well depth or location is apparent. Brazil Creek flows 1 cubic foot per second or less about 25 percent of the time and has no flow about 15 percent of the time. Water in Brazil Creek is a mixed cation carbonate/bicarbonate type. Dissolved-solids concentrations upstream from old and recent mines ranged from 30 to 100 milligrams per liter whereas concentrations downstreams from the mines ranged from 50 to 600 milligrams per liter. Excessive levels of cadmium, chromium, lead, and mercury at times preclude use of water from Brazil and Rock Creeks for public supply. Maximum suspended-sediment discharge, in tons per day, was 2,500 for Brazil Creek and 3,300 for Rock Creek. Silt-clay particles with diameters less than 0.062 millimeter were the dominant sediment size. (USGS)
W86-02951

DISTRIBUTION AND SOURCE OF BARIUM IN GROUND WATER, CATTARAUGUS INDIAN RESERVATION, SOUTHWESTERN NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02955

PRELIMINARY EVALUATION OF HYDROLOGY AND WATER QUALITY IN RELATION TO THE TACOMA LANDFILL, PIERCE COUNTY, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, and G. L. Turney.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4351, 1985. 35 p, 3 fig, 8 tab, 21 ref.

Descriptors: Water quality, *Groundwater pollution, Aquifers, Land use, *Landfills, Domestic water, Municipal water, Pierce County, *Washington, Tacoma landfill, *Groundwater quality, Surface water quality, *Hazardous wastes, Domestic water supplies, Municipal water supplies.

The Tacoma landfill, located in western Pierce County, Washington, has been used for the disposal of waste since about 1960. Disposal operations are planned to continue at this site until at least 1990. Data were compiled and interpreted to help understand the possible effects of the landfill on water quality in the surrounding area. Data were collected from published and unpublished reports of the U.S. Geological Survey, and from predominantly unpublished data in the files of other government agencies. The Tacoma landfill is underlain by unconsolidated, glacially derived deposits that consist of a wide variety of mixtures of clay to boulder-sized materials. Ground water is mostly the result of rainfall on the land surface, and moves through artesian aquifers (under the landfill) that are tapped for both domestic and municipal use. Hazardous liquid and dissolved wastes are probably present in the landfill, and potential flow paths for waste migration exist. An undetermined number of single-family domestic wells and 18 public-supply wells are within 3 miles of the landfill, three as close as 0.2 miles. There is only limited evidence indicating ground- and surface-water contamination. Further investigations of the geology, hydrology and water quality are needed to characterize the impact the landfill has on ground- and surface-water of the surrounding area. (USGS)
W86-02961

SELECTED TRACE-ELEMENT DATA FOR STREAMS IN THE SOUTHERN YAMPA RIVER BASIN, NORTHWESTERN, CO,

Geological Survey, Lakewood, CO. Water Resources Div.
W. S. Maura.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-192, 1985, 154 p, 1 fig, 5 tab, 3 ref.

Descriptors: *Water quality, Data collections, Surface water, Water sampling, *Trace elements, Coal mining, Yampa River, *Colorado, Routt County, Moffat County.

Increases in coal mining in northwestern Colorado have increased concerns about the impact of mining on the chemical quality of surface water. One area of particular concern is in the southern part of the Yampa River basin. To identify the possible changes in water quality produced by mining in this area, it is first necessary to determine the present water chemistry resulting from the geology, climate, and land use. Because few data were available, a program for the synoptic collection of water-quality data was developed in which sampling sites were selected to determine the surface-water chemistry. (USGS)
W86-02967

CONCEPTUAL HYDROLOGIC MODEL OF FLOW IN THE UNSATURATED ZONE, YUCCA MOUNTAIN, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
P. Montazer, and W. E. Wilson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4345, 1984. 55 p, 14 fig, 1 tab, 37 ref.

Descriptors: *Hydrogeology, *Model studies, *Path of pollutants, Unsaturated zone, Fracture permeability, Infiltration, Percolation, Perched groundwater, Porous media, *Radioactive waste disposal, Aquifers, Yucca Mountain, Nevada Test Site, *Nevada Desert hydrology.

The unsaturated volcanic tuffs beneath Yucca Mountain, Nevada, are being evaluated as a host rock for a potential repository for high-level radioactive waste. A conceptual hydrologic model is proposed to describe the flow of fluids through these rocks. Thickness of the unsaturated zone is about 500 to 750 meters and consists of three welded units interlayered with two nonwelded units. Compared to nonwelded units, welded units have low matrix porosities and permeabilities, high fracture densities, and high bulk hydraulic conductivities. The principal repository area is bounded by normal fault zones. Of the average annual precipitation of 150 millimeters per year, 0.5 to 4.5 millimeters per year becomes net infiltration. Percolation through the matrix of the welded units is principally vertical and is less than 1 millimeter per year. Percolation through nonwelded units occurs both vertically and laterally and has variable rates (0.1 to 100 millimeters per year). Fracture flow is predominant in the uppermost welded unit during intense pulses of infiltration, but is insignificant in the welded unit that forms the potential host rock. Lateral flow in the upper nonwelded unit, enhanced by existence of a capillary barrier, probably is the factor controlling the low fluxes in the host rock and relatively high fluxes in the structural features. (USGS)
W86-02974

WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY - AN OVERVIEW,

Geological Survey, Reston, VA. Water Resources Div.
E. Callender, V. Carter, D. C. Hahl, K. Hitt, and B. I. Schultz.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $. USGS Water-Supply Paper 2233, 1984. 46 p, 48 fig, 1 tab, 2 ref.

Descriptors: *Estuaries, *Tidal rivers, Water quality, Aquatic plants, Nutrients, Phytoplankton, Sediment transport, Dissolved oxygen, Benthic invertebrates, Hydrodynamics, Sedimentation, Maryland, Virginia, *Potomac River, *Potomac River Estuary, District of Columbia, *Path of pollutants.

The U.S. Geological Survey began a 5-year interdisciplinary study of the tidal Potomac River and Estuary in October, 1977. Its objectives are: (1) to provide an understanding of physical, chemical, and biological processes; (2) to develop models to predict the movement and fate of nutrients and algae; to improve techniques for the study of tidal rivers and estuaries; and to aid water-quality decision making for the Potomac. The study is being conducted by scientists from many disciplines involved in 14 inter-related studies. They are addressing five major problem areas: nutrient enrichment, algal blooms, dissolved oxygen, sedimentation, and aquatic animal and plant resources. Preliminary results show that sewage treatment reduced organic carbon and phosphorus below that of the 1960's and 1970's and changed the form of dissolved nitrogen in the tidal river. Concentrations of chlorophyll a were less than those during the massive algal blooms of the 1960's. Dissolved oxygen concentrations fluctuate in response to changes in algal populations, but remain above the EPA limits during the summer low-flow period. Sedimentation rates have accelerated during the past 50-70 years due to urbanization and farming. Asian clams recently invaded the tidal river; submersed aquatic vegetation declined since the early 1900's but conditions may now favor its return. (USGS)
W86-02975

SIMULATED EFFECTS OF ANTICIPATED COAL MINING ON DISSOLVED SOLIDS IN SELECTED TRIBUTARIES OF THE YAMPA RIVER, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
R. S. Parker, and J. M. Norris.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4084, 1983. 65 p, 38 fig, 15 tab, 3 ref.

Descriptots: *Mine drainage, *Model studies, Water quality, Stream discharge, Streamflow, Water quality, *Colorado, *Yampa River basin, *Routt and Moffat Counties.

Identifying cumulative effects of coal mining on dissolved solids downstream from multipe coal-mining operations is particularly important in western basins. The problem of identifying cumulative effects is evident in the Trout Creek drainage, a tributary to the Yampa River in northwestern Colorado, where a number of mines are active and mine expansions are planned. As an evaluation tool, a model was developed and calibrated for the Trout Creek drainage and a reach of the Yampa River main stem. This model uses a series of nodes on the stream network to sum water quantity and quality through the network. The model operates on a monthly basis and uses data from water years 1976 to 1981. Output is mean monthly discharge, dissolved-solids concentration, and dissolved-solids load. Observed data are needed to initiate the model and for model calibration. Some data were extrapolated from records of nearby streamflow-gaging stations. Some nodes within the stream network were for inputs from anticipated mining and were inactive during calibrations. After calibration, these nodes were used to input water discharge at a given dissolved-solids concentration to reflect various future mine configurations. (USGS)
W86-02982

POTENTIOMETRIC SURFACE AND WATER QUALITY IN THE PRINCIPAL AQUIFER, MISSISSIPPIAN PLATEAUS REGION KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02983

TRAVELTIME, LONGITUDINAL-DISPERSION, REAERATION, AND BASIN CHARACTERISTICS OF THE WHITE RIVER, COLORADO AND UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02984

QUALITY OF GROUND WATER USED FOR PUBLIC SUPPLY IN FLORIDA, 1983-84,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02986

HAZARDOUS WASTE RESEARCH, PENSACOLA, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
H. C. Mattraw, and B. J. Franks.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-466, 1984. 193 p, 35 fig, 23 tab, 67 ref.

Descriptors: *Creosote, *Groundwater pollution, Organic compounds, Biodegradation, Sorbtion, Sorption, Phenols, *Florida, Pensacola, *Hazardous waste, Gas chromatography, Mass spectrometry, Pentachlorophenol.

In 1983, the U.S. Geological Survey, Office of Hazardous Waste Hydrology, selected the former American Creosote Works site near Pensacola, Florida as a national research demonstration area. Seventy-nine years (1902-81) of seepage from unlined discharge impoundments had released creosote, diesel fuel, and pentachlorophenol (since 1950) wastes into the ground-water system. A cluster of from 2 to 5 wells constructed at different depths at 9 sites yielded water which revealed contamination 600 feet downgradient and to a depth of 100 feet below land surface near the site. The best cross-sectional representation of the contaminant plume was obtained from samples collected and analyzed for oxidation-reduction sensitive inorganic chemical constituents. Energy dispersive x-ray fluorescence detected recently formed iron carbonate in soil samples from highly reducing ground-water zones. Approximately eighty specific organic contaminants were isolated from ground-water samples by gas-chromotography/mass spectrometry. Column studies indicate the dimethyl phenols are not sorbed or degraded by the sand-and-gravel aquifer materials. Five of nineteen individual phenolic and related compounds are biodegradable based on anaerobic digestor experiments with ACW site bacterial populations. The potential impacts in the nearby Pensacola Bay biotic community are being evaluated. (USGS)
W86-02989

PRIMARY PRODUCTIVITY IN THE POTOMAC TIDAL RIVER, MARYLAND, MAY 1980 TO AUGUST 1981,

Geological Survey, Reston, VA. Water Resources Div.
R. R. H. Cohen, and S. O. Pollock.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4255, 1983. 28 p, 7 fig, 7 tab, 13 ref.

Descriptors: *Phytoplankton, *Potomac River, *Maryland, *Primary productivity, *Algae, Algal growth, Oxygen, Light intensity, Photosynthesis, Depth-integrated primary productivity, Productivity-light relationships, Photosynthesis-light relationship.

Primary productivity by phytoplankton was measured on samples collected from the Potomac Tidal River, Maryland. The studies were performed monthly from May 1980 to September 1981. Additional studies were done once a week in August 1980, twice a week from August 4 to 8, 1980 and twice in September 1980. Depth-integrated samples were collected at five stations and incubated in boxes that were exposed to natural sunlight. The boxes were covered with neutral density filters transmitting 100, 65, 32, 16, and 6 percent surface light. River water was pumped continuously over the samples. The extinction of light in the water column by phytoplankton was measured when samples were collected. Experiments were performed to select a method for routine productivity analysis. No difference was found between productivity: (1) determined in situ and in boxes; (2) measured in 300 ml and (4) calculated from short term (4 hours) and long term (10-24 hours) incubations. There were higher productivity differences in samples that were rotated among different light intensities every 15 minutes (simulating mixing) than those remaining stationary. Respiration was significantly less in samples pumped through a hose from those collected using a depth-integrating sampler. Depth-integrated primary productivity was determined from the productivity data using an equation modified from one reported in the literature. Depth-integrated gross primary productivity was highest in August 1980 and 1981 and lowest in January 1980. (USGS)
W86-03000

GROUND-WATER DEVELOPMENT ALTERNATIVES IN THE CHIPUXET GROUND-WATER RESERVOIR, RHODE ISLAND,

Geological Survey, Providence, RI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03001

EFFECT OF EUSTATIC SEA-LEVEL CHANGES ON SALTWATER-FRESHWATER RELATIONS IN THE NORTHERN ATLANTIC COASTAL PLAIN,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03010

DISSOLVED-OXYGEN REGIME OF THE JORDAN RIVER, SALT LAKE COUNTY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
D. W. Stephens.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4056, 1984. 56 p, 24 fig, 10 tab, 34 ref.

Descriptors: *Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Reaeration, Photosynthetic oxygen, Wastewater treatment, Jordan River, *Utah, Water quality, *Water pollution sources.

Concentrations of dissolved oxygen in the Jordan River in Salt Lake County decrease considerably as the river flows northward. Mean concentrations of dissolved oxygen decreased from 8.1 milligrams per liter at the Jordan Narrows to 4.7 milligrams per liter at 500 North Street during April 1981 to September 1982. Coincident with the decrease, the biochemical-oxygen demand increased from 5 to 7 milligrams per liter. About 50 percent of the dissolved-oxygen concentrations and 90 percent of the 5-day biochemical-oxygen demand measured downstream from 1700 South Street exceeded the State intended-use standards. An estimated 6. million pounds of oxygen-demanding substances as measured by 5-day biochemical-oxygen demand were discharged to the Jordan River during 1981 from point sources downstream from 9000 South Street. Seven wastewater-treatment plants contributed 77 percent of this load, nonstorm base flows contributed 22 percent, and storm flows less than 1 percent. The Surplus Canal diversion at 2100 South Street removed about 70 percent of this load, and travel time of about 1 day also decreased the actual effects of the load on the river. Reaeration rates during September and October were quite high (average K2 at 20 degrees Celsius was about 12 per day) between the Jordan Narrows and 9000 South Street, but they decreased to 2.4 per day in the reach from 1330 South to 1800 North Streets. (USGS)
W86-03011

GEOCHEMICAL SURVEY TO DETERMINE WATER-QUALITY CHARACTERISTICS OF THE BIG SIOUX AQUIFER IN EASTERN SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
N. F. Leibbrand.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4069, 1985. 54 p, 7 ill, 4 tab, 10 ref.

Descriptors: Water Quality, *Water Sampling, *Groundwater, Statistical Analysis, *Groundwater quality, *Groundwater pollution, Water pollution sources, *South Dakota, Big Sioux River.

A geochemical survey of the Big Sioux aquifer, South Dakota was under taken to: (1) Estimate the quality of the water in the aquifer, (2) determine if there are any water-quality problems in the aquifer, and (3) design a water-quality monitoring network to monitor changes in present and potential water-quality problems. For most agricultural uses, the water in the Big Sioux aquifer is of acceptable quality. However, in some locations, the ground water is either marginally acceptable or unfit for human use. The major water-quality problem is the high nitrate concentrations (geometric mean of 4 and up to 120 milligrams per liter as N) found in many domestic water supplies. The fact that samples taken from observation wells located by rooads away from houses and barnyards show lower concentrations of nitrate (geometric means of 0.4 and up to 22 milligrams per liter as N) indicates that the source of nitrate pollution is

probably localized and due to barnyard wastes. A monitoring network is proposed consisting of at least: (1) Three wells adjacent to domestic wells, (2) three wells about 1,000 feet away and down the potentiometric gradient from domestic wells, and (3) three wells at least 3,000 feet from any source of pollution. This monitoring network would provide information on changes in both localized nitrate pollution and other selected water-quality parameters. (USGS)
W86-03019

WATER QUALITY AND STREAMFLOW DATA FOR THE WEST FORK TRINITY RIVER IN FORT WORTH, TEXAS,

Geological Survey, NSTL Station, MS. Water Resources Div.
S. C. McCutcheon, H. E. Jobson, R. E. Rathbun, and W. Gibbons.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4330, 1985. 101 p, 25 fig, 26 tab, 32 ref.

Descriptors: *Water quality data, Stream pollution, *Model studies, Steady flow, *Oxygen balance, *Biochemical oxygen demand, Organic carbon, Nitrogen cycle, Phosphorus, Lagrangian models, *Texas, Trinity River.

Water-quality data were collected on a 13.6-mile reach of the West Fork Trinity River in Fort Worth, Texas to test a dynamic Lagrangian model. Flow was steady. Loads of dissolved constituents varied with time at the beginning of the study reach and in the reach, primarily because of photosynthesis. River quality was fairly good despite low dissolved oxygen measured in the headwaters and the significant sewage load from the tributaries. Diel and longitudinal trends were defined by sampling at fixed sites and by following dyed parcels of water. Nitrification, deoxygenation, reaeration, and photosynthesis affected the dissolved oxygen balance. Independent estimates of some of the rate coefficients were 0.1 to 0.2, 0.8, and 0 to 3.6, all per day, for deoxygenation, nitrification, and reaeration, respectively. (USGS)
W86-03020

WATER RESOURCES AND POTENTIAL HYDROLOGIC EFFECTS OF OIL-SHALE DEVELOPMENT IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-03021

PRELIMINARY STUDY USING DIGITAL MODELING TECHNIQUES TO UNDERSTAND AND PREDICT THE TEMPERATURE REGIME IN A STREAM BELOW A MAJOR RESERVOIR--THE NORTH SANTIAM RIVER BELOW DETROIT DAM, OR,

Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 6G.
W86-03022

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1983 - NOVEMBER 30, 1984,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03023

ASSESSMENT OF A STEADY-STATE PROPANE-GAS TRACER METHOD FOR DETERMINING REAERATION COEFFICIENTS-CHENANGO RIVER,

Geological Survey, Reston, VA. Water Resources Div.
N. Yotsukura, D. A. Stedfast, and G. H. Jirka.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4368, 1984. 69 p, 12 fig, 7 tab, 23 ref.

Descriptors: *Reaeration, *Tracers, *Open channels, Steady flows, Air-water interface, Gas tracers, Wind speeds, Mass transfer, *New York, Chenango River.

A test was conducted in a meandering 9.6-km reach of the Chenango River, New York, to assess the feasibility of a two-dimensional steady-state propane-gas tracer method as a means of estimating in situ reaeration coefficients. It is concluded that the method, which combines an instantaneous release of dye tracer with a long duration release of propane gas tracer, is very feasible for determining gas-desorption coefficients and wind effects in a wide river. However, the method does not appear to be ready for immediate operational applications. (USGS)
W86-03033

CHEMICAL QUALITY OF THE SAW MILL RIVER, WESTCHESTER COUNTY, NEW YORK 1981-83,

Geological Survey, Albany, NY. Water Resources Div.
R. J. Rogers.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4225, 1984. 51 p, 9 fig, 18 tab, 39 ref.

Descriptors: *Bottom sediments, Water quality, Heavy metals, Rivers, Nutrients, Pesticides, Organic compounds, Contamination, *Urbanization, Westchester County, *New York, Saw Mill River, *Water pollution sources.

Surface waters, bottom sediments and coatings formed on artificial substrates (ceramic tiles) were analyzed to evaluate the chemical quality of the Saw Mill River, New York. Heavy metals, nutrients, and organic contaminants were studied. Dissolved orthophosphate concentrations were highest in the lower third of the river. Dissolved manganese was the only metal to exceed U.S. Environmental Protection Agency water-quality criteria. Arsenic, cadmium, copper, lead, and zinc concentrations were highest in waters from the lowest 4 river miles. Concentrations of copper, lead, and zinc in bottom sediments from the lowest 3 river miles were greater than in upstream sediments. Concentrations of nine heavy metals were higher on tiles emplaced below river mile 3 than on tiles upstream. Few organic compounds were detected in the water column; none persisted at all sites. Chlordane, DDD, DDE, DDT, dieldrin, and polychlorinated biphenyls (PCB's) were found in bottom sediments throughout the basin. PCB concentrations were highest in the lowest 6 river miles; the other organic compounds exhibited no spatial patterns. Polynuclear aromatic hydrocarbons were most abundant in bottom sediments from the lowest 2 river miles. Collectively the distribution of contaminants indicates that river quality deteriorates in the lower, more heavily urbanized reach. (USGS)
W86-03035

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF PRAIRIE DU CHIEN-JORDAN, AQUIFER, SOUTHEAST MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03042

DETERMINING THE EFFECTIVENESS OF HIGHWAY DRAINAGE SYSTEMS IN PREVENTING SALT CONTAMINATION OF GROUND WATER,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5G.
W86-03044

WATER-QUALITY DATA FOR 34 SITES, APRIL AND JUNE, 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
P. J. Pulliam.
Available from OFSS, USGS, ox 25425, Lakewood, CO 80225. USGS Open-File Report 85-165, 1985. 13 p, 2 fig, 6 tab, 6 ref.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Nuclear wastes, *Radioactive waste disposal, Radioactive wastes, *Stream pollution, Waste disposal, Water quality data, Water sampling, *Oak Ridge, Oak Ridge Reservation, Y-12 Plant, Roane County, Anderson County, *Tennessee.

Water-quality data were collected at 34 sites in the vicinity of the Y-12 Plant, Oak Ridge, Tennessee, on April 12 and 13, 1984. Concentrations of dissolved major and trace constituents were determined; field determinations of specific conductance, pH temperature, alkalinity, and dissolved oxygen were made. Gross alpha and beta activity were determined for 10 of the 34 sites, and dissolved organic carbon and oil and grease concentrations were determined for 11 of the sites sampled on June 3, 1984. (USGS)
W86-03048

MEASUREMENT OF GROUND-WATER VELOCITY USING RHODAMINE WT DYE NEAR SHEFFIELD, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03051

DATA COLLECTION FOR A TIME-OF-TRAVEL AND DISPERSION STUDY ON THE COOSA RIVER NEAR CHILDERSBURG, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03052

DATA FROM A SOLUTE TRANSPORT EXPERIMENT IN THE LEVIATHAN MINE DRAINAGE, ALPINE COUNTY, CALIFORNIA, OCTOBER 1982,

Geological Survey, Menlo Park, CA. Water Resources Div.
M. R. Flint, K. E. Bencala, G. W. Zellweger, and D. P. Hammermeister.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-85, 1985. 17 p, 60 fig, 28 tab, 8 ref, 3 append.

Descriptors: *Solute transport, Experimental data, *Chlorides, *Sodium, *Sulfate, *Fluorides, Streams, *Acid mine drainage, Environmental tracers, *Path of pollutants, *Tracers, Alpine County, *California.

A twenty-four hour injection of chloride and sodium was made into Leviathan Creek, Alpine County, California to aid interpretation of the coupled interactions between physical transport processes and geochemical reactions. Leviathan Creek was chosen because it receives acid mine drainage from Leviathan Mine, an abandoned open-pit sulfur mine. Water samples were collected at 15 sites along a 4.39 kilometer reach and analyzed for chloride, sodium, sulfate and fluoride. Dissolved concentrations are presented in tabular format and time-series plots. Duplicate samples were analyzed by two laboratories: the Central Laboratory, Denver, Colorado and a research laboratory in Menlo Park, California. A tabular comparison of the analyses and plots of the differences between the two laboratories is presented. Hydrographs and instantaneous discharge measurements are included. (USGS)
W86-03055

SEASONAL PATTERNS OF ALKALINITY IN THE SAN FRANCISCO BAY, CALIFORNIA, ESTUARINE SYSTEM DURING 1980,

Geological Survey, Menlo Park, CA. Water Re-

sources Div.
L. E. Schemel.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 82-4102, 1984. 54 p, 33 fig, 28 tab, 32 ref.

Descriptors: *Alkalinity, Salinity, *Estuaries, Mixing, Seasonal variation, Water quality, Path of pollutants, *Water pollution sources, *San Francisco Bay, *California, Sacramento River, Sacramento-San Joaquin Delta.

Salinity and alkalinity were measured in the near-surface waters of San Francisco Bay estuarine system at two-week intervals during 1980. Results are presented in figures and as numerical values, and the analytical methods are detailed. The transport of alkalinity to the Bay from the delta during 1980 was 3.8 x 10 to Ohe 10th power equivalents; this estimate is based on the freshwater alkalinity concentrations predicted by the north San Francisco Bay salinity-alkalinity distributions. North San Francisco Bay distributions are primarily the result of conservative mixing of freshwater from the Delta with Pacific Ocean water. Nonlinear distributions are the consequence of alkalinity variations in the freshwater rather than the effects of in-estuary processes or sources. Seasonal inflow of agricultural waste water is a major cause of freshwater alkalinity variations. South San Francisco Bay salinity-alkalinity distributions show the effects of variations in Delta outflow rate, local streams, and municipal waste-water inflows. (USGS)
W86-03059

SALINITY, ALKALINITY, AND DISSOLVED AND PARTICULATE ORGANIC CARBON IN THE SACRAMENTO RIVER WATER AT RIO VISTA, CALIFORNIA, AND AT OTHER LOCATIONS IN THE SACRAMENTO-SAN JOAQUIN DELTA, 1980,

Geological Survey, Menlo Park, CA. Water Resources Div.
L. E. Schemel.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4059, 1984. 45 p, 14 fig, 7 tab, 39 ref.

Descriptors: *Alkalinity, *Organic carbon, *Salinity, River flow, Storm runoff, Return water, Seasonal variations, Path of pollutants, *Water pollution sources, *Estuaries, *San Francisco Bay, Water quality, *Sacramento River, San Joaquin River, Sacramento-San Joaquin Delta, *California.

Salinity, alkalinity, and dissolved and particulate organic carbon (DOC and POC respectively) concentrations in the Sacramento River water at Rio Vista were measured every three to five days during 1980 as part of an effort to identify time-dependent variations in the composition of the freshwater flow from the Sacramento-San Joaquin Delta to San Francisco Bay. Concentration ranges were generally small compared to the seasonal range of river flow rate; transport rates to the Delta and to the Bay varied primarily as a function of flow rate. Surface runoff from winter storms diluted salinity and alkalinity concentrations. DOC and POC were generally more concentrated during winter than during other times of the year. Variations in tributary flows resulted in sometimes-large salinity and alkalinity variations during spring through fall. Late summer concentrations were high because of large inflows of agricultural waste waters. POC and DOC concentrations were lowest during summer. (USGS)
W86-03063

CLASSIFICATION OF STREAM BASINS IN SOUTHEASTERN OHIO ACCORDING TO EXTENT OF SURFACE COAL MINING,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-03071

HYDROLOGIC DATA FOR LEVIATHAN MINE AND VICINITY, ALPINE COUNTY, CALIFORNIA, 1981-83,

Geological Survey, Carson City, NV. Water Resources Div.
D. P. Hammermeister, and S. J. Walmsley.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-160, 1985. 161 p, 23 fig, 90 tab, 13 ref.

Descriptors: *Groundwater, Lysimeters, Piezometers, Sulfur, *Waste dumps, Bedrock, Biomass, Core drilling, *Mine wastes, *Water pollution sources, Bryant Creek, Leviathan Creek, Leviathan Mine, Countaineer Creek, Alpine County, *California, Sierra Nevada.

The U.S. Geological Survey collected basic hydrologic and water-quality data during 1981-83 to facilitate the geohydrologic evaluation of the Leviathan Mine area and the design of a pollution-abatement project. Surface-water field data included one or more measurements of pH, water temperature, and specific conductance at 45 sites in and adjacent to the mine area. At nine of these sites, daily data on discharge, specific conductance, and water temperature were collected during parts of 1981-82 by using electronic monitor-recorder systems. Ground-water field data included one or more of the water-quality measurements listed above at 71 piezometers in the mine area. Borehole geophysical data included neutron-moisture, neutron-porosity, gamma-gamma density, natural gamma, and temperature logs at three sites. Mineralogic and hydrologic data were obtained for cores taken from nine test holes. One or more surface-water samples from 26 sites were analyzed for major cations, major anions, and a wide range of minor inorganic constituents. Single ground-water samples from 36 piezometers were analyzed for the same array of major and minor constituents. (USGS)
W86-03091

RECONNAISSANCE OF MINE DRAINAGE IN THE COAL FIELDS OF EASTERN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
D. J. Growitz, L. A. Reed, and M. M. Beard.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4274, 1985. 54 p, 6 fig, 38 tab, 23 ref.

Descriptors: *Mine drainage, Streamflow, *Acid mine discharge, Rainfall, Runoff, *Water pollution sources, *Coal mine wastes, Coal mine drainage, *Pennsylvania, Anthracite, Northern Field, Eastern Middle Field, Western Middle Field, Southern Field.

Anthracite has been extensively mined in four area of eastern Pennsylvania. Almost all underground mining in the Northern, Eastern Middle, Western Middle, and Southern Fields has been discontinued and many mines are abandoned and flooded. Precipitation on much of the 408 square miles of coal fields infiltrates to the underground mine complexes, and is discharged as mine drainage from tunnels, mine entrances, and boreholes. Mine drainage was measured and sampled at 251 sites, that had a total discharge of 918 cubic feet per second, and a total sulfate load of 1,470 tons per day. The largest sulfate yield was 5.4 tons per day per square mile from the Western Middle Field. Yields from the Northern, Eastern Middle, and Southern Fields were 4.6, 3.6, and 1.4 tons per day per square mile, respectively. (USGS)
W86-03092

DISTRIBUTION OF POLYCHLORINATED BIPHENYLS IN THE HOUSATONIC RIVER AND ADJACENT AQUIFER, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
F. B. Gay, and M. H. Frimpter.
Available from Distribution Br, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2266, 1985. 26 p, 17 fig, 30 ref.

Descriptors: *Polychlorinated biphenyls, *Aroclors, *Path of pollutants, Bottom sediments, *Sediment distribution, *Sediment transport, Induced infiltration, Unconfined aquifers, Suspended sediments, Sorption, Groundwater movement, Water quality, Dissolved oxygen, Ammonia, Iron, Manganese, Water temperature, *Stratified-drift aquifers, *Housatonic River, Woods Pond, Berkshire County, *Massachusetts.

Polychlorinated biphenyls (PCBs) are sorbed to the fine-grained stream-bottom sediments along the Housatonic River from Pittsfield, Massachusetts, southward to the Massachusetts-Connecticut boundary. The highest PCB concentrations, up to 140,000 micrograms per kilogram, were found in samples of bottom material from a reach of the river between Pittsfield and Woods Pond Dam in Lee, Massachusetts. Sediments in Woods Pond Contain about 11,000 pounds of PCBs. The distribution of hydraulic-heads, water-temperatures, and concentrations of dissolved-oxygen, ammonia, nitrate, iron, and manganese in water from the aquifer show that industrial water-supply wells in a sand and gravel aquifer adjacent to Woods Pond have been inducing ground-water recharge through the PCB-contaminated bottom sediments of the pond for the last 25 years. These data indicate that, at the shore of the pond, the upper 40 feet of the aquifer contains water derived from induced infiltration. However, this induced recharge has not moved PCBs from the bottom sediments into a vertical section of the aquifer located 5 feet from the edge of Woods Pond. At the detection limits of the chemical analyses, no PCBs were found sorbed to the aquifer material or dissolved in the ground water at selected intervals throughout this vertical section. (USGS)
W86-03093

URBAN WATER-QUALITY DATA AND STATISTICAL SUMMARIES FOR SELECTED SITES IN THE SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
L. M. Pope, A. M. Diaz, and M. K. Butler.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. Kansas Department of Health and Environment Bulletin B2-49, 1983. 203 p, 1 fig, 19 tab, 17 ref.

Descriptors: *Urban hydrology, *Urban runoff, Urbanization, Water quality, Chemical analysis, Sediment concentration, Statistical analysis, Biological properties, Shunganunga Creek, Topeka, *Kansas, Monitoring systems, *Data collections.

In 1978, the U.S. Geological Survey, in cooperation with the Kansas Department of Health and Environment, began an investigation to evaluate the quantity and quality of storm runoff from a major urban area in Kansas. The area chosen for study was the Shunganunga Creek basin, a rapidly urbanizing area in Shawnee county that includes a large part of the City of Topeka. Urban water-quality data, collected from May 1979 to December 1981, and statistical summaries are presented for six streamflow sites in the Shunganunga Creek basin. Included are data for discrete water samples dry-weather flow, storm runoff, snowmelt runoff, and data for composite samples of storm runoff. The statistical summaries include mean, minimum and maximum observed values, and standard deviation. These data may be of interest to Federal, State, and local agencies, or management councils that need information on general water quality, constituent concentrations, pollutants, and hydrographic distributions during storm-runoff periods from a major urban area in a sub-humid, central-plains environment. (USGS)
W86-03099

MAY 1984-APRIL 1985 WATER BUDGET OF REELFOOT LAKE WITH ESTIMATES OF SEDIMENT INFLOW AND CONCENTRATIONS OF PESTICIDES IN BOTTOM MATERIAL IN TRIBUTARY STREAMS--BASIC DATA REPORT,

Geological Survey, Nashville, TN. Water Re-

sources Div.
C. H. Robbins, J. W. Garrett, and D. M. Mulderink.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-498, 1985. 37 p, 31 fig, 14 tab, 2 ref.

Descriptors: *Lake levels, *Streamflow, Precipitation, *Sediment load, Suspended sediment, *Pesticides, *Water budget, Lakes, *Tennessee, Reelfoot Lake, Hydrologic data.

This report contains hydrologic data collected at Reelfoot Lake, Tennessee from May 1, 1984, through April 30, 1985. Continuous streamflow data were collected at four sites on the three major tributaries to Reelfoot Lake and at one site on the lake outflow channel. Daily rainfall and lake-stage were each collected at two sites on the lake shore. Additionally, suspended-sediment samples were collected by automatic samplers and also manually during equipment maintenance visits at three of the four tributary inflow sites. At these three inflow sites, samples of stream-bottom material were collected at low flow once during the study period and were analyzed to determine the concentration of various pesticides. Periodic observations of ground-water levels were made at 30 wells in the Reelfoot Lake basin. Monitoring sites and types of data collected at each site are listed. (USGS)
W86-03100

SELECTED HYDROLOGIC DATA FOR THE POWELL RIVER BASIN IN WISE COUNTY, VIRGINIA,

Geological Survey, Richmond, VA. Water Resources Div.
J. D. Larson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-186. 22 p, 14 fig, 4 tab, 63 ref.

Descriptors: *Water quality, Groundwater, Surface water, Water supply, *Coal mining, *Virginia, Wise County, Powell River basin.

Evaluation of selected surface-water, groundwater, and water-quality data shows that hydrologic data collected by governmental agencies comprises less than 10 percent of the total data available in the Powell River basin, Virginia. Only a small portion of the hydrologic data for the basin has been compiled and stored by Federal and state agencies in two computerized hydrologic indexing systems (National Water Data Exchange and Commonwealth Data Base). Selected ground-water, surface-water, and water-quality data collected in the Powell River Basin in Wise County, Virginia are summarized. The data are obtained from three coal-mining companies, the Virginia State Water Control Board, and the U.S. Geological Survey. Water-quality data for 61 ground-water and 86 surface-water sites indicate elevated iron and manganese concentrations are present throughout the basin. A bibliography of available hydrologic reports on the area and selected pertinent hydrologic reports from other coal-producing areas is present. (USGS)
W86-03103

TRAVELTIME AND DISPERSION IN THE POTOMAC RIVER, CUMBERLAND, MARYLAND, TO WASHINGTON, D.C.,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03123

ATMOSPHERIC DEPOSITION OF SELECTED CHEMICALS AND THEIR EFFECT ON NONPOINT-SOURCE POLLUTION IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
R. G. Brown.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4195, 1984. 24 p, 10 fig, 3 tab, 21 ref.

Descriptors: *Fallout, Runoff, *Water quality, *Nonpoint pollution sources, *Acid rain, *Twin Cities metropolitan area, *Minnesota.

Atmospheric inputs and runoff concentrations of total Kjeldahl nitrogen, dissolved nitrite-plus-nitrate nitrogen, total phosphorus, total sulfate (only for atmospheric input), total chloride, and total lead were studied from April 1 to October 31, 1980, in one rural and three urban watersheds in the Twin Cities metropolitan area, Minnesota. Seasonal patterns of wetfall and dryfall generally were similar for all constituents except chloride in both rural and urban watersheds. Similarity between constituents and between rural and urban watersheds suggested that regional air masses transported from the Gulf of Mexico by frontal storm movements influence seasonal patterns of atmospheric input in the metropolitan area. Local influences such as industrial, agricultural, and vehicular air pollutants were found to influence the magnitude or rate of atmospheric input rather than the seasonal pattern. Chloride was primarily influenced by northwest frontal storms laden with coastal chloride. Local influences such as dust from road de-icing salt are thought to have caused an increase in atmospheric chloride during June. The atmospheric contribution to nonpoint-source-runoff pollution of nitrogen, in the form of nitrite-plus-nitrate, and lead was extremely high, constituting as much as 84 percent of the runoff load. In contrast, phosphorus and chloride inputs were low, averaging 6 percent of the total runoff load. (USGS)
W86-03125

TOXIC SUBSTANCES IN SURFACE WATERS OF THE B. EVERETT JORDAN LAKE WATERSHED.

North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
Water Quality Section Report No 85-02, March 1985. 113 p, 32 fig, 22 tab, 36 ref.

Descriptors: Watershed management, *Urban runoff, Drinking water, *Toxicants, Water resources planning, Organic compounds, Heavy metals, *Toxic wastes, *Water pollution sources, *North Carolina, Piedmont reservoir.

A comprehensive review was made of possible sources of toxicants in the watershed (1628 sq. mi) of a newly formed reservoir (14,300 acre) in North Carolina in order to help state officials decide whether it was a suitable drinking water source. Point and nonpoint sources were analyzed including agriculture, urban areas, abandoned mines, landfills and industrial and municipal wastewater treatment plants. Point and nonpoint heavy metal sources were compared. Basin water quality was also assessed. In general, watershed rivers and streams showed reduced metal levels since 1980 reflecting improved WWTP's in the basins. Effluent toxicity was uncommon. Urban runoff contributes more metals than point sources. A large portion of this appears to be controllable with detention basins. Organic chemical analyses of the lake water did not detect any contaminants. Detailed recommendations for improved government monitoring of effluents, stream water quality and aquatic communities (macrobenthos) were made. Letters were sent to dischargers to collect full disclosure of information on toxicants. In summary, available water quality data did not identify any toxicants in the lake which would limit its use as a water supply. However, uncertainty still remains with respect to toxicants since the lake lies within a developed watershed. This report is the first in a series of comprehensive reviews of existing surface drinking water sources to more accurately focus state efforts to protect these water supplies.
W86-03132

COASTAL DEVELOPMENT AND SHELLFISH WATERS,

North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
Water Quality Section Report No. 85-05, April 1985. 38 p, 13 tab, 55 ref.

Descriptors: Coasts, Urban runoff, Microorganisms, Shellfish, Septic tanks, *Water pollution sources, Marinas, *North Carolina, Coastal development.

Collected stormwater runoff from medium and high density development in North Carolina contains indicator bacteria and pathogens, as well as a number of toxic pollutants. Several studies have demonstrated that is this runoff is collected and discharged into estuarine waters, standards for shellfish waters will be violated. New development practices are necessary in areas adjacent to estuarine waters if these waters are to remain open for shellfishing. Available information indicates that the construction and operation of marinas can adversely affect water quality. Data collected by the Division of Health Services (Shellfish Sanitation Branch) demonstrate that large marinas contribute to the loss of the best intended use of SA waters--shellfish harvesting. Unless siting and operational practices now in effect are modified, continued pollution of coastal waters can be expected. While guidelines for marina operation which have the potential to reduce water quality impacts can be included as conditions in permits, field studies documenting the effectiveness of these restrictions are lacking. Water quality problems associated with on-site sewage systems result from systems located on poor sites or from systems where there is inadequate separation between drain fields and the ground water table. Viruses and bacteria are not readily adsorbed in sandy coastal soils, and therefore use of on-site sewage systems under these conditions in proximity to SA waters may not adequately protect shellfish resources. Management options are discussed.
W86-03133

TEMPORAL TRENDS IN THE ACIDITY OF PRECIPITATION AND SURFACE WATERS IN NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.
N. E. Peters, R. A. Schroeder, and D. E. Troutman.
Available from Distr. Br., USGS, 604 So. Pickett St., Alexandria, VA 22304. USGS Water-Supply Paper 2188, 1981. 39 p, 12 fig, 9 tab, 50 ref.

Descriptors: *Acid streams, *Acid rain, *Chemistry of precipitation, *Hydrogen ion concentration, Statistical methods, Water chemistry, Water pollution sources, *Acid precipitation, *New York, *Temporal trends.

Statistical analysis of monthly bulk-precipitation data from a nine-station monitoring network indicate little change in pH from 1965-1978 within New York as a whole but suggests a decrease in the western part by approximately 0.2 pH units and a comparable increase in the eastern part (equivalent to an average annual hydrogen-ion change of 0.2 microequivalents per liter). An average annual increase in precipitation quantity since 1965 has resulted in an increased acid load in the western and central parts of the state. During the same period, sulfate concentration decreased an average of 1-4 percent annually and no trend was detected for nitrate. Calculated trends in hydrogen ion do not correlate with trends in sulfate and nitrate. Neutralization, possibly by particles from dry deposition in the bulk samples, has produced an increase of about 0.3 pH units in nonurban areas and 0.7 pH units in urban areas over wetfall concentrations in reported other studies. Sulfate concentrations in streams throughout the state decreased an average of 1 to 4 percent per year, which is comparable to the decrease noted in precipitation. In most areas of the state, chemical contributions from urbanization and farming, as well as the neuralizing effect of carbonate soils, conceal whatever effects acid precipitation may have on pH of streams. (USGS)
W86-03135

EFFECTS ON WATER QUALITY OF COAL MINING IN THE BASIN OF THE NORTH FORK KENTUCKY RIVER, EASTERN KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
K. L. Dyer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 81-215, 1983. 94 p, 6 fig, 9 tab, 93 ref.

Descriptors: Coal mines, Strip mines, *Mine drainage, *Strip mine wastes, *Mine acid, Acid streams, Water pollution sources, Neutralization, Pyrite, Acid rain, *Sediment yield, *Kentucky.

A study of the effects on water quality of coal mining in the basin of the North Fork Kentucky River shows increases in the mean annual total dissolved solids concentrations from about 8 to 50 milligrams per liter. It shows that the Hazard Number 9 coal seam produces the largest quantities of acid and sulfate. The study also shows that most of the acid mine drainage is neutralized by carbonate minerals or is replaced by exchangeable bases from the aquifer materials before it reaches the streams. The generation of sediment is probably the most damaging effect of strip mining on water quality in the basin. (USGS)
W86-03136

DISTRIBUTION AND OCCURRENCE OF TOTAL COLIFORM BACTERIA IN FLORIDAN AQUIFER WELLS, WESTERN LAKE COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
G. F. Taylor.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4130, 1984. 28 p, 7 fig, 7 tab, 3 ref.

Descriptors: *Total coliform bacteria, *Floridan aquifer, Groundwater, Aquifer, *Florida, Western Lake County, Water quality, Water pollution sources.

Total coliform bacteria data for Floridan aquifer wells in western Lake County, central Florida, are presented. Included are data collected from 1966 to 1979 by the Florida Department of Environmental Regulation for 98 public-supply wells, and data collected during 1982 by the U.S. Geological Survey for 29 wells. The data for the 98 public supplies indicate that 85 percent have a record of total coliform occurrence in the raw water. Data from the 29 wells sampled by the Geological Survey indicate that 55 percent have a record total coliform occurrence. Further comparison of the two data sets indicates that the Geological Survey data generally indicate a lower percentage of sites with coliform occurrence and, in some cases, a different pattern of occurrence than did the Department of Environmental Regulation data. (USGS)
W86-03145

CHEMICAL AND BIOLOGICAL QUALITY OF STREAMS AT THE INDIANA DUNES NATIONAL LAKESHORE, INDIANA, 1978-80,

Geological Survey, Indianapolis, IN. Water Resources Div.
M. A. Hardy.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4208, 1984. 95 p, 27 fig, 18 tab, 39 ref.

Descriptors: Bacteria, Chlorinated hydrocarbons, Coliforms, DDD, DDE, DDT, Great Lake Region, *Indiana, Invertebrates, Land use, Macroinvertebrates, *National Lakeshores, Nutrients, Polychlorinated biphenyls, Sewers, Streams, Wastewater, *Water chemistry, Water quality, Wetlands, Indiana Dunes National Lakeshore, Periphyton.

Discharge from storm sewers and runoff from roads contributed lead, zinc, and chlorinated hydrocarbons (chlordane, DDT, DDD, DDE, and PCB's) to all streams except Derby ditch. In addition, the Little Calumet River received ammonia from industrial discharges, and organic materials, nitrogen, phosphorus, and fecal coliform from wastewater-treatment plant and sewer discharges. As a result, water at some sites in the lower reaches of the Little Camulet River contained dissolved ammonium nitrogen concentrations exceeding 0.10 mg/L (milligrams per liter), dissolved-oxygen concentrations less than 3.0 mg/L and fecal coliform populations exceeding 2,000 colonies per 100 milliliters. Seepage from two landfills may have caused the concentration of dissolved solids in the west Grand Calumet River lagoon to exceed that in the east lagoon. Ammonium concentrations in the west lagoon ranged from 13 to 16 mg/L as nitrogen. Pesticides used in agricultural areas were the major source of DDT, DDD, DDE, and dieldrin on streambed materials. Runoff from residential areas was a major source of nitrate, organic materials, and chlordane in Derby ditch and Dunes Creek. Wetland drainage contributed significant amounts of organic materials to streams and, at times, increased concentrations of dissolved sulfate and iron. Dissolved iron concentrations correlated with dissolved-organic-carbon concentrations in yellow-brown water of Kintzele ditch and Derby ditch. (USGS)
W86-03163

PROCESSES OF ATMOSPHERIC DEPOSITION OF METALS AND ACIDS TO FORESTS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
S. E. Lindberg, R. R. Turner, and G. M. Lovett.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-017442, Price codes: A02 in paper copy, A01 in microfiche. 1982. 13 p, 1 fig, 3 tab, 21 ref. RP1907-1.

Descriptors: *Acid rain, *Metals, *Forest watersheds, *Air pollution, *Path of pollutants, Acids, Hydrogen ion concentration, Cations, Lead, Cadmium, Manganese, Zinc, Forests, Rain, Leaves, Absorption, Fate of pollutants.

This study attempted to quantify the atmospheric deposition of the water-leachable fractions of trace metals to upper canopy foliage, determine the major mechanisms of deposition, and assess the interactions between deposited metals and acid rain for several forested areas of the Walker Branch, Camp Branch, Coweeta, and Cross Creek Watersheds. Atmospheric sources contributed significantly to the annual flux of metals and acids to the forest floor in Walker Branch Watershed, Tennessee; deposition supplied 14% Mn, approximately 40% Cd and Zn, and approximately 99% Pb to this flux. The measured water solubility of these metals in suspended and deposited particles showed that they may be readily dissolved following deposition; however, only Pb appeared to be absorbed directly at the leaf surface. Dry deposition constituted a major fraction of the total annual atmospheric input of Cd and Zn (approximately 20%), Pb, (approximately 55%), and Mn (approximately 90%). In southern forests, interactions between dry deposition and acid rain can result in concentrations of metals and hydrogen ions on leaves considerably higher than those in rain alone. In the subalpine forests of New England, cloud deposition can also contribute to increased ion concentrations on leaves. (Geiger-PTT)
W86-03236

NEW INSTRUMENTATION FOR AIRBORNE ACID-RAIN RESEARCH,

Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 7B.
W86-03242

PRESENCE OF PATHOGENIC MICROORGANISMS IN POWER PLANT COOLING WATERS: REPORT FOR OCTOBER 1, 1979, TO SEPTEMBER 30, 1981,

Oak Ridge National Lab., TN. Environmental Sciences Div.
R. L. Tyndall.
Available from the National Technical Information Service, Springfield, VA 22161 as NUREG/CR-2980, Price codes: A02 in paper copy, A01 in microfiche. Publication No. 2060, ORNL/TM-8523, September 1982. 26 p, 13 tab, 30 ref.

Descriptors: *Cooling water, *Pathogens, *Power plants, Electric power plants, Bacteria, Bacterial analysis, Water analysis, Pathogenic bacteria.

Cooling waters of eleven nuclear power plants and associated control source waters were studied for the presence of Legionnaires' Disease Bacterium (LDB) and thermophilic free-living amoebae. Concentrations of LDB were determined microscopically by fluorescent antibody analysis, and infectious LDB was demonstrated by guinea pig inoculation. Presence of pathogenic Naegleria was demonstrated by mouse inoculations. In general, the artificially heated waters showed only a slight increase (i.e., < or=10-fold) in concentrations of LDB relative to source water. In a few cases, source waters had higher levels than heated waters. Infectious LDB was found in seven of eleven test waters and five of eleven source waters. A new species of Legionella was isolated from one of the test sites. Concentrations of LDB in source and test water correlated with the concentration of nitrite, sulfate, and total organic carbon. While all but one test site was positive for thermophilic free-living amoebae, only two test sites were positive for pathogenic Naegleria fowleri. Pathogenic Naegleria were not found in control source waters. Laboratory studies demonstrate that both Acanthamoeba and Naegleria species could support the growth of various Legionella species. (Author)
W86-03243

ACIDITY, NUTRIENTS, AND MINERALS IN ATMOSPHERIC PRECIPITATION OVER FLORIDA: DEPOSITION PATTERNS, MECHANISMS, AND ECOLOGICAL EFFECTS,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. L. Brezonik, C. D. Hendry, E. S. Edgerton, R. L. Schulze, and T. L. Crisman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-165837, Price codes: A08 in paper copy, A01 in microfiche. EPA-600/3-83-004, February 1983. 165 p, 48 fig, 30 tab, 141 ref, 2 append.

Descriptors: *Acidity, *Nutrients, *Minerals, *Precipitation, *Ecological effects, Fate of pollutants, Nitrogen, Phosphorus, Hydrogen ion concentration, Chlorophyll, Sulfur compounds, Nitrogen compounds, Acid rain, Deposition, Zooplankton, Benthos, Invertebrates, Phytoplankton.

Nitrogen deposition via bulk precipitation averaged 0.77 g/sq m-yr at 21 sampling sites within Florida during the period May 1978-April 1979. Comparable values for total P are 17-111 and 50 mg P/sq m-yr. Nutrient concentrations were higher in summer than in winter. Wet-only input accounted for most of the deposition of NH4 and NO3 but dryfall was more important for organic N and TP. Statewide deposition of N and P was below the loadings associated with eutrophication, but loadings exceeded mesotrphic criteria at a few agricultural sites. The acidity of Florida rainfall has increased markedly in the past 25 yr; annual average pH < 4.7 now occurs over the northern two-thirds of the state. Summer rain is about 0.2-0.3 pH units lower than winter rain; excess sulfate levels are higher at most sites during summer. H2SO4 accounts for about 70% of the acidity, and HNO3 accounts for the remainder. Local emissions of SO2 seem to control the acidity of Florida rainfall. The pH in softwater lakes; the major trend in phytoplankton was a replacement of bluegreen algae by green algae in acidic lakes. Slight trends were noted in zooplankton and benthic invertebrate populations along a pH gradient, but results indicate that acidic conditions as low as pH 4.6 do not have major impacts on community structure in Florida lakes. (Author)
W86-03246

ACID PRECIPITATION: A CRITIQUE OF PRESENT KNOWLEDGE AND PROPOSED ACTION,

Virginia Center for Coal and Energy Research, Blacksburg.

W. R. Hibbard.
Availaole from the National Technical Information Service, Springfield, VA 22161 as DE83-900303, Price codes: A03 in paper copy, A01 in microfiche. June 1, 1982. 33 p, 10 fig, 5 tab, 69 ref.

Descriptors: *Acid rain, *Sulfur, *Nitrogen, *Water pollution prevention, *Cost-benefit analysis, *Air pollution, Sulfur compounds, Nitrogen compounds, Cost analysis, Nonpoint pollution sources, Fate of pollutants, Water pollution effects, Ecological effects, Environmental effects, Coal gasification, Legislation.

Acid precipitation is damaging to the ecology and is present in many areas. Possible sources of acid precipitation have been identified, but their specific roles in the production of acid rain have not yet been clarified. There are many natural sources of N and S that may contribute to the formation of acid precipitation. Research is needed to determine the mechanism of acid transformation, transport and disposition so that the role of various sources can be evaluated and the most cost-effective counter measures can be chosen. The effects of actual acid precipitation on forests, vegetation, fish, lakes and ecology are not as bad as originally thought. The acidification does not seem to be changing very rapidly. Current legislation, focused on sulfur dioxide emission from coal burning utilities, will cost $2 to $6 billion/yr and will be paid for primarily by utility customers in 10 states. The benefits of this legislation are not certain. Experiences in The Netherlands and Japan have shown that controlling the sulfur dioxide emissions did not reduce the amount of acid precipitation. It is highly probable that local sources are a significant cause of acid precipitation, and these sources are not addressed by the legislation. Further legislation aimed only at coal burning and distant sources will be expensive and probably ineffective. Research results that identify the major sources of acid precipitation will allow the implementation of effective preventive remedies and the lowering of pollution control costs. (Geiger-PTT)
W86-03273

UNSATURATED FLOW MODELING OF A RETORTED OIL SHALE PILE,

Battelle Pacific Northwest Labs., Richland, WA.
F. W. Bond, M. D. Freshley, and G. W. Gee.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83-002632, Price codes: A05 in paper copy, A01 in microfiche. PNL-4284, UC-91, October 1982. 81 p, 34 fig, 4 tab, 21 ref, 5 append. DE-AC06-76RLO 1830.

Descriptors: *Oil shales, *Oil recovery, *Path of pollutants, *Unsaturated flow, *Hydraulic models, Groundwater movement, Groundwater pollution, Permeability coefficient, Hydraulic properties, Fate of pollutants, Simulation analysis, Models, Retention time.

Spent shales, generated during the recovery of crude oil from oil shale, contain soluble salts and other constituents that may exceed permissible levels if they enter local surface and groundwater systems. This study demonstrates the use of the UNSAT1D model for assessing the potential threat to the environment by simulating water movement through spent shale piles. Infiltration, redistribution, and drainage in a spent shale pile were simulated with the UNSAT1D model for two test cases: an existing 35 m pile, and a transient pile growing at a rate of 10 m/yr for 5 yr. The first test case simulated three different layering scenarios with each one being run for 1 yr. The second test case simulated two different initial moisture contents in the pile with each simulation being run for 30 yr. Grand Junction and Rifle, Colorado climatological data were used to provide precipitation and potential evapotranspiration for a wet and dry year. Hydraulic properties on Paraho process spent shale, soil and clay were used as model input to describe water retention and hydraulic conductivity. Results demonstrated that the UNSAT1D model can adequately simulate flow in a spent shale pile for a variety of initial and boundary conditions, hydraulic properties, and pile configurations. These results provided a preliminary sensitivity analysis in which it was shown that the material hydraulic properties, material layering, and initial moisture content are the principal parameters influencing drainage from the base of a pile. (Geiger-PTT)
W86-03281

SELECTED HYDROLOGIC AND GEOCHEMICAL ISSUES IN SITE CHARACTERIZATION FOR NUCLEAR WASTE DISPOSAL: FLOOD BASALTS AT THE HANFORD RESERVATION,

California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5E.
W86-03282

MATHEMATICAL SIMULATION OF SEDIMENT AND RADIONUCLIDE TRANSPORT IN ESTUARIES,

Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi, and D. S. Trent.
Available from the National Technical Information Service, Springfield, VA 22161 as NUREG/CR-2423, Price codes: A04 in paper copy, A01 in microfiche. NUREG/CR-2423, PNL-4109, November 1981. 62 p, 41 fig, 5 tab, 14 ref.

Descriptors: *Mathematical models, *Sediment transport, *Radioactive wastes, *Estuaries, *Fate of pollutants, Models, Model studies, Nuclear powerplants, Fluvial sediments, Finite element method, Mathematical studies, Simulation analais, Cesium, Heavy metals, Salinity.

The finite element model FLESCOT (Flow, Energy, Salinity, Sediment and Contaminant Transport Model) was synthesized to simulate radionuclide transport in estuaries and to obtain accurate radionuclide distributions which are affected by time variance, three-dimensional flow, temperature, salinity, and sediments. FLESCOT simulates sediment and a sediment-sorbed radionuclide for the total of three sediment-size fractions (or sediment types) of both cohesive and noncohesive sediments. It also calculates changes of estuarine bed conditions, and three-dimensional distributions of three bed sediment sizes and sediment-sorbed radionuclides within the bed. The model also simulates transport of heavy metals, pesticides, or toxic chemicals. FLESCOT can use large aspect ratios of computational cells needed in handling long estuarine study areas. The model was applied to the Hudson River estuary between Chelsea and the mouth of the river for four cases to predict radionuclide transport through simulation of tidally influenced three-dimensional flow, salinity, sediment and radionuclide (Cs137) movements with their interactions. Considering the complexity of estuarine flow-transport processes, the lack of detailed radionuclide release rates from the Indian Point Nuclear Powerplant to the Hudson River, and the small number of adjustable model parameters, agreement between predicted results and measured data was reasonable. Further testing of FLESCOT and coupling with one-dimensional transport models is recommended. (Geiger-PTT)
W86-03284

SIMULATION OF GROUNDWATER FLOW AND CONTAMINANT TRANSPORT USING THE DETERMINISTIC-PROBABILISTIC CONTAMINANT TRANSPORT (DPCT) MODEL,

CGS, Inc., Urbana, IL.
E. D. McKay, T. M. Johnson, and M. T. Reade.
Available from the National Technical Information Service, Springfield, VA 22161 as NUREG/CR-2904, Price codes: A03 in paper copy, A01 in microfiche. CGS/8115C029, April 1982. SAND 82-7077. 49 p, 15 fig, 13 tab, 11 ref, 2 append. 68-2130.

Descriptors: *Groundwater movement, *Path of pollutants, *Fate of pollutants, *Simulation analysis, *Computer models, *Probabilistic process, Mathematical models, Computer programs, Model studies, Stochastic process, Mathematical studies, Ion exchange, Water pollution sources.

Ten example problems are presented that illustrate the use and specific features of the deterministic-probabilistic contaminant transport (DPCT) computer program. DPCT provides solutions to the mass balance equation, known as the dispersion-convection equation, which represents mathematically the physiochemical and nuclear processes that are involved in the subsurface groundwater transport of a contaminant. Because DPCT has a stochastic component for the treatment of dispersion, it is inherently stable and free of the numerical dispersion that can occur with most other codes. The ten examples presented include input/output data and explanations of both code utilization and significance to transport characteristics. The ten examples cover the following conditions: two-dimensional transport by advective groundwater flow; dispersion with low dispersivity values; dispersion with higher dispersivity values; dispersion with high dispersivity ratio; ion exchange with low selectivity coefficient; ion exchange with higher selectivity coefficient; radioactive decay of contaminants; multiple contaminant source locations with different release characteristic; two-dimensional transport in a system of multiple geologic units with different hydraulic properties; and combined constant head and no-flow boundary. (Geiger-PTT)
W86-03288

TRANSPORT, FATE AND EFFECTS OF ENERGY-RELATED POLLUTANTS: EVALUATION OF SURFACE AND GROUNDWATERS,

Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
G. R. Hendrey, H. C. Thode, and N. Gmur.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82016610, Price codes: A06 in paper copy, A01 in microfiche. Second progress report, September, 1981. BNL-51473, Vol 1. 114 p. 19 fig, 17 tab, 2 app, 18 ref. DE-AC02-76CH00016.

Descriptors: *Water quality, *Acidic water, Freshwater, Alkalinity, Conductivity, Hydrogen ion concentrations, Pollutants, Water pollution sources, Water pollution effects, Path of pollutants.

Sensitivity of U.S. streams to acidification was studied by collecting data on alkalinity and alkalinity trends. The paper contains data in (a) an appendix and (b) a long table. The acquisition of new water quality data for inclusion in the Acidification Chemistry Information Database in fiscal year 1981 is reported. Stations with 3 or more values of alkalinity < or = 100 microequivalents/liter and/or 3 or more values of pH < or = 5.5 are regarded as candidates for listing as sensitive to acidification. There are 3,684 stations meeting this criteria for alkalinity, constituting 9.33% of all stations in ACID. There are 2,103 stations meeting the pH criterion, some of which are included in the total for alkalinity, and vice versa. The table includes the following: (1) county FIPS codes, (2) station code and abbreviated name, (3) latitude, (4) longitude, (5) total observations at each station, (6) number of alkalinity values < or = 100 meq/liter, (7) average of alkalinity values < or = meq/liter, (8) number of pH observations < or = pH 5.5, (9) average of H+ concentrations below pH 5.5, reexpressed as pH, (10) number of conductivity values associated with the above pH and/or alkalinity measurements, and (11) average of these conductivity values.
W86-03306

EFFECTS OF WEATHER SYSTEMS, CURRENTS, AND COASTAL PROCESSES ON MAJOR OIL SPILLS AT SEA,

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
S. P. Murray.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120221, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 343. In: Pollutant Transfer and Transport in the Sea, Vol II, CRC Press, Boca Raton, FL, 1982. Edited by Gunnar Kullenberg. pp 169-227, 35 fig, 2 tab, 82 ref. NR 388-002. N00014-75-C-0192.

Descriptors: *Oil spills, *Fate of pollutants, *Coastal waters, *Path of pollutants, *Oil slicks, Weather, *Oil pollution, *Water currents, Ocean waves, Environmental effects, Water pollution effects, Microbial degradation, Models, Model studies, Evaporation, Emulsions, Turbulence, Surface tension, Sedimentation.

The effects of weather systems on the movement and dispersal of oil slicks on the ocean's surface are considered. Currents driven by wind systems are affected by the rotation of the earth, which causes them to veer to the right of the wind in the northern hemisphere and to the left of the wind in the southern hemisphere. Evidence is accumulating that energy is being transferred from surface waves directly into moving oil slicks, imparting to them a speed slightly greater than that of the wind-driven current entraining the oil slick. Tidal currents play an important role in the near-field region of an oil spill. Evaporation, emulsification, turbulence, surface tension effects, sedimentation, and microbial activity are active in dispersing or degrading the oil slick. In the Torrey Canyon spill off the west coast of England, large scale winds controlled oil movement, while in the Chevron Platform spill in the Gulf of Mexico, rapidly migrating high- and low-pressure systems were in effect. The Argo Merchant spill was largely controlled by oceanic processes while the Amoco Cadiz was a coastal spill controlled by littoral and esturine processes. The most effective models of oil spill movement still use empirical rules. The Galt's numerical diagnostic model allows for complex coastal boundaries and the incorporation of barcolinic pressure gradients. The model of Hess and Kerr solves the oil momentum equations directly for the thickness of the oil slick as well as the velocity of the oil in space and time. Suites of processes representative of certain areas considered critical on the basis of biological, recreational, or navigational factors should be modeled.
W86-03314

INFLUENCE OF HUMIC-ACID COMPLEXING ON THE MOBILITY OF AMERICIUM IN THE SOIL AQUATIC ENVIRONMENT,

Washington State Univ., Pullman. Dept. of Chemical Engineering.
J. C. Sheppard, M. J. Campbell, and J. A. Kittrick.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-013666, Price codes: A02 in paper copy, A01 in microfiche. DOE/EV/73012-2, March, 1982. 10 p, 1 tab, 4 ref.

Descriptors: *Americum, *Humic acids, Soil, Actinide, Environment, Diffusion coefficient, Radioactive tracers, *Path of pollutants, Soil water movement.

Diffusion data indicate the Am, Cm and Np migrate 1.2, 0.8 and 26 cm. respectively, in 1000 years. Measured diffusion coefficients, corrected for distribution between the aqueous and soil phases, tortuosity, negative absorption, and relative fluidity are in reasonable agreement with aqueous diffusion coefficients. Two sets of experiments with Am241 and Eu152 tracers measured distribution ratios as a function of the aqueous humic acid concentration. In the first experiments the solid phase was kaolinite and in the second series, distribution ratios were measured with Burbank sandy loam. Both of these experiments indicated that Am(III) and Eu(III) form very strong humic acid complexes with formation constants of approximately 100,000.
W86-03315

CHARACTERIZATION OF GLENWOOD SPRINGS AND DOTSERO SPRINGS WATERS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2K.
W86-03333

SOURCES, CHEMISTRY, FATE AND EFFECTS OF AMMONIA IN AQUATIC ENVIRONMENTS,

EA Engineering, Science, and Technology, Inc., Sparks, MD.
American Petroleum Institute, Washington, DC, 1981. 130 p, 4 fig, 21 tab, 115 ref.

Descriptors: *Ammonia, *Aquatic environment, Industrial wastes, Municipal wastes, Water quality Standards, Toxicity, Analytical techniques, Fate of pollutants, Aquatic fauna, Aquatic flora, Temperature effects, Hydrogen ion concentration, Salinity, Dissolved oxygen, Sublethal effects.

The relevant published and unpublished literature pertaining to the sources, chemistry, fate, toxicity, and detection of ammonia in surface waters is reviewed. Four basic ammonia analytical techniques currently available are compared in terms of chemical interferences, sensitivity ranges, analytical precision, and ease of determination. The chemistry of ammonia in aquatic systems is reviewed. The role of ammonia in the nitrogen cycle; the role of nitrification in ammonia losses; environmental factors affecting nitrification; the significance of nitrite buildup; assimilation by aquatic species; and other natural mechanisms of ammonia removal are all discussed. Published and unpublished data are used to evaluate the relative contribution of industrial point sources of ammonia to surface waters compared to publicly owned treatment works (POTWs). Natural and anthropogenic nonpoint sources are also discussed, although quantitative assessments cannot be as definitive as the industrial point sources. The acute, chronic, and sublethal effects of ammonia on vertebrate and invertebrate aquatic organisms are reviewed. Chemical and biological factors that have been shown to influence the toxicity of un-ionized ammonia are summarized including: temperature, pH, salinity, dissolved oxygen and carbon dioxide, acclimation to and recovery from sublethal exposures, species and life-stage differences, and the effect of chemical mixtures containing ammonia. The existing regulatory framework concerning the discharge of ammonia in industrial point-source effluents is considered with emphasis on how aquatic toxicity data is used by regulatory agencies in the derivation of water quality criteria and standards.
W86-03334

HEAVY METALS POLLUTION OF THE UPPER ARKANSAS RIVER, COLORADO, AND ITS EFFECTS ON THE DISTRIBUTION OF THE AQUATIC MACROFAUNA,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. A. Roline, and J. R. Boehmke.
Available from Engineering and Research Center, Denver, CO. Report No REC-ERC-81-15, September 1981. 71 p, 21 fig, 6 tab, 1 app, 173 ref.

Descriptors: *Heavy metals, *Water pollution, *Water pollution effects, *Aquatic life, *Water pollution sources, Chemical analysis, Water analysis, Water quality, Mine drainage, Environmental effects, Arkansas River, Cclorado.

A limnology study was done on a 30 km section of the upper Arkansas River, Colorado, to determine the effects of heavy metals pollution on the distribution of the aquatic macrofauna. Physical and chemical water parameters were measured, aquatic macroinvertebrates were collected, and fish populations at selected stations were evaluated to determine density and heavy metal content of tissue. Historically, river flows which dilute heavy metal concentrations were not as high as those occurring since transmountain diversions began, so it is possible that heavy metal concentrations in the river were greater in the past. However, water quality, species diversity of aquatic macroinvertebrates, fish populations, and metal accumulation in fish tissue show that heavy metal pollution of the upper Arkansas River near Leadville, Colorado, is presently very severe. Conditions for aquatic life are generally poor even though physical parameters and major ion concentrations are adequate for the survival of most aquatic organisms. Heavy-metal-laden inflows adversely affect water quality and thus the aquatic animal populations, while freshening inflows improve water quality and, therefore, conditions for the aquatic fauna. The major sources of heavy-metal-laden inflows are the Leadville Drainage Tunnel, California Gulch, and a number of intermittent flows entering between Lake Fork and Lake Creek. Important freshening flows are Tennessee Creek, Lake Fork (containing Halfmoon Creek), and Lake Creek. It is highly probable that a substantial reduction or elimination of any of these freshening inflows will result in a degradation of water quality and adversely affect the aquatic organisms.
W86-03338

ENVIRONMENTAL PROTECTION: STANDARDS, COMPLIANCE AND COSTS,

Ellis Horwood Ltd, Chichester, England. 1984. Edited by T. J. Lack. Ellis Horwood Series: Water and Wastewater Technology. 329 p.

Descriptors: *Aquatic environment, *Environmental protection, *Water pollution control, *Great Britain, Europe, Toxicity, Water pollution effects, Legal aspects, Law of the sea, Water law.

This book presents an examination and critical appraisal of the scientific basis and operational approaches to pollution control. It provides an insight into the problems facing those charged with the responsibility of protecting the environment. The focus of the book is the criteria used in judging compliance with standards, the balance between cost and health hazard, and the priorities for pollution control measures in Great Britain. The importance of toxicological and epidemiological studies is stressed, and operational approaches are illustrated with case studies. The major topics covered are the nature and associated risks of water pollution, the assessment of the effects of pollution, protection and control, operational aspects, and environmental management. (Halterman-PTT)
W86-03344

ORIGINS AND PATHWAYS OF AQUATIC POLLUTANTS,

Department of the Environment, London (England).
N. J. King, P. R. Hinchcliffe, and J. L. Vosser.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd., Chichester, England, 1984. p 22-32, 5 tab, 3 ref.

Descriptors: *Aquatic environment, *Toxicity, *Water pollution effects, *Water pollution sources, Chemical wastes, Industrial wastes, Runoff, Agricultural runoff, Urban runoff, Farm wastes, Mine wastes, Oil pollution.

A complete understanding of the many facets of the protection of aquatic environments requires a basic knowledge of the origins and pathways of aquatic pollutants. This review discusses the routes, or pathways, by which substances which might cause significant and undesirable changes can reach the environment. The primary sources discussed are domestic sewage, manufacture and use of chemicals, toxic waste leachates, atmospheric fallout, run-off, accidental spills or explosions, mineral oil production, mining, farming, solubilization of solid substances due to changes in the chemistry of the surrounding environment, waste heat generation, and natural sources. Several pathways are discussed, with emphasis on dircct discharges to inland surface waters. Several transformation processes are described which may affect the passage of materials into aquatic environments. These processes are photodegradation, hydrolysis, neutralization, precipitation, solubilization and chelation. (Halterman-PTT)
W86-03345

NATURE AND CONCENTRATION OF POLLUTANTS IN WATER,

Water Research Centre, Medmenham (England). Medmenham Lab.
M. Fielding, and D. T. E. Hunt.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 33-54 p, 2 fig, 9 tab, 55 ref.

Descriptors: *Aquatic environment, *Water pollution effects, *Water pollution sources, Chemical wastes, Industrial wastes, Acids, Bases, Trace metals, Nitrogen, Phosphate, Sulphur, Organic matter, Hydrocarbons.

This paper presents a review of chemical pollutants found in both marine and freshwater environments. The primary emphasis is the importance of pollution by each group of pollutants discussed; the standards, or regulations, concerning allowable concentrations in aquatic systems; and the ranges of concentrations at which these are generally observed. The pollutants that are included in the review are grouped as organic and inorganic. The inorganic materials are acids, alkalis, nitrate, ammonia, trace metals, trace metalloids, sulphur, cyanide and sulphite. The organic materials that are covered in this paper are 'total organic matter', hydrocarbons, halogenated compounds, carboxylic acids and esters, and oxygenated compounds such as ketones, aldehydes, and ethers. Several natural organic substances often found in waters are also discussed. These are amino acids, sugars, fatty acids, phenols, sterols, vitamins, ketones, aldehydes, hydrocarbons, urea, and uronic acids. Techniques for analyzing water samples for pollutants are also discussed. (Halterman-PTT)
W86-03346

ROLE AND ACTIVITIES OF THE OSLO AND PARIS COMMISSIONS,

F. Bjerre, and P. A. Hayward.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 142-157 p.

Descriptors: *Aquatic environment, *Environmental protection, *Toxicity, *Ocean dumping, Standards, Water quality standards, Monitoring, Specifications, Paris, France, Oslo, Norway.

To adequately protect the marine environment, international control is not only justified, but is thought by many, including the author of this paper, to be the only appropriate level at which action can be initiated. Therefore, for the protection from pollution of the North East Atlantic region, the Oslo and Paris Commissions were established by international treaty. The Oslo Convention dealt with the issue of ocean dumping by European countries. A list of substances which are prohibited for dumping was generated. Furthermore, several regulations governing dumping procedures, such as distance from land and depth of water, were outlined. The Paris Convention dealt with controlling ocean pollution from European land-based sources. These sources include discharges through rivers, estuaries, outfalls and pipelines and national jurisdiction. A major problem faced by the two commissions in the ten years since their negotiation is the differing environmental problems and policies of the various participating European countries. The commissions decided that a better understanding of these different circumstances is necessary, and therefore, they set aside specific times for participating countries to make presentations describing national policies. (Halterman-PTT)
W86-03352

FATE OF CHEMICALS IN THE ENVIRONMENT: COMPARTMENTAL AND MULTIMEDIA MODELS FOR PREDICTIONS,

American Chemical Society, Washington, DC.
ACS Symposium Series 225, American Chemical Society, Washington, DC, 1983. Edited by Robert L. Swann and Alan Eschenroeder. 320 p.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, Organic compounds, Water pollution sources, Pesticides, Mathematical models, Aquatic environment.

The latest modeling methods for predicting the effect and ultimate fate of chemicals released into the environment are presented. Single media models outline the actions of chemicals within an isolated segment of the environment. Aquatic, soil and groundwater, and airborne models are discussed, followed by multimedia models. The latter describe chemical interactions within a single compartment as well as between different media. The current situation in calibration, verification, and field testing of models is summarized. Uses of several models in practical applications are given. These include a series of polychlorobiphenyls, binding of humic and fulvic acids with organic chemicals, and fate of several herbicides in soil. The use of models in determining human and environmental risks is also illustrated. (Caesar-PTT)
W86-03362

RELEASE OF CHEMICALS INTO THE ENVIRONMENT,

SRI International, Menlo Park, CA.
S. L. Brown, and D. C. Bomberger.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Prediction, American Chemical Society, Washington, DC, 1983. p 3-21, 8 fig, 4 tab, 3 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, Water pollutions sources.

Chemicals can be released directly or indirectly into water resources from natural processes and from human activity (during raw materials extraction, manufacture or processing, accidents, storage and transportation, use, and after disposal. Chemicals may be released in solid, liquid, or gaseous form from a variety of sources: point (smoke stack), line (highway transport), area (group of homes), and volume (smog). Time patterns of release can be continuous, intermittent, cyclic, random, or concentrated. Techniques for estimating release are reviewed. One method measures the amount of substance released, as in a pesticide application. Another uses material balance. Mathematical models and ad-hoc methods are also useful. Benzene is used as a case study to illustrate the ad-hoc approach. (Caesar-PTT)
W86-03363

FATE OF CHEMICALS IN AQUATIC SYSTEMS: PROCESS MODELS AND COMPUTER CODES,

Environmental Research Lab., Athens, GA.
L. A. Burns.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. p 25-40, 1 fig, 56 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, Computers, Chemical reactions, Aquatic environment, Pesticides, Mass transfer, Ionization, Sorption, Volatility, Bioaccumulation, Accumulation, Photolysis, Hydrolysis, Oxidation, Microbiological studies, EXAM models, HSPF model, PEST model, SERATRA model, TOXIC model, UTM-TOX model, WASP model.

Aquatic fate models are designed to forecast the residual concentrations, dominant transformation pathways, distributions among subsystems, and characteristic time scales of xenobiotic chemicals. Most are constructed as systems of differential equations organized around mass balances. The resulting computer codes are used as aids in chemical use and disposal evaluations; their primary function is to reduce complex chemical and environmental data sets to useful forms. Relevant chemical phenomena include direct and indirect photochemical reactions, hydrolytic processes, biotransformations, ionic speciation, and sorption. These phenomena include both reversible and irreversible processes, with a mixture of time scales ranging from the virtually instantaneous to the imperceptible, depending on the structure and reactivity of the chemical involved. Aquatic transport processes include hydrodynamic transport of chemicals sorbed with particulates, volatilization, and exchange across the benthic boundary layer. The models combine chemical partitioning and rate constants with environmental driving forces, yielding a set of differential equations that can be analyzed to reveal chemical behavior as a function of time, space, and extrinsic chemical loadings. (Authors)
W86-03364

SOIL AND GROUNDWATER FATE MODELING,

Little (Arthur D.), Inc., Cambridge, MA.
M. Bonazountas.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. p 41-65, 2 fig, 4 tab, 37 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, *Soil, Groundwater, Aeration zone, Saturated zone, Mathematical models, Equilibrium, Water pollution sources, Land disposal, Landfills, Leachates, Industrial wastes, Agriculture, Sorption, Ion exchange, Chemical reactions, Ionization, Oxidation, Hydrolysis, Bioaccumulation, Accumulation, Chelation, PESTAN model, SCRAM model, SESOIL model, PATHS model, AT123D model, MMT model.

Soil compartment chemical fate modeling has been traditionally performed for three distinct subcompartments: the land surface (or watershed); the unsaturated soil (or soil) zone; and the saturated (or groundwater) zone of a region. In general, the mathematical simulation is structured around two major cycles; the hydrologic cycle and the pollutant cycle, each cycle being associated with a number of physicochemical processes. Watershed models account for a third cycle; sedimentation. This paper discusses: (1) soil and goundwater; and (2) aquatic equilibrium and ranking models. The second category deals with the chemical speciation in soil and groundwater, and with the environmental rating of waste sites, in cases where detailed modeling is notot desirable. Unsaturated soil zones models can simulate flow and quality conditions of a soil zone profile extending between the ground surface and the groundwater table. The traditional modeling employs either the time dependent diffusive convective mass transport differential equation in homogeneous isotropic soils, or simplified analytic expressions. Compartmental modeling is an area of current research. Equations are principally solved numerically or analytically when seeking exact solutions for simplified environments. Groundwater models describe the fate of pollutants in aquifers. Ironically enough, although the number of model types is large, only a few basic processes are modeled, mainly via the convective, dispersive, adsorptive, reactive, pollutant transport equation in a saturated porous medium, which is solved via analytical, numerical, or statistical techniques, and for one pollutant at a time. (Author)
W86-03365

ROLE OF MULTIMEDIA FATE MODELS IN CHEMICAL RISK ASSESSMENT,

Little (Arthur D.), Inc., Cambridge, MA.
A. Eschenroeder.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. p 89-104, 22 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, *Risks, Water pollution sources, Mathematical models.

This paper relates mathematical models for chemicals moving through air, water, soil, and biota to methodologies for assessing health risks to individuals or ecosystems experiencing environmental exposures. The procedures for assessing risks are traced from sources to receptors, and the application of models to this process is described. The paper sets out to answer questions of how to select and link models in the context of risk assessment. The theory, structure, verification, and application of the models themselves is left to other papers in this symposium. Acute risks are distinguished from chronic risks in the context of environmental regulatory requirements. A technique for selecting and assembling multimedia models based on release, environmental and receptor characteristics is described. (Author)
W86-03366

NEW MATHEMATICAL MODELING SYSTEM,

University of the Pacific, Stockton, CA. Dept. of Civil Engineering.
R. C. Johanson.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions,

American Chemical Society, Washington, DC, 1983. p 125-147, 12 fig, 13 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, Mathematical models, Hydrological Simulation program, Adsorption, Sediments, Pesticides, Degradation, Computer models, Water quality.

The Hydrological Simulation Program - Fortran (HSPF) simulates the movement of water, sediment and many associated constituents over and under the land surface, and through streams, rivers and shallow lakes. It is a relatively new package, funded by the U.S. EPA. Substances such as pesticides are handled by simulating the processes of adsorption and desorption, transport in the dissolved and adsorbed states, and degradation through hydrolysis, photolysis, oxidation by free radicals, etc. Spatial variation is handled by subdividing the area into processing units, each of which represents a relatively homogeneous segment of pervious or impervious land-surface, or a reach of channel or an impoundment. HSPF operates on the basis of continuous simulation; the user can select a time step ranging from 1 minute to 1 day. The software package incorporates many modern features which have made it reliable and easy to install on a variety of machines. It is also easy to use and extend. (Author)
W86-03367

MODEL PREDICTIONS VS. FIELD OBSERVATIONS: THE MODEL VALIDATION/TESTING PROCESS,

Anderson-Nichols and Co., Inc., Palo Alto, CA.
A. S. Donigian.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. p 151-171, 3 fig, 2 tab, 14 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, *Field tests, Calibrations, Validation, Error analysis, Lakes, Sediments, Streams.

Model validation and field testing of chemical fate and transport models were discussed in several recent workshops, summarized in this paper. The terms calibration, verfication, and post-audit are clearly defined. Field validation and testing of models involves error analysis. The types of errors affecting the process are input errors (usually the most significant), system representation errors, parameter errors (derived from the inability to accurately measure and predict many parameters), and output errors (the most insidious). The possibility of these errors dictates that model results be considered with informed skepticism. The extent of field testing is listed for many modeled processes (dispersion-diffusion, advection, intermedia transfers, sediment/particulate transport, and transformation) used in the following media: air, runoff, streams, lakes, estuaries, soil unsaturated zone, and soil saturated zone. In general, screening level models have been more widely field tested than site-specific models. At present, unified and accepted procedures for model validation do not exist. However, most procedures fall into three categories: small-scale parameter estimation followed by field application, split-sample field testing, and site-to-site extrapolation of model results. In model performance testing three types of comparisons are often made: paired-data; time and space integrated, paired-data; and frequency domain. (Cassar-PTT)
W86-03368

PARTITION MODELS FOR EQUILIBRIUM DISTRIBUTION OF CHEMICALS IN ENVIRONMENTAL COMPARTMENTS,

Dow Chemical Co., Midland, MI.
P. J. McCall, R. L. Swann, and D. A. Laskowski.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. 105-123 p, 3 fig, 4 tab, 29 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, Equilibrium, Partition coefficients, Bioaccumulation, Accumulation, Aquatic environment.

Distribution of organic chemicals among environmental compartments can be defined in terms of simple equiolibrium expressions. Partition coefficients between water and air, water and soil, and water and biota can be combined to construct model environments which can provide a framework for preliminary evaluation of expected environmental behavior. This approach is particularly useful when little data is available since partition coefficients can be estimated with reasonable accuracy from correlations between properties. In addition to identifying those environmental compartments in which a chemical is likely to reside, which can aid in directing future research, these types of models can provide a base for more elaborate kinetic models. (Author)
W86-03369

APPLICATION OF FUGACITY MODELS TO THE ESTIMATION OF CHEMICAL DISTRIBUTION AND PERSISTENCE IN THE ENVIRONMENT,

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, S. Paterson, and M. Joy.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. 175-196 p, 9 fig, 2 tab, 15 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Model studies, Fugacity models, Organic compounds, Polychlorinated biphenyls, Chlorobiphenylks, QWASI model, Quantitative Water Air Sediment Interaction model, Mathematical models, Lakes.

The roles of mathematical models for predicting the likely behavior of chemicals in real and evaluative environments are discussed, and it is suggested that more consideration should be given to defining acceptable levels of model complexity. The concepts underlying a series of fugacity models are described and illustrated by applying the models to (1) an assessment of the behavior of a trichlorobiphenyl with four fugacity models of an evaluative lake environment as an illustration of various levels of complexity, (2) an assessment of the relative behavior of mono-, di-, tri-, and tetrachorobiphenyls in the same environment as an illustration of the effect of changing chemical properties on behavior, and (3) a description of trichlorbiphenyl behavior in a lake similar to Lake Michigan using the QWASI (Quantitative Water Air Sediment Interaction) fugacity model. It is concluded that evaluative models can generate behavior profile information of value for hazard assessment purposes by integrating data on partitioning, reaction, advection, and interphase transport. By applying the same concepts and equations to models of real environments and validating them, the evaluative and real modeling efforts become mutally supportive and the credibility of both is increased. (Author)
W86-03370

INTERACTIONS BETWEEN DISSOLVED HUMIC AND FULVIC ACIDS AND POLLUTANTS IN AQUATIC ENVIRONMENTS,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
C. W. Carter, and I. H. Suffet.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. 215-229 p, 6 fig, 2 tab, 24 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, *Organic carbon, Fulvic acids, Humic acids, Organic compounds, Octanol/water partition coefficient, Pesticides, DDT, Polyaromatic hydrocarbons, Aromatic hydrocarbons, Phthalates.

Binding of organic compounds to dissolved humic and fulvic acids was quantitatively measured. The extent of binding increased with increasing octanol/water partition coefficient and decreasing water solubility. The compounds included fluorene, fluoranthene, di-n-buyl phthalate, dicyclohexylphthalate, 1,2,3-trichlorobenzene, di-(2-ethylhexyl) phthalate, anthracene, lindane, and DDT. Humic acids showed greater binding tendency than fulvic acids. Large variations in binding were observed within a group of different humic acids and within a group of different fulvic acids. Compounds with low log octanol/water partition coefficients such as lindane will probably not bind appreciably in the environment. Compounds with very high octanol/water partition coefficients such as DDT may bind to a significant extent. DDT binding to humic acid increased with temperature decreases. DDT was also bound to the dissolved organic carbon in sewage effluent. (Cassar-PTT)
W86-03371

COMPARATIVE STUDY OF THE RELATIONSHIPS BETWEEN THE MOBILITY OF ALAHLOR, BUTYLATE, AND METACHLOR IN SOIL AND THEIR PHYSIOCOCHEMICAL PROPERTIES,

Stauffer Chemical Co., Mountain View, CA.
C. J. Spillner, V. M. Thomas, D. G. Takahashi, and H. B. Scher.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. 231-247 p, 5 fig, 5 tab, 20 ref.

Descriptors: *Fate of pollutants, *Chemical wastes, Pesticides, Alachlor, Butylate, Metolachlor, Soil, Herbicides, Adsorption, Soil density, Volatility, Soil water.

The order of the mobilites of alachlor, butylate, and metalachlor in columns of various soils was metolachlor>alachlor>butylate. This correlates directly with the water solubilities and inversely to the adsorption coefficients and octanol/water partition coefficients in these compounds. Diffusion of these compounds in soil thin-layers were as follows: butylate>alahlor>metolachlor, which properties affecting diffusion appeared to be bulk density and temperature. Soil moisture is also probably important, but its effect on the diffusion of these compounds was not determined. (Author)
W86-03372

MATHEMATICAL MODELING APPLICATION TO ENVIRONMENTAL RISK ASSESSMENTS,

CIBA-GEIGY Corp., Greensboro, NC. Agricultural Div.
R. C. Honeycutt, and L. G. Ballantine.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. 249-262 p, 1 fig, 9 tab, 3 ref.

Descriptors: *Fate of pollutants, *Pesticides, *Model studies, *Risks, Insect growth inhibitors, CGA-72662, SWRRB model, EXAMS model, Mathematical models, Toxicity, Lakes, Ponds, Degradation, Aquatic life, Fish, Daphnia, Rainfall intensity.

The risks of an insect growth inhibitor, CGA-72662, in aquatic environments were assessed using a combination of the SWRRB and EXAMS mathematical models. Specific application rates were put into the model for a pond, a eutrophic lake, and an oligotrophic lake. For the same application rate, the eutrophic lake had greater concentrations of the compound and much longer half-life and self-purification time than the oligotrophic lake. Comparing the concentrations of CGA-72662 in water and sediment with toxicity data showed that aquatic safety factors for bluegill, rainbow trout, channel catfish, and daphnia were on the order of 50 million to 900 million, of no environmental consequence. Model limitations were discussed. Rainfall intensity was one of the most important parameters affecting runoff in SWRRB. EXAMS was very sensitive to application load. (Cassar-PTT)
W86-03373

APPLICATION OF THE PRELIMINARY POLLUTANT LIMIT VALUE (PPLV) ENVIRONMENTAL RISK ASSESSMENT APPROACH TO SELECTED LAND USES,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
D. H. Rosenblatt, M. J. Small, and R. J. Kainz.
IN: Fate of Chemicals in the Environment: Compartmental and Multimedia Models for Predictions, American Chemical Society, Washington, DC, 1983. 263-284 p, 2 fig, 5 tab, 32 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Chemical wastes, *Model studies, *Risk, Land use, Preliminary Pollutant Limit Value, Toxicity, Public health.

The site-specific Preliminary Pollutant Limit Value (PPLV) process for environmental risk assessment has been applied to contaminated land areas in order to determine what use might be made of them at various levels of contamination. The process involves examination of the potential for each chemical of concern to proceed from the soil or water, through defined pathways, to man or other target organisms. Each pathway is treated as if it consisted of a series of compartments at equilibrium, except that the exposure of man to the last of these compartments is handled as a consumption rate process. The best available toxicological information is used to estimate an acceptable daily dose (Dt) for human (or other organism) exposure to each compound. This value is used to calculate levels of the compound in the soil or water such that Dt is not likely to be exceeded during the course of specified categories of human activity. A PPLV is derived from consideration of the Dt along with the probable exposure level. Four specific examples of the use of the PPLV concept are described. Soil and water PPLVs are developed for several compounds. The PPLVs vary according to envisioned scenario; for example, subsistence farming, residential housing, hunting, fishing, and industrial or timbering operations. Each scenario entails one or more exposure pathways. The PPLVs so derived allow for various options for cleanup or restriction of land use, such that public health will not be jeopardized by residual contamination. Each potential cleanup effort represents a different level of hazard reduction. (Author)
W86-03374

DYNAMICS OF LOTIC SYSTEMS,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5C.
W86-03375

EFFECT OF SIMULATED CANOPY COVER ON REGULATION OF NITRATE UPTAKE AND PRIMARY PRODUCTION BY NATURAL PERIPHYTON ASSEMBLAGES,

Geological Survey, Menlo Park, CA.
F. J. Triska, V. C. Kennedy, R. J. Avanzino, and B. N. Reilly.
IN; Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 129-159, 13 fig, 1 tab, 34 ref.

Descriptors: *Aquatic environment, *Productivity, *Algae, *Nutrient removal, Model studies, Lotic environment, Stream biota, Aquatic productivity, Primary productivity, Microbial studies, Canopy, Nitrates, Cycling nutrients.

To test canopy impact on biological response to a simulated reset, or nutrient input event, an experiment was conducted in five Plexiglas channels set in Little Lost Man Creek in California. An unshaded control channel (40 micrograms nitrate-nitrogen per liter and 10 micrograms phosphate-phosphorous per liter background) received no nutrient addition. Treatment channels (0, 30, 66, and 92% shaded), amended with approximately 100 micrograms nitrate-nitrogen per liter and 25 micrograms phosphate-phosphorous per liter simulated onset of autumnal storms. Periphyton biomass increased at least fivefold except in the 92% shaded channel. Maximum biomass was essentially similar in both the control and the fully lighted treatment channel, but chlorophyll was half as great in the control. Biomass-to-chlorophyll ratio in the control stream increased throughout the experiment, but decreased by half or more in treatment flumes within 4 days. Diel fluctuations in nitrate concentrations were observed, but their magnitude did not increase directly with biomass accumulation because of gradual periphyton senescence. Results suggest that the cycling distance of biologically important nutrients in a stream reach depends on input location on the watershed (stream order and canopy cover) and time elapsed since the previous setting event. (Author)
W86-03382

INVERTEBRATE DRIFT AND PARTICULATE ORGANIC MATERIAL TRANSPORT IN THE SAVANNAH RIVER BELOW LAKE HARTWELL DURING A PEAK POWER GENERATION CYCLE,

Arizona Univ., Tucson. School of Renewable Natural Resources.
W. J. Matter, P. L. Hudson, and G. E. Saul.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 357-370 p, 3 fig, 4 tab, 17 ref.

Descriptors: *Aquatic environment, *Lotic environment, Lotic ecosystems, Stream biota, Aquatic communites, Invertebrate drift, Particulate organic material, Particulate matter, Organic matter.

The Savannah River below Lake Hartwell, Georgia-South Carolina, receives hypolimnetic water discharged from the reservoir for peak-power generation. Invertebrates and particulate organic material (POM) in the water column were collected during a 24 hour release cycle at sites 1.0, 4.5, and 12.5 km downstream from the dam. Water was released during a 6-hr period, reaching a maximum generation discharge of 688 cu m/s. Highest POM concentrations were associated with the initial downstream surge of water at the start of power generation; values were 200 to 400 times greater than those during nongeneration periods. The POM rapidly decreased to less than one-tenth the original surge levels. Much of the POM originated in the tailwater, and concentrations increased at successive downstream sites. Of the drifting invertebrates, 80 to 93% originated in the reservoir. Densities of benthic invertebrates were highest during passage of the initial release surge, whereas densities of invertebrates originating in the reservoir peaked 2 to 3 hours after the initial surge at each station, during maximum release. Evidence of 'behavioral' drift suggested that benthic production may still be in excess, despite repeated 'catastrophic' losses during releases. (Author)
W86-03392

NITRATE-NITROGEN MASS BALANCES FOR TWO ONTARIO RIVERS,

York Univ., Downsview (Ontario).
A. R. Hill.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 457-477, 4 fig, 3 tab, 34 ref.

Descriptors: *Nitrate, *Denitrification, Sinks, Nottawasaga River, Ontario, Duffin Creek, Ontario, Sediments, Aquatic environment, Lotic environment, Microbial studies, Nutrients.

Analysis of nitrogen transport revealed an average daily loss of 45 + or - 9 kg N03-N (160 mg N/sq m)in Duffin Creek and 35 plus or minus 21 kg NO3-N(60 mg N/sq m)in the Nottawasago River during low flows between May and October. Laboratory experiments suggested that most of the nitrate disappearance was caused by denitrification and nitrate reduction in stream sediments. Contrasts in nitrate removal rates in the two rivers probably resulted mainly from differences in sediment characteristics. The Nottawasaga River sediments had very low percentages of organic carbon and silt in comparison to sediments from pool reaches in Duffin Creek. Nitrate losses during stream transport rose rapidly to high levels in May and fell to lower levels in November as water temperature declined. Laboratory experiments suggested that denitrification and nitrate reduction may still occur, although at very low rates, during the winter months when water temperatures in the Nottawasaga River and Duffin Creek are 0 to 2 C. Denitrification was considered to be negligible during major flood events. The removal of nitrate represented 5% of the annual export of nitrogen from the two rivers. In low flow conditions, however between May and October, nitrate losses corresponded to 50% of the average daily input of total nitrogen and 75% of the nitrate input in Duffin Creek. The Nottawasaga River had a much smaller assimilative capacity, removing only about 13% of the daily nitrate input. (Author)
W86-03396

USE OF SOLUTE TRANSPORT MODELS TO ESTIMATE SALT BALANCE BELOW IRRIGATED CROPLAND,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3F.
W86-03402

KILLING RAIN: THE GLOBAL THREAT OF ACID PRECIPITATION,

T. Pawlick.
Sierra Club Books, San Francisco. 1984. 206 p.

Descriptors: *Acid rain, *Acidification, Aquatic environment, Ecosystems, Aquatic life, Environment, Aquatic plants, Aquatic animals, Public health, Political aspects, Legal aspects, Forests.

Various aspects of atmospheric acid deposition and its possible impacts on aquatic and terrestrial ecosystems, and on public health, are presented in a non-technical, primarily anecdotal, format. Topics discussed include the costs of damage thought to result from acid rain, possible impacts to lakes and streams, public health problems related to sulfates and sulfur dioxide emissions, stunted growth and dieback in forests, various forms of atmospheric acid deposition, and U.S.-Canada relations as a result of the acid rain issue. (Halterman-PTT)
W86-03416

MODELING THE FATE OF CHEMICALS IN THE AQUATIC ENVIRONMENT.

Ann Arbor Science, Ann Arbor, MI. 1982. 413 p.
Edited by Kenneth L. Dickson, Alan W. Maki, and John Cairns, Jr.

Descriptors: *Model studies, *Fate of pollutants, *Aquatic environment, Pollutants, Ecosystems, Mathematical models, Distribution, Regulations, Legal aspects, Prediction, Hydrologic models, Legal aspects.

The proceedings of a workshop on modeling the fate of chemicals, with an emphasis on aquatic ecosystems, are presented. Specific areas discussed include assessment of modeling the fate of chemicals, modeling the distribution of chemicals, the role of environmental transport and fate models in regulations, environmental compartmentalization, transport and transformation models, partitioning of chemicals in lakes and streams, hydrologic transport, groundwater, complex effluents, model testing, field validation, and legal validation of environmental fate models. (Halterman-PTT)
W86-03417

ASSESSMENT OF MODELING THE FATE OF CHEMICALS IN THE AQUATIC ENVIRONMENT,

Manhattan Coll., Bronx, NY.
D. J. O'Connor, and J. P. St. John.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. 13-34 p, 2 fig, 1 tab.

Descriptors: *Model studies, Pollutants, *Fate of pollutants, Organic wastes, Organic matter, Heavy metals, Metals, Aquatic environment, Ecosystems, Path of pollutants, Sorption, Volatility.

A brief categorization of the state-of-the-art of modeling the fate of chemicals in aquatic environments is presented. The basic principles of modeling include mass balance and dynamic equilibrium. Model components included in the discussion are kinetic and transfer elements, transport regimes and bed characteristics. The chemical transfer mechanisms that are described include sorption/

desorption, volatilization, settling, resuspension, sediment mechanics, and sediment/water diffusive exchange. The discussion of chemical kinetic transformations includes photolysis, hydrolysis, free-radical oxidation, and biodegradation. The ability of a model to reproduce observed conditions is discussed, with emphasis on the dependence on available data, calibration/validation procedures, criteria, and standards. (Halterman-PTT)
W86-03418

MODELING THE DISTRIBUTION OF CHEMICALS IN AQUATIC ENVIRONMENTS,
Oak Ridge National Lab., TN.
G. T. Yeh.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. 35-48 p, 3 fig, 18 ref. EPA-78-D-X0387.

Descriptors: *Model studies, *Path of pollutants, Pollutants, *Fate of pollutants, Aquatic environment, Ecosystems, Public health aspects, Mathematical models, Distribution, Spatial distribution, Temporal distribution.

The prerequisite of modeling the chemical distribution among various carriers in an aquatic ecosystem in order to assess the hazard to the ecosystem and the health of man is discussed. Because of the complexity of various processes in transporting, transferring, and transforming chemicals, mechanistic mathematical models offer the most promising means for describing the spatial and temporal distribution of chemical perturbations to aquatic environments as completely and accurately as possible. The need to determine the appropriate level of resolution is discussed because differeut levels of resolution often yield very different answers, with lower-level resolution giving more conservative solutions. (Halterman-PTT)
W86-03419

5C. Effects Of Pollution

PRIMARY PRODUCTIVITY IN THE POTOMAC TIDAL RIVER, MARYLAND, MAY 1980 TO AUGUST 1981,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03000

DISTRIBUTION AND ABUNDANCE OF SUBMERSED AQUATIC VEGETATION IN THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W86-03012

DATA COMPILATION OF BENTHIC INVERTEBRATES FROM TRIBUTARY STREAMS OF THE YAMPA AND NORTH PLATTE RIVER BASINS, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
L. J. Britton.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-140, 1983. 99 p, 5 fig, 18 tab, 3 ref.

Descriptors: *Water quality, *Aquatic insects, *Benthic invertebrates, *Colorado, Yampa River Basin, North Platte River Basin.

Benthic invertebrates were collected from Trout Creek, Fish Creek, and the Williams Fork (tributaries of the Yampa River in Routt and Moffat Counties), and Little Grizzly and Grizzly Creeks (tributaries of the North Platte River in Jackson County). Stream-sampling sites were upstream and downstream from potential, existing, or historical coal-mining areas. Field water-quality measurements of water temperature, specific conductance, pH, and dissolved oxygen were also made to aid in assessing stream water-quality conditions. The purpose of the study was to describe and quantify the benthic invertebrate communities in selected streams in coal-mining areas. Sampling was conducted on a near bimonthly basis throughout the growing season, beginning in April and May 1980, and continuing through September 1981. This report describes the methods of data collection and presents qualitative and quantitative results of benthic invertebrates and associated water-quality data. (USGS)
W86-03126

COASTAL DEVELOPMENT AND SHELLFISH WATERS,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5B.
W86-03133

WATER QUALITY CRITERIA FOR PRIMARY NURSERY AREAS IN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
Water Quality Section Report No. 84-10, April 1984. 53 p, 9 tab, 5 fig, 141 ref.

Descriptors: *Estuaries, Brown shrimp, *Water quality standards, *North Carolina, Primary nursery areas.

A comprehensive review was made of the environmental factors influencing early development of commercially important fish and shellfish in North Carolina estuarine areas. Brown shrimp was chosen as an indicator species since it is most commercially important and sensitive to nursery areas: Salinities should be maintained between 8 and 300 parts per thousand. Bottom temperatures should be maintained between 20 and 30 C. The natural seasonal temperature and salinity patterns should not be changed. Water Quality standards are proposed for a variety of parameters. Additional regulatory steps are outlined for establishing a primary nursery area classification.
W86-03134

EFFECTS ON WATER QUALITY OF COAL MINING IN THE BASIN OF THE NORTH FORK KENTUCKY RIVER, EASTERN KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03136

ECOLOGICAL STUDIES OF WOOD-BORING BIVALVES IN THE VICINITY OF THE OYSTER CREEK NUCLEAR GENERATING STATION,
Academy of Natural Sciences of Philadelphia, PA.
K. E. Hoagland.
Available from the National Technical Information Service, Springfield, VA 22161 as NUREG/CR-2727, Price codes: A03 in paper copy, A01 in microfiche. NUREG/CR-2727, Vol. 4, December 1982. 36 p, 20 tab, 8 ref, 1 append.

Descriptors: *Nuclear powerplants, *Mollusks, *Temperature effects, *Thermal pollution, *Species composition, Fouling, Thermal water, Thermal powerplants, Termal stress, Water pollution effects, Estuaries, Bays, Population dynamics, Aquatic populations, Salinity, Water temperature.

The species composition, distribution, and population dynamics of wood-boring bivalves are being studied in the vicinity of the Oyster Creek Nuclear Generating Station, Barnegat Bay, New Jersey. Untreated wood test panels are used to collect organisms at 12 stations, some of which are control stations and some of which are under the thermal influence of the nuclear powerplant. Physiological tolerances of three species are also under investigation in the laboratory. Competition among the fouling species is being studied. Adult populations of the shipworm Teredo bartschi existed in both Oyster Creek and Forked River the summer of 1982, but the species was rare. There was no large settlement of this or any other terodinid species in Barnegat Bay. Teredo navalis was the most common species in the monthly panels. The fouling community reached its maximum yearly diversity in June-July. There was a thermal effluent causing a water temperature change of 3-4 degrees during most of the summer, and salinity in Oyster Creek and Forked River was similar to that of Barnegat Bay. The lack of a shipworm outbreak in 1982 may be related to the low temperature changes in summer, plus the lack of a thermal effluent in the preceding winter-spring period. (Geiger-PTT)
W86-03230

EFFECTS OF CHLORINE ON FRESHWATER FISH UNDER VARIOUS TIME AND CHEMICAL CONDITIONS: TOXICITY OF CHLORINE TO FRESHWATER FISH,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
A. S. Brooks, J. M. Bartos, and P. T. Danos.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-905841, Price codes: A04 in paper copy, A01 in microfiche. EPRI-EA--2481, July 1982. Final Report. 2 p, 13 fig, 12 tab, 24 ref. 1435-1.

Descriptors: *Bioassay, *Water pollution effects, *Chlorine, *Chloramines, Residual chlorine, Toxicity, Emerald shiner, Channel catfish, Rainbow trout.

Laboratory bioassays to determine the acute toxicity of monochloramine, dichloramine, hypochlorous acid and hypochlorite ion, conducted on emerald shiners, channel catfish, and rainbow trout, are described. The emerald shiner was the most sensitive fish studied, averaging 1.8 times more sensitive to chlorine than channel catfish and 3.3 times more sensitive than ranbow trout. Actual LC50 values varied with length of exposure. Monochloramine was found to be 2.4 - 3.5 times less toxic than dichloramine, 2.5 - 3.4 times less toxic than hypochlorous acid, and 1.3 - 1.4 times less toxic than hypochlorite ion, depending on the species of fish tested. The suggestion that careful attention should be paid not ony to total residual chorine but to the duration of exposure, and to both chlorine and fish species presented in establishing safe effluent limitations, is discussed. (Halterman-PTT)
W86-03231

PROCESSES OF ATMOSPHERIC DEPOSITION OF METALS AND ACIDS TO FORESTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W86-03236

ACIDITY, NUTRIENTS, AND MINERALS IN ATMOSPHERIC PRECIPITATION OVER FLORIDA: DEPOSITION PATTERNS, MECHANISMS, AND ECOLOGICAL EFFECTS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W86-03246

PLANT RESPONSE TO AQUEOUS EFFLUENTS DERIVED FROM IN SITU FOSSIL FUEL PROCESSING PART II: FIVE GRASS PLANT SPECIES AND THEIR RESPONSE TO FIVE PRODUCED RETORT WATERS; OIL SHALE, TAR SANDS AND UNDERGROUND COAL GASIFICATION,
Wyoming Univ., Laramie. Range Management Div.
Q. D. Skinner.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83-002785, Price codes: A05 in paper copy, A01 in microfiche. DOE/LC/01761-T4 (Pt. 2), November 1981.nal Report. 85 p, 7 fig, 2 tab, 3 ref, 5 append.

Descriptors: *Oil shale, *Plant growth, *Oil recovery, *Grasses, *Water pollution effects, Ecological effects, Industrial wastes, Fuel reprocessing, Fuel, Coal gasification, Fate of pollutants, Statistical analysis, Process water.

Five in situ produced waters collected from retorting oil shale and tar sands to produce oil and coal to produce gas were tested for their effect on plant growth. Five native grass plant species were utilized for leaf area, root/shoot ratio and shoot/leaf area ratio were parameters measured. All experiments were conducted under greenhouse conditions using hydroponic techniques and commercial grade perlite as support systems. Measurements were collected after a 10 week growth period. Factor analyses of variance revealed differences existed between waters and their effect on plants for all six parameters measured except shoot/leaf area ratio were parameters measured. All experiments were conducted under greenhouse conditions using hydroponic techniques and commercial grade perlite as support systems. Measurements were collected after a 10 week growth period. Factor analyses of variance revealed differences existed between waters and their effect on plants for all six parameters measured. Differences among dilution treatments were significant for all parameters measured except shoot/leaf area ratio. There were no differences in water-treatment interactions. Collectively, the six parameters utilized in the study seperated responses of plants tested to treatments of various in situ produced retort waters. Comparing response of different species to each water is subjective due to varying capabilities among plant species to grow under the given experimental system due to their different genetic characteristics. Overall, Tar Sands had the least effect on plant species, whereas 150-T Retort water (simulates in situ oil shall processing) caused death to more species than any other aqueous effluent tested. (Geiger-PTT)
W86-03248

PLANT RESPONSE TO AQUEOUS EFFLUENTS DERIVED FROM IN SITU FOSSIL FUEL PROCESSING PART I. EIGHT PLANT SPECIES AND THEIR RESPONSE TO OMEGA 9 OIL SHALE RETORT WATER,

Wyoming Univ., Laramie. Range Management Div.
Q. D. Skinner.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83003784, Price codes: A04 in paper copy, A01 in microfiche. DOE/LC/01761-T4 (Pt. 1), November 1981. Final Report. 60 p, 2 fig, 2 tab, 9 ref, 5 append.

Descriptors: *Plant growth, *Oil shale, *Ecological effects, *Water pollution effects, *Oil recovery, Industrial wastes, Fate of pollutants, Grasses, Fuel, Fuel reprocessing.

Problems reside in the handling, containment, treatment, disposal, use, and eventual fate of waters associated with synfuel processing techniques. Plant growth response to oil shale report water collected from the 1976 Rock Springs Site 9 true in situ oil shale combustion experiment conducted by the Laramie Energy Technology Center was investigated. The purposes of the present study were to evaluate the effect of retort water on plants and document effective parameters for detecting differences in plant growth by species. A self-feeding hydroponic system was used to subject different dilutions of oil shale retort water to plants grown in horticulture grade perlite under greenhouse conditions for 10 weeks. Parameters measured included leaf area, total dry weight, shoot weight, root weight, root/shoot ratio and shoot/leaf area ratio. Seven grass and one forb species were utilized as test plants. Results showed that growth was impaired when plants were subjected to retort water. Species response to retort water varied. The parameters measured also varied as to their ability to detect change in growth response due to exposure of plants to retort water. This study shows that methods utilized can provide a separation of plant species to one in situ oil shale retort water. These methods should give controlled technology flexibility based on potential toxicity for selecting plant species for reclamation of mined sites and for testing water treatment effects. (Geiger-PTT)
W86-03249

PLANT RESPONSE TO AQUEOUS EFFLUENTS DERIVED FROM IN SITU FOSSIL FUEL PROCESSING PART III: THREE GRASS SPECIES AND THEIR RESPONSE TO OMEGA 9 AND TO FIVE PRODUCED RETORT WATERS; OIL SHALE, TAR SANDS AND UNDERGROUND COAL GASIFICATION.

Wyoming Univ., Laramie. Range Management Div.
Q. D. Skinner.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83003786, Price codes: A04 in paper copy, A01 in microfiche. DOE/LC/01761-T4 (Pt. 3), December 1981, Final Report. 63 p, 7 fig, 41 tab, 5 ref, 4 append.

Descriptors: *Fuel reprocessing, *Process water, *Oil shale, *Plant growth, *Water pollution effects, Fuel, Coal, Oil, Industrial wastes, Coal gasification, Groundwater pollution, Fate of pollutants, Ecological effects, Grasses, Oil recovery.

Six in situ produced waters, collected from retorting oil shale and tar sands to produce oil and coal to produce gas, were tested for their produced waters diluted by groundwater and those that remain undiluted. Three native grass species (basin wildrye, western wheatgrass, and alkali sacaton) were used to monitor growth response under greenhouse conditions using hydroponic techniques and commercial grade perlite as support systems. Measurements were collected on root weight, shoot weight, total dry weight, leaf area, root/shoot ratio and shoot/leaf area ratio after a 10-week growth period. Results showed that different process waters collected from retorting oil shale, tar sands, and coal, affect plant species in diffeent ways and to different degrees. However, in general, retort waters diluted by groundwater were less toxic to plant species tested than were the undiluted counterparts. Parameters measured and experimental design did separate reaction of plant species to various in situ retort waters. (Geiger-PTT)
W86-03253

REVIEW OF THE IMPACT OF COPPER RELEASED INTO MARINE AND ESTUARINE ENVIRONMENTS,

Lawrence Livermore National Lab., CA.
F. L. Harrison.
NUREG/CR-2823, UCRL-53042, November 1982, 119 p, 29 tab, 390 ref.

Descriptors: *Marine environment, *Estuarine environment, *Copper, Estuarine fishes, Marine fishes, Heavy metals, Environmental effects, Toxicity, Invertebrates.

Information on the concentrations of copper in abiotic and biotic compartments of marine and estuarine ecosystems and the effect on biota of increased amounts of copper in the water and the sediments were reviewed. Data compiled and discussed include the quantities and physicochemical forms of copper in the water column, the concentrations of copper in the bedload sediments and interstitial waters, and the concentrations of copper in primary producers, annelid worms, molluscs, crustacea, minor invertebrates, and fishes. In addition, the acute and sublethal effects of copper on the same groups of biota are presented as well as data on copper concentration factors. This information can be used to evaluate, for different types of ecosystems, the ranges of concentrations that occur in nature, to identify ecosystems that are or may be impacted by copper released from industrial and urban sources, and to assess the effects on biota of the use of copper alloys in nuclear power station cooling systems. (Author)
W86-03265

WYCOALGAS COAL GASIFICATION PROJECT: PRELIMINARY DRAFT ENVIRONMENTAL IMPACT STATEMENT, VOLUME 1,

Woodward-Clyde Consultants, San Francisco, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83-001083, Price codes: A17 in paper copy, A01 in microfiche. DOE/RA/50404--1232-App.Q-Vol. 1, August 1981. 393 p, 144 fig, 93 tab. DE-F-CO2-81RA50404

Descriptors: *Coal gasification, *Environmental impact statement, Coal mines, Environmental effects, Siting, Environmental protection, Water pollution control, Environmental quality, Groundwater, Wildlife, Aquatic environment.

An environmental impact statement for a proposed coal gasification plant is presented. The topics discussed in this volume include project background and organization, the purpose and need of the plant, a detailed description of the proposed plant, a description of the water supply system, the product pipeline, the railroad, the coal mine, and the interrelationships of the proposed plant with other planned projects. The environmental effects of the proposed plant are also described, emphasizing air quality, soils, hydrology and water quality, vegetation, wildlife, aquatic biology, rare and endangered species, recreation resources, visual resources, land use, cultural resources and socioeconomics. (Halterman-PTT)
W86-03271

ACID PRECIPITATION: A CRITIQUE OF PRESENT KNOWLEDGE AND PROPOSED ACTION,

Virginia Center for Coal and Energy Research, Blacksburg.
For primary bibliographic entry see Field 5B.
W86-03273

ASSESSMENT OF IMPLANTED SUBSTRATE SAMPLERS FOR MACROINVERTEBRATES INHABITING STONE DIKES OF THE LOWER MISSISSIPPI RIVER,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. B. Mathis, C. R. Bingham, and L. G. Sanders.
Miscellaneous Paper E-82-1, U.S. Army Environmental and Water Quality Operational Studies, February 1982. Final Report. 55 p, 3 fig, 13 tab, 41 ref.

Descriptors: *Ecological effects, *Dikes, *Aquatic populations, *Environmental effects, *Biological samples, *Levees, *Aquatic insects, *Macroinvertebrates, Aquatic animals, Substrates, Sampling, Water sampling, Crustaceans, Isopods, Caddisflies, Mayflies, Midges, *Mississippi River.

The aquatic macroinvertebrate assemblage of a dike in the Lower Mississippi River was evaluated by implanting substrate basket samplers into the structure. The resulting data indicated that a diverse (38 taxa) and productive (average density = 101,968.4 organisms/sq m) assemblage was present, and was characterized by net-spinning caddisflies, tube-building chironomids, clinging mayflies, and isopods. A comparison of the surface stones of the basket samplers with adjacent surface stones of the dike indicated that the implanted substrates provided representative estimates of both the composition and structure of the macroinvertebrate assemblage. These data also indicated significant macroinvertebrate activity below the surface substrate of the dike. Differences in habitat conditions among dike positions (downstream, top, upstream) were the major contributors to overall sample variability. Thus, stratified random sampling based on dike position is recommended for future comparative studies. (Author)
W86-03309

CONSIDERATIONS IN SELECTING BIOASSAY ORGANISMS FOR DETERMINING THE POTENTIAL ENVIRONMENTAL IMPACT OF DREDGED MATERIAL,

EG and G Bionomics, Pensacola, FL. Marine Research Lab.
P. J. Shuba, S. R. Petrocelli, and R. E. Bentley.
Technical Report EL-81-8, Army Engineer Waterways Experiment Station, Vicksburg, MS., September 1981. Final report. 86 p, 4 tab, 1 app, 50 ref.

DACW39-78-C-0093.

Descriptors: *Bioindicators, *Bioassays, *Indicators, *Aquatic animals, *Dredging, *Bioaccumulation, *Environmental impact statement, Literature review, Assay, Biological samples, Ecological effects, Environmental effects, Water pollution effects.

A list of factors was developed to aid in the selection of test species for bioassay and bioaccumulation potential studies with dredged material. Factors to be considered for the selection of test species include whether the organism was indigenous to the disposal site or closely related to an indigenous species; was available through collecting or purchasing; had a toxicological data base; could be maintained and cultured in the laboratory; was useful in acute, chronic, and bioaccumulation tests; was ecologically and economically important; had a wide geographic distribution, and was compatible with other test species in the test containers. For the selection of test species to determine bioaccumulation potential in the laboratory, the same factors were used but with the stipulation that the organism be large enough to provide sufficient tissue for chemical analyses and that they survive the 10-day exposure period. Based on a literature review, a 10-day exposure period was sufficient to qualitatively determine if most chemical contaminants would be accumulated from dredged material by test organisms and was a useful tool in evaluating the potential environmental impact of dredged material.
W86-03319

HEAVY METALS POLLUTION OF THE UPPER ARKANSAS RIVER, COLORADO, AND ITS EFFECTS ON THE DISTRIBUTION OF THE AQUATIC MACROFAUNA,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5B.
W86-03338

ENVIRONMENTAL PROTECTION: STANDARDS, COMPLIANCE AND COSTS,

For primary bibliographic entry see Field 5B.
W86-03344

NATURE AND CONCENTRATION OF POLLUTANTS IN WATER,

Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5B.
W86-03346

ROLE OF TOXICOLOGY,

Water Research Centre, Medmenham (England). Medmenham Lab.
J. K. Fawell.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd., Chichester, England, 1984. 72-84 p, 3 fig, 3 tab, 16 ref.

Descriptors: *Aquatic environment, *Environmental protection, *Toxicity, *Bioassay, Carcinogenicity, Mutagenicity, Epidemiology, Teratology.

The assessment of the probability of occurrence of toxic effects is a relatively new field and one which presents particular difficulty for toxicologists. Because the potential for exposure of most of the population through water is enormous, a great responsibility rests with industry to ensure their own actions do not create new problems while solving others. To provide a proper framework for toxicological endeavors, the author discusses a variety of aspects of this important area of study. First, there are a number of aspects of the biological activity of a compound, including acute toxicity, chronic toxicity, carcinogencity, mutagenicity, reproductive toxicity, metabolism, and pharmacokinetics. Second, there is information from special studies such as behavior, immuno-toxicity and allergic responses. The value of information resulting from testing is also discussed; several pitfalls of using toxicity data are outlined. Finally, the use of toxicity data in environmental protection and future research needs are discussed.
W86-03347

EPIDEMIOLOGY AND WATER QUALITY,

London School of Hygiene and Tropical Medicine (England). Dept. of Medical Statistics and Epidemiology.
P. Fraser.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 85-93 p, 26 ref.

Descriptors: *Aquatic environment, *Epidemiology, *Toxicity, *Water pollution, Great Britain, Water pollution effects, Carcinogenicity, Nitrogen, Public health.

Examples of the spread of disease resulting from poor water quality are discussed in this paper. Swimming-associated illnesses are mainly gastrointestinal problems, arising from swimming in contaminated water. Cardio-vascular disease appears to be associated with consumption of hard water, but the exact relationship or possible mechanisms are not understood. The disease methaemo-globinaemia has been shown to be related to nitrates in water. Although the exact role of nitrate pollution in the spread of this disease is not known, it does occur primarily in countries where water quality is low. Nitrates have also been implicated in cases of stomach cancer. The author points out, however, that recent studies conducted in England, Italy, Chile, Denmark, Hungary and France did not reveal a link between water-borne nitrates and cancer. Finally, although a controversy existed in which fluoridation of water linked to cancer, subsequent research has indicated that there is no link between the two. (Halterman-PTT)
W86-03348

ECOTOXICOLOGY AND ENVIRONMENTAL QUALITY,

Ministerie van Volkshuisvesting en Ruimtelijke Ordening, Leidschendam (Netherlands).
W. H. Konemann.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 94-103 p, 3 fig, 3 tab, 12 ref.

Descriptors: *Aquatic environment, *Toxicity, *Bioassay, *Environmental protection, Median tolerance limit, Mortality, Algae, Fish, Zooplankton.

The role of ecotoxicology in environmental protection is discussed in order to describe the extent to which it helps to improve or defend the quality of the environment. First, the goals of ecotoxicology were defined as (a) the prediction of levels of chemicals which do not have a negative impact on environmental quality; (b) the identification of chemicals responsible for poor environmental quality; and (c) the monitoring of the actual quality of surface water. Second, the currently used ecotoxicity tests are described. Of primary interest are the no-effect-levels, LC50-mortality type tests, immobilization tests such as the Daphnia EC50, and algal growth tests. Third, several aspects of toxicity testing are discussed: the importance of knowing the form or species of the test compound, the uses and limitations of multiple species tests, and the problems of testing mixtures of chemicals. It is concluded that a set of about five acute tests and two chronic tests is sufficient for thorough ecotoxicity testing. Safety factors are necessary because of differences between the real environment and the laboratory. (Halterman-PTT)
W86-03349

STANDARDS AND LIMITS FOR WATER QUALITY CONTROL,

Water Research Centre, Medmenham (England). Medmenham Lab.
R. F. Packham.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 108-122 p, 3 tab, 19 ref.

Descriptors: *Aquatic environment, *Standards, *Toxicity, *Bioassay, Median tolerance limit, Mortality, Microbiological studies, Chemical composition, Radioactivity.

Despite all of the uncertainties involved in setting limits for water constitutents, they are useful and even vital in many aspects of water quality management. The number of limits established for various purposes will continue to grow and some of the present uncertainties will diminish as a result of research. This paper addresses several aspects of standards and limits for water quality, with emphasis on some specific research needs and some suggested guidelines for the implementation of standards and limits. The relative toxicity of different chemical species of the same element, and the toxicity of mixtures of substances, are problems which need more research. One of the major guidelines suggested for the use of standards is that when standards are exceeded, all aspects of the contamination should be investigated, including its significance to health in the local context. Obviously, the need to safeguard public health and environmental quality is unquestionable, but excessive safety margins have important cost implications which cannot be ignored. (Halterman-PTT)
W86-03350

MONITORING COMPLIANCE WITH STANDARDS,

Water Research Centre, Medmenham (England). Medmenham Lab.
J. C. Ellis, and D. G. Miller.
IN: Enviromental Protection: Standards, Compliance, and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 123-139 p, 11 fig, 3 ref, 1 append.

Descriptors: *Aquatic environment, *Monitoring, *Toxicity, Standards, Water quality standards, Specifications, Environmental protection.

With the move toward increasing legislation and the tendency to prefer a more rigorous numerical approach to standards, operating agencies are being obliged to examine in more detail a variety of measures covering the field of environmental protection. This paper reviews the statistical principles involved in compliance monitoring, and sets out the compromises necessary in practice. The conclusions drawn from this review are as follows: All persons involved in monitoring must come to terms with the limitations of practical monitoring schemes. Those entrusted with operational functions should give priority to protection of life, but should allowed flexibility in reacting to standards infringements. Fuller use should be made of the scientific knowledge of systems and of the underlying statistical relationships involved in monitoring. Concentrated surveys, which would define underlying trends, should be followed by long-term, less intensive monitoring. Finally, uniform approaches which ignore local factors are unlikely to be cost-effective.
W86-03351

EUROPEAN COMMUNITY POLICY ON ENVIRONMENTAL MANAGEMENT,

Commission of the European Communities, Brussels (Belgium).
A. J. Fairclough.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 158-168 p, 21 ref.

Descriptors: *Aquatic enviroment, *Environmental protection, *Standards, *Enviromental management, Europe.

The European Community approved the first 'Action Program' in 1973. The aim was to ensure the sound management of natural resources and to bring qualitative aspects into the planning and organization of economic and social development. This paper describes the origin of the Environmental Action Program, indicates the rationale for its existence, reviews its achievements, and describes its effects on the field of water pollution control. Some 70 legislative measures, many of which deal with water pollution, have been adopted in the ten years between the adoption of the program and the writing of this paper. The Dangerous Substances Directive, a number of directives dealing with surface water, drinking water, bathing water, freshwater fish and shellfish, and finally, a series of

directives pertaining to certain specific industrial processes were among the major actions in the field of water pollution control. The authors conclude with a discussion of the importance of sound, forward-looking enviromental policy in the whole body of the socio-economic policies. (Halterman-PTT)
W86-03353

APPROACH OF THE FEDERAL GERMAN REPUBLIC-ANTICIPATING ENVIRONMENTAL EFFECTS,

Council of Experts on Environmental Matters, Bonn (Germany, F.R.).
J. Salzwedel.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 167-180 p.

Descriptors: *Aquatic environment, *Environmental protection, *Standards, Federal German Republic, Enviromental effects.

A primary requirement of the management of water resources by the authorities is the task of regulating effluent disposal in such a way as not to place the public water supply at risk. Up to the promulgation of the Federal German Republic's Fourth Amendment to the Water Resources Policy Act, only the public water supply received special recognition in federal law. Specifically, authorization and permission for water use were to be refused if the use was prejudiced to public well being, particulary if it was expected to pose a threat to public water supply. On the other, hand, it was left to the discretion of management to ensure that the requirements for proper effluent disposal were duly met. The 1976 Amendment Four of the Water Act, however, listed provisions which included the introduction of liability for effluent disposal planning, and the ad hoc application of the Water Law to indirect dischargers. Furthermore, minimum requirements for production and purification technology are outlined. (Halterman-PTT)
W86-03354

UK APPROACH - ENVIRONMENTAL QUALITY STANDARDS,

Department of the Environment, London (England).
J. A. L. Gunn.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 181-188 p.

Descriptors: *Aquatic environment, *Environmental protection, *Standards, Environmental effects, United Kingdom, Enviromental management, Europe, Water quality standards, Toxicity.

The principles on which water pollution control policies are currently founded in the United Kingdom are explained. There are four basic principles. First, a single authority exercises control over all discharges within a river basin, and provides water services throughout the area of that river basin. This is the principle of unified management. Second, dischargers are required to meet conditions which are set by reference to the enviromental quality objective propounded for the receiving water. This is the principle of using environmental quality objectives. Third, the polluter should pay the cost of the measures necessary to avert, reduce or remedy any pollution he causes. This is the polluter pays principle. Fourth, in environmental matters the British Government participates constructively in the work of the European Community and complies with its requirements. This principle is referred to as the European Community commitment. The author expresses his belief that together, these principles should provide a sound basis for the development of policy and practice in the protection of the aquatic environment. (Halterman-PTT)
W86-03355

SPILLAGES-AN OPERATIONAL APPROACH,

Wessex Water Authority, Bristol (England).
For primary bibliographic entry see Field 5G.
W86-03357

CONTINGENCY PLANNING FOR CHEMICAL ACCIDENTS,

World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5G.
W86-03358

PROTECTION OF THE AQUATIC ENVIRONMENT - RESEARCH NEEDS,

Water Research Centre, Medmenham (England). Medmenham Lab.
S. C. Warren.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. p 283-294, 2 tab.

Descriptors: *Aquatic environment, *Environmental protection, *Public health, Wastewater facilities, Environmental quality, Ocean dumping, Acid rain, Sewage sludge, Sewage treatment, Chemical wastes.

Despite the hope that economic factors should not be allowed to impede environmental improvements, in practice they will. It is essential that the money available for environmental protection be spent where it will do the most good. Environmental concern can be divided into three major categories: risk of damage to human health, the 'ecological balance', and the aesthetic aspects of the environment. Research on the impact of a variety of possible pollutants on these three areas is clearly needed. Some of the more critical areas are heavy metals, nitrate, oxides of nitrogen and sulphur, organic compounds, sewage effluent and sludge, agricultural wastes, and the exploitation of the environment in the forms of farming and forestry, angling, land drainage, and river improvements. Both basic and applied research are needed to provide the information needed to adequately address the many issues that exist regarding these research needs. (Halterman-PTT).
W86-03361

APPLICATION OF THE PRELIMINARY POLLUTANT LIMIT VALUE (PPLV) ENVIRONMENTAL RISK ASSESSMENT APPROACH TO SELECTED LAND USES,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5B.
W86-03374

DYNAMICS OF LOTIC SYSTEMS,

Savannah River Ecology Lab., Aiken, SC
Ann Arbor Science, Ann Arbor, MI. 1983. Edited by Thomas D. Fontaine, III and Steven M. Bartell. 494 p.

Descriptors: *Aquatic environment, *Lotic environment, Stream biota, Productivity, Aquatic productivity, Primary productivity, Secondary productivity, Consumers, Aquatic communities, Microbial studies, Invertebrates, Nutrients, Denitrification.

Increases in the number of stream ecologists, technical articles, and frequency of special symposia on lotic ecosystems reflect a growing interest in the structure and function of streams and rivers. While progress has been made in many areas of specialization related to lotic ecosystem studies, communication across borderlines of separate disciplines has been all too infrequent. The purpose of the symposium, published in these proceedings, was to provide a format for the assembly of individuals from academia, industry, and government to explore a variety of factors that govern the structure and function of flowing water systems. The major topics covered include system concepts, synthesis studies, dynamics, and control of system components, consumers, detritus and nutrients. (Halterman-PTT)
W86-03375

RESOURCE SPIRALING: AN OPERATIONAL PARADIGM FOR ANALYZING LOTIC ECOSYSTEMS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Elwood, J. D. Newbold, R. V. O'Neill, and W. Van Winkle.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 3-27 p, 4 fig, 1 tab, 67 ref.

Descriptors: *Stream biota, *Streams, *Lotic environments, Nutrients, Cycling nutrients, Nutrient spiraling theory, Organic carbon, Organic matter, Detritus, Model studies.

The cycling of nutrients and organic carbon within a stream is a critical process driving the aquatic ecosystem. A conceptual view of this phenomenom is spiraling, defined as the spatially dependent cycling of nutrients and the processing of organic matter in lotic ecosystems. This view provides a framework for describing and measuring the temporal and spatial dynamics of nutrients and organic carbon. The authors conclude that nutrient spiraling length and organic carbon turnover length are indices of the use of these resources supplied from the surrounding watershed relative to their rate of downstream transport. Furthermore, nutrient spiraling in most undisturbed streams is predominantly a biotic process involving the sorption, retention and turnover of nutrients by microbes. Shortening of the spiraling length is associated with increased productivity. Further use of the spiraling concept will allow an examination of the many complex community- and system-level interactions in streams and rivers to better understand their longitudinal interdependencies and mechanisms in stream communities for stabilizing the supply of nutrients and energy resources. (Halterman-PTT)
W86-03376

SERIAL DISCONTINUITY CONCEPT OF LOTIC ECOSYSTEMS,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
J. V. Ward, and J. A. Stanford.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 29-42 p, 3 fig, 34 ref.

Descriptors: *Aquatic environment, *Lotic environment, Stream biota, Stream order, Reservoirs, Aquatic productivity, Aqquatic communities, Microbial studies, Nutrients, Detritus, Controlled streams, Serial discontinuity.

The theoretical concepts of lotic ecosystems centering on the river continuum concept, which describes the gradient of physical conditions and resulting biotic responses from the headwaters to the mouths of rivers, and nutrient spiraling, concerned with the unidirectional and biologically mediated recyling of nutrients along a river continuum, do not provide for the effects of impoundments on lotic reaches. The work described in this paper is an attempt to attain a broad theoretical perspective of regulated lotic systems over the entire longitudinal stream profile. Discontinuity distance (DD), defined as the longitudinal shift of a given parameter by stream regulation, may be positive (downstream shift), negative (upstream shift), or near zero. The direction and intensity of DD vary as functions of the specific parameter examined and the position of the dam(s) along the longitudinal stream profile. The serial discontinuity concept can be applied to physical parameters (e.g., temperature summation) and biological phenomena at the population (e.g., species abundance patterns), community (e.g., biotic diversity), or ecosystem levels (e.g., photosynthesis/respiration). (Author)
W86-03377

CONCEPTUAL FRAMEWORK FOR PROCESS STUDIES IN LOTIC ECOSYSTEMS,

Oregon State Univ., Corvallis. Dept. of Botany and Plant Physiology.
C. D. McIntire.
IN: Dynamics of Lotic Systems, Ann Arbor Sci-

ence, Ann Arbor, MI. 1983. 43-68 p, 6 fig, 7 tab, 19 ref.

Descriptors: *Lotic ecosystems, *Model studies, Aquatic environment, Functional groups, Aquatic productivity, Cycling nutrients, Decomposing organic matter, Invertebrates, Stream biota, Microbial studies.

This paper presents an approach to lotic ecosystem studies based on the concept of relevant dynamic processes. A process is defined as a systematic series of actions relevant to the dynamics of the system as it is modeled. Each process is expressed as a set of variables, and state variables represent either biomass or process capacity, depending on whether or not qualitative aspects within a process are represented. Process dynamics in lotic ecosystems are discussed relative to (1) the potential to expand process capacity, (2) process production, (3) realized growth of process capacity, and (4) process regulation. A set of variables are defined which aid in the investigation of mechanisms regulating process dynamics in lotic ecosystems. Process models are discussed in relation to their role in hypothesis generation, data assessment, and the setting of research priorities. Specific hypotheses relative to process dynamics in lotic ecosystems are proposed and related to the behavior or a lotic ecosystem model. (Author)
W86-03378

PREDICTABILITY OF STREAM ECOSYSTEM MODELS OF VARIOUS LEVELS OF RESOLUTION,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2H.
W86-03379

ALTERNATIVE FOR CHARACTERIZING STREAM SIZE,

Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 2E.
W86-03380

RIVER WASTE HEAT ASSIMILATION VS. ORGANIC WASTE DISCHARGE,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
E. F. Joeres, and N. Tetrick.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 103-125, 9 fig, 4 tab, 15 ref.

Descriptors: *Waste heat, *Thermal pollution, *Wastewater pollution, Wastewater oxidation, Power plants, Wisconsin River, Lake Wisconsin, Model studies, Biological oxygen demand, Dissolved oxygen.

The issue of water as a constraint to power plant siting was investigated at the Wisconsin River between Wisconsin Dells and Lake Wisconsin. This stretch of river has been the subject of much interest since the construction of the 1000-MW coal-fired Columbia power plant. An attempt was made to determine future trade-offs between using the river for waste heat assimilation or organic waste discharge. Simulations of water quality were carried out to evaluate the effect of potential heat discharges from projected power plants at three possible sites on the levels of dissolved oxygen, biochemical oxygen demand, and algae growth during periods of extremely low flow. Model parameters, boundary conditions, and assumptions made to specify the hydraulic parameters of the system to model the river are discussed. Results indicate that future development along the river will adversely affect dissolved oxygen levels in Lake Wisconsin (dropping to 4 mg/1 at one point), but that nutrient loadings are of greater consequence than waste heat discharges. Neither waste heat nor nutrient discharges were found to limit projected biochemical oxygen demand levels caused by organic waste discharges. (Author)
W86-03381

ENERGY BASIS OF ECOSYSTEM CONTROL AT SILVER SPRINGS, FLORIDA,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 2H.
W86-03383

ALTERATIONS IN THE BIODYNAMICS OF THE RED CEDAR RIVER ASSOCIATED WITH HUMAN IMPACTS DURING THE PAST 20 YEARS,

Michigan State Univ., East Lansing. Dept. of Zoology.
T. M. Burton, and D. L. King.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 181-197, 3 fig, 4 tab, 27 ref. A-099-MICH.

Descriptors: *Aquatic environment, *Lotic environment, *Ecosystems, Algae, Organic matter, Primary productivity, Sedimentation, Nutrients, Red Cedar River, Michigan, Phosphorous, Periphyton, Macrophytes.

In recent years efforts to improve water quality in streams have intensified. Because of the passage of the Federal Water Pollution Control Act, most point sources of pollution now receive best practicable wastewater treatment. However, the effects of this upgrading of treatment of point-source pollution in receiving waters has not been studied in detail. This paper presents data from studies that do illustrate the long-term changes in a stream with point sources. After a 20-year period, total annual phosphorous discharge from the upper portion of Red Cedar River Michigan has increased 2.4-fold. Discharge of phosphorous from the lower portion only increased 1.2-fold. Sediment accrual, macrophyte productivity, and periphyton production have all declined. Nutrient loading is essentially the same for an upstream and a downstream station, meaning nutrient input is from diffuse sources. (Halterman-PTT)
W86-03384

SIGNIFICANCE OF FLOODPLAIN SEDIMENTS IN NUTRIENT EXCHANGE BETWEEN A STREAM AND ITS FLOODPLAIN,

East Carolina Univ., Greenville, NC. Dept. of Biology.
M. M. Brinson, H. D. Bradshaw, and R. N. Holmes.
In: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 199-221, 7 fig, 1 tab, 31 ref. B-114-NC.

Descriptors: *Sediments, *Nutrients, *Nitrogen, *Phosphorous, *Cycling nutrients, Aquatic environment, Ecosystems, Tar River, North Carolina, Flood plains, Mud-water interfaces.

A year-long comparison of stream channel and floodplain water of the lower Tar River, North Carolina, established that hydrologic phases resulting in water flow from floodplain to stream channel would dilute nitrate (and usually ammonium) concentrations in stream water. In contrast, floodplain drainage water would normally augment filterable reactive phosphorous in the stream. Nitrate loss exceeded ammonium loss from surface water to which these ions were added above background levels. Loss rates of both ions were greater in July and November than in February, the coldest month. Nitrogen-15 trace experiments confirmed a one-way path of nitrate from the surface water; this was made possible by denitrification in the sediments. Ammonium diffusion was bidirectional between surface water and sediments. Background concentrations of inorganic nitrogen in interstitial water of surface sediments underwent greatest changes during warm season dry down. Loss of 32PO4 from surface water was mostly by abiotic mechanisms during all seasons and was entirely so during the coldest part of the year. (Author)
W86-03385

INFLUENCE OF HYDROLOGIC VARIATIONS ON PHOSPHORUS CYCLING AND RETENTION IN A SWAMP STREAM ECOSYSTEM,

North Carolina Univ. at Chapel Hill.
For primary bibliographic entry see Field 2H.
W86-03386

ORGANIC CARBON SUPPLY AND DEMAND IN THE SHETUCKET RIVER OF EASTERN CONNECTICUT,

East Carolina Univ., Greenville, NC. Dept. of Biology.
For primary bibliographic entry see Field 2E.
W86-03387

AQUATIC MACROPHYTE CONTRIBUTION TO THE NEW RIVER ORGANIC MATTER BUDGET,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 2E.
W86-03388

PRIMARY PRODUCTION AND DECOMPOSITION OF SUBMERGENT AND EMERGENT AQUATIC PLANTS OF TWO APPALACHIAN RIVERS,

North Texas State Univ., Denton. Inst. of Applied Sciences.
J. H. Rodgers, M. E. McKevitt, D. O. Hammerlund, K. L. Dickson, and J. Cairns.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 283-301 p, 4 fig, 6 tab, 48 ref.

Descriptors: *Aquatic environment, *Lotic environment, *Primary productivity, Productivity, Macrophytes, Ecosystems, Niutrients, Submerged plants, Emergent plants.

Relatively little attention has been given to investigating the dynamics and functions of macrophytes in lotic systems. This paper presents studies comparing production and relative importance of submerged and emergent macrophytes of the New River, Virginia, and Watauga River, Tennessee. Primary production and decomposition rates of macrophytes were estimated by removing sequential standing crop and measuring weight lost over time from in situ litter-bag incubations of plant materials. Standing crops ranged from 790.1 g/sq m ash free dry weight for Typha latifolia to 9.8 g/sq m for Potamogeton crispus in the New River. In the Watauga River, the maximal standing drops of P. crispus and Podostemum ceratophyllum were 86.8 and 97.6 g/sq m, respectively. The maximal standing crop of P. ceratophyllum in the New River was 12.8 g/sq m. Examination of decomposition rates revealed two apparent categories: fast (k=0.12 - 0.21 g/g/day) and slow (k=0.03 0.04 g/g/day). Comparisons of these rates with those reported for allochthonous inputs can further clarify the role of macrophytes in lotic ecosystems. (Haltermann-PTT)
W86-03389

BIOTIC INTERACTIONS OR ABIOTIC LIMITATIONS. A MODEL OF LOTIC COMMUNITY STRUCTURE,

Cornell Univ., Ithaca, NY. Dept. of Entomology.
B. L. Peckarsky.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 303-323 p, 6 fig, 3 tab, 38 ref.

Descriptors: *Aquatic environment, *Lotic environment, Stream biota, Aquatic communities, Model studies, Competition, Invertebrates, Consumers, Aquatic habitats, Habitats.

The relative roles of biological interactions and physical-chemical factors in structuring benthic stream communities have not been established. If streams are placed on a gradient from harsh to benign physical conditions, harsher streams may be characterized by unfavorable ranges of diel and seasonal fluctuation of such factors as current, depth, substrate shifts, temperature, and availability of habitable space. Biological interactions may be relatively unimportant if harsh physical conditions eliminate predators and maintain prey populations at low numbers. As streams become more benign, biological interactions may increase in importance. Predation may override competition in benign streams where predators are not excluded by physical conditions, where prey have effective

defenses or where prey cannot find spatial refuge from predators. Competition may dominate as a determinate of species distribution within prey refuges, in systems where prey defenses are effective, or within moderately harsh systems where predator populations do not reach levels high enough to exert sufficient pressure on prey populations. (Author)
W86-03390

INTERMEDIATE-DISTURBANCE HYPOTHESIS: AN EXPLANATION FOR BIOTIC DIVERSITY PATTERNS IN LOTIC ECOSYSTEMS,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
J. W. Ward, and J. A. Stanford.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. 347-356 p, 2 fig, 35 ref.

Descriptors: *Aquatic ecosystems, *Lotic environment, Species diversity, Ecology, Species composition, Species density, Stream biota, Biological communities, Model studies.

The intermediate-disturbance hypothesis predicts that biotic diversity will be greatest in communities subjected to moderate levels of disturbance. It is consistent with diversity patterns observed in natural and altered lotic ecosystems. Species diversity is suppressed in stream habitats exposed to disturbances that are severe (organic loading or acid mine drainage) or frequent (diel flow fluctuations). In addition, habitats with enhanced environmental constancy (spring sources or streams below storage reservoirs) exhibit suppressed diversity even if adverse conditions (e.g., oxygen deficits) are not apparent. It is postulated that 'undisturbed' lotic systems are in fact 'disturbed' and that the high biotic diversity of natural streams is a function of moderate perturbation. Diversity is enhanced by the spatio-temporal heterogeneity resulting from intermediate disturbance, which maintains the community in a nonequilibrium state. This theory may account for much of the diversity variance within stream systems and between different types of lotic habitats. (Author)
W86-03391

DYNAMICS OF LEAF PROCESSING IN A MEDIUM-SIZED RIVER,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. W. Paul, E. F. Benfield, and J. Cairns.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983. p 402-423, 3 fig, 3 tab, 58 ref. CNE-(40-1)-4939.

Descriptors: *Aquatic environment, *Lotic environment, *Microbial studies, Particulate organic matter, Detritus, Litter, Particulate matter, New River, Virginia, Cycling nutrients.

Leaf processing in the middle reaches of the New River, Virginia, proceeds at rates equivalent to those reported for small streams. The initial stages of New River leaf processing are mediated by microorganisms and enhanced by mechanical fragmentation, but macroinvertebrates important in initial leaf processing in small streams are unimportant in the section of New River studied. Sycamore(Platanus occidentalis) leaves decomposed at a significantly slower rate than did those of box elder(Acer negundo). Differences in processing rates were caused by differences in initial proportions and distributions of leaf chemical constituents and the rapidity of chemical constituent loss during incubation. Microbial numbers were greater and microbial activity higher on box elder leaves in comparison with sycamore; this was probably because the faster decomposing leaves were favored as a nutritional substrate. Seasonal reductions in chemical constituent losses, microbial activity, and processing rates occurred during winter. In spring, leaf chemical losses, microbial activity, and processing rates gradually increased; this suggests that seasonal temperature regulated all processing mechanisms studied. (Author)
W86-03393

ROLE OF SHREDDERS IN DETRITAL DYNAMICS OF PERMANENT AND TEMPORARY STREAMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. M. Kirby, J. R. Webster, and E. F. Benfield.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983, 425-435 p, 4 fig, 2 tab, 3 ref.

Descriptors: *Aquatic environment, *Lotic environment, *Microbial studies, Invertebrates, Particulate organic matter, Detritus, Litter, Particulate matter, Guys Run, Virginia.

Leaves form the major trophic base of many streams, especially small headwater streams draining forested watersheds in the eastern deciduous forest of North America. Leaves entering these streams are broken down by a combination of physical, chemical, and biological factors, including mechanical breakage, leaching of water-soluble compounds, microbial decomposition, and invertebrate feeding. The concern of this report is the importance of invertebrate feeding on leaf breakdown rates and generation of small particles of detritus. It has been suggested that leaf-shredding insects have an important role in breakdown of leaf detritus and the production of particulate organic matter (POM) in streams. This role was evaluated by comparing detrital dynamics in three permanent and three temporary tributaries of Guys Run, Rockbridge County, Virginia. In general, the streams with fastest leaf breakdown, highest low-flow POM concentrations, and largest average POM particulate sizes were found to have the greatest shredder and total insect densities. It was concluded that this is further evidence for the importance of shredders in woodland streams.
W86-03394

MICROBIAL ACTION IN DETRITAL LEAF PROCESSING AND THE EFFECTS OF CHEMICAL PERTURBATION,

Columbia National Fisheries Research Lab., MO.
J. F. Fairchild, T. P. Boyle, E. Robinson-Wilson, and J. R. Jones.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983, 437-456 p, 11 fig, 27 ref.

Descriptors: *Aquatic environment, *Lotic environment, *Microbial studies, Detritus, Cycling nutrients, Organic carbon, Aquatic communities, Sodium penta-chlorophenol, Adenosine triphosphate, Lipid synthesis, Electron microscopy.

A laboratory study was conducted to determine the effects of microbial action on detrital leaf processing and to quantify the effects of an anti-microbial agent on our microbial functions. Preleached disks from leaves of Acer saccharum were incubated in flasks of stream water on a rotary shaker at 20 degree C for 56 days. Treatments consisted of a control, killed control, and 1.0 and 10.0 mg/l sodium pentachlorophenol(PCL). Leaf disks were periodically measured for changes in dry weight, ash weight, ash-free dry weight(AFDW), and nitrogen. Microbial measurements included respiration, adenosine triphosphate, and 14C acetate incorporation in lipids. Changes in AFDW of leaf disks in the control indicated that microbes processed 21% of leaf material during the 56-day study. The PCP treatments did not differ significantly from the control in loss of AFDW from leaf disks. Significant differences were noted among several microbial characteristics, however, this possibly indicates structural differences caused by the PCP treatments. Chemical perturbation could alter the structure of microbial communities and therefore adversely affect leaf processing, invertebrate productivity, and fishery resources. (Author)
W86-03395

CHARACTERIZATION OF THE KINETICS OF 'DENITRIFICATION' IN STREAM SEDIMENTS,

Guelph Univ. (Ontario).
W. N. Stammers, J. B. Robinson, H. R. Whiteley, and N. K. Kaushik.
IN: Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI. 1983, 479-486 p, 2 fig, 1 tab, 7 ref.

Descriptors: *Kinetics of denitrification, *Denitrification, Sediments, Nitrogen removal, Model studies, Nitrates, Sinks.

Inferences have been drawn from experiments, involving sediment columns with supernatant nitrate solutions, on the kinetic nature of the denitrification process which occurs in stream sediments. Work reported in this paper examines the utility of continuous and lumped models of nitrate transport as bases for the investigation of both transient and steady-state responses to pulse and constant supernatant nitrate solutions input concentrations to sediment columns. The measured system output was supernatant nitrate concentration in the case of the pulse input and nitrate flux into the sediment in the case of the constant supernatant nitrate solution concentration. The transient response in all cases was found to be inappropriate for the investigation of denitrification process kinetics. However, the steady-state response to a constant supernatant nitrate solution concentration was found appropriate for testing hypotheses about process kinetics using both lumped and continuous transport models. Results indicate that the denitrification process may be kinetically described as a zero-order process. (Author)
W86-03397

KILLING RAIN: THE GLOBAL THREAT OF ACID PRECIPITATION,

For primary bibliographic entry see Field 5B.
W86-03416

5D. Waste Treatment Processes

DISSOLVED-OXYGEN REGIME OF THE JORDAN RIVER, SALT LAKE COUNTY, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03011

WASTEWATER AND SLUDGE CONTROL-TECHNOLOGY OPTIONS FOR SYNFUELS INDUSTRIES; VOL. 2: TAR-SAND-COMBUSTION PROCESS WATER -- REMOVAL OF ORGANIC CONSTITUENTS BY ACTIVATED-SLUDGE TREATMENT,

Argonne National Lab., IL. Energy and Environmental Systems Div.
M. F. Torpy, L. A. Raphaelian, and R. G. Luthy.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-017656, Price codes: A04 in paper copy, A01 in microfiche. ANL/ES-115, Vol. 2, November 1981. 53 p, 8 fig, 12 tab, 23 ref, 3 append. W-31-109-Eng-38.

Descriptors: *Wastewater treatment, *Wastewater analysis, Activated sludge, Chemical oxygen demand, Oxygen demand, Wastewater, Chemical sludge, Sludge, Organic carbon.

Gas-chromatography/mass spectrometry analysis of raw process water from reverse-forward combustion in a tar sand extraction experiment indicated that identifiable compounds were distributed in about equal portions among acid, base, and neutral fractions. The compounds in the neutral fraction were unsaturated, oxygenated methyl cyclohexenyl ketones, methyl-methylcyclohexenyl ketones, acetophenones including methyl-tolyl ketones, lactones, and indanones. Neutral fraction constituents were reduced by about 99% during activated-sludge treatment. The base fraction consisted of pyridines, quinolines and their alkane substitutes, and acridines. These compounds were reduced by about 76% during treatment. The acid fraction consisted of carboxylic acids ranging in molecular weight from C1 to C11, phenols and cresols, and benzoic and toluic acids. These materials were reduced by about 95% through activated-sludge treatment. It was concluded that (1) activated-sludge treatment can reduce soluble organic carbon and chemical oxygen demand by about

90% in the process water and (2) the water is nonmutagenic as defined by the standard Salmonella/Ames test. (Author)
W86-03232

REMOVAL OF TOXIC METALS IN ELECTROPLATING WASH WATER BY A DONNAN DIALYSIS PROCESS,

Southwest Research Inst., San Antonio, TX.
H. F. Hamil.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-148155, Price codes: A03 in paper copy, A01 in microfiche. EPA-600/2-82-098, December 1982. 31 p, 2 fig, 12 tab, 7 ref, 1 append. CR807476.

Descriptors: *Seperation techniques, *Donnan process, *Heavy metals, *Industrial wastewater, *Electroplating, *Anion exchange, Cadmium, Copper, Zinc, *Ion exchange, Wastewater treatment, *Membrane processes, Anions, Metal-finishing wastes, Metals, Cyanide, *Dialysis.

A program was conducted to develop anion-exchange membranes to be used in the removal of Cu, Cd, and Zn, as their cyanide anions, from cyanide process electroplating wash waters by a Donnan dialysis process. For these laboratory studies, simulated wash waters prepared by diluting electroplating bath solutions to the desired metal content were utilized. Series of anion-exchange membranes based on radiation grafted polyethylene films were prepared. The grafting monomers used were vinylpyridines or vinylbenzylchloride. These grafted membranes were converted to anion-exchange membranes by quaternization with alkyl halides or trialkylamines, respectively. The series of membranes exhibited varying ion-exchange capacities and varying hydrophilicity. Evaluation of the membranes in Donnan dialysis showed that ion transport rates are directly proportional to ion-exchange capacity. Previous studies have shown that the effect of membrane hydrophilicity is more complex; very low hydrophilicity leads to zero ion transport. Moderate hydrophilicity gives membranes with good transport properties. Very high hydrophilicity leads to membranes with very low ion selectivity. Cation leakage becomes excessive and reduces the potential for anion selective transport. (Author)
W86-03239

REVISED SECTION 301 (H) TECHNICAL SUPPORT DOCUMENT,

Tetra Tech, Inc., Bellevue, WA.
For primary bibliographic entry see Field 6E.
W86-03259

MONITORING AND ANALYSIS OF HAZARDOUS ORGANICS IN MUNICIPAL WASTEWATER - A STUDY OF TWENTY-FIVE TREATMENT PLANTS,

Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W86-03262

BENCH-SCALE TREATMENT OF COAL LIQUEFACTION PROCESS WASTEWATERS,

Oak Ridge National Lab., TN.
W. D. Bostick, R. L. Jolley, J. D. Hewitt, and J. B. Overton.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83000468, Price codes: A03 in paper copy, A01 in microfiche. ORNL/TM-8408, September 1982, 45 p, 7 fig, 11 tab, 31 ref, 2 append.

Descriptors: *Wastewater treatment, *Coal liquefication process, Chemical composition, Chemical treatment, Solvent extraction, Ozonation water treatment, Adsorption, Activated carbon.

Coal conversion wastewaters present unusual control technology problems due to their high concentrations of certain toxic chemicals such as phenolics, ammonia, and sulfide ion. The most contaminated wastewater streams are the process condensates or sourwaters that have been in direct contact with organic species at high temperature during the conversion process. Treatment of these process condensates to meet present and projected discharge limits is thus a formidable challenge. The specific effects of the bench-scale treatment of a sample of process condensate from the H-coal liquification process pilot plant located at Catlettsburg, Kentucky, are presented. The unit operations used were: stream-stripping to remove ammonia and sulfide ion; solvent-extraction with methyl isobutyl ketone to remove phenolic compounds and neutral organics; and ozonation and carbon adsorption as 'polishing' steps. Some of the advantages and limitations of these operations are reported. (Halterman-PTT)
W86-03267

WASTEWATER APPLICATIONS IN FOREST ECOSYSTEMS,

Cold Regions Research and Engineering Lab., Hanover, NH.
H. L. McKim, W. E. Supper, D. Cole, W. Nutter, and D. Urie.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A119994, Price codes: A02 in paper copy, A01 in microfiche. CRREL Report 82-19. August 1982. 22 p, 9 fig, 19 tab, 39 ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Forests, Chlorination, Buffer zones, Bioaccumulation, *Land disposal, Trees.

The purpose of this report is to summarize the current state of knowledge relating to the application of municipal wastewater in forest ecosystems and to assist in the design of such systems. This report will supplement the Process Design Manual for Land Treatment of Municipal Wastes, EM 1110-1-501. The data in this report covers three forest regions 1)Western forest ecosystems (Douglas fir, Poplar), 2)Eastern forest systems (mixed hardwoods, red pine, white spruce and others), and 3)Southern yellow pine ecosystems. Necessary pretreatment is minimal; Chlorination should be avoided as residual chlorine and chlorinated organics reduce the ability of the trees to assimilate nutrients. Narrower buffer zones are needed due to lower sprinkler pressures, the generally confined areal distribution in forests, and the physical barrier provided by the trees. Wastewater application to immature, but not mature, trees significantly increases the diameter and height of the trees.
W86-03295

TREATMENT TECHNOLOGY FOR REMOVAL OF DISSOLVED GASOLINE COMPONENTS FROM GROUND WATER,

IT Corp., Knoxville, TN.
Final Report, Vol 1, D87-API, American Petroleum Institute, Washington, DC, May 13, 1983. 201 p, 10 fig, 6 tab, 5 app, 5 ref.

Descriptors: *Water treatment, *Activated carbon, *Air stripping, *Gasoline, Benzene, Toluene, Xylene, Ethylbenzene, Methyl t-butyl ether, t-Butyl alcohol, Groundwater, Organic compounds, Cost, Oil industry.

Laboratory evaluations of activated carbon adsorption and air stripping of groundwater containing dissolved gasoline were conducted to identify optimum design conditions. These were then used to develop capital and operating cost estimates for full-scale treatment systems. Activated carbon adsorption was evaluated in the laboratory in a 1-in. diameter miniplant column and a 1/4-in. diameter microcolumn. The activated carbon adsorption technology was very effective in removing the aromatic compounds from water (e.g., benzene, toluene, xylene, ethylbenzene), but was relatively ineffective in removing the oxygenates. A hydraulic loading of 2 gpm/sq. ft. resulted in slightly better carbon loading performance than 7 gpm/sq. ft. and 6 ft. of carbon provided a better staging efficiency and superior column performance than 3 ft. A curve of loading capacity vs feed concentration was generated based on the experimental results. Air stripping was evaluated in the laboratory using a 1 1/2-in. diameter column packed with 1/4-in. berl saddles. The air stripping technology was very effective in removing all compounds from the water except t-Butylalcohol. Remove efficiency did not appear to be a function of either composition of influent concentration over the range investigated. Increasing air/water ratio improved removal efficiency and lower water temperature resulted in decreased removal efficiencies. At relatively low contaminant concentrations (<10 ppm), carbon adsorption and air stripping are comparable in treatment cost; but as concentration increases, air stripping gains a cost advantage.
W86-03311

PRETREATMENT AND BIOLOGICAL DIGESTION OF METC (MORGANTOWN ENERGY TECHNOLOGY CENTER) STIRRED FIXED BED GAS PRODUCER WASTEWATERS,

Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. D. Neufeld, C. Moretti, F. Ali, and J. Paladino.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-004748, Price codes: A08 in paper copy, A01 in microfiche. Final Report, Dept. of Energy, Morgantown, WV. Morgantown Technology Center. September 30, 1981. 173 p, 24 fig, 14 tab, 4 app, 24 ref. DE/AC2180MC14372.

Descriptors: *Coal gasification, *Ammonia stripping, *Biological treatment, *Activated sludge, Water, Pollution control, Gasification, Ozonation, Phenols, Sludges, Bulking sludge, Flocculation.

Wastewater was pretreated by a series of operations which included one stage cold or two stage hot ammonia stripping, pH adjustment followed by chemical coagulation and flocculation, and aerobic biological processing at 1 day detention time. The overall objective of research was to document and demonstrate the capabilities of a properly designed aerobic biological system for the stable treatment of fixed bed gas producer wastewaters. A comprehensive flow sheet design based upon laboratory derived parameters is included for the treatment of gas producer wastewaters. For tertiary treatment, preliminary data is presented on the ozonation of pretreated and biologically treated gasifier wastewaters both with and without the use of activated carbon. Preliminary chemical data is also presented from gas chromatography/mass spectroscopy determinations of acid and base extractable portions of wastewaters at various sampling locations within the pretreatment and biological treatment scheme. When the feed strength of the gasifier wastewater was >30%, several problems occurred. The oxygen supply was depleted in the laboratory sized facility, and foaming, bulking sludge and sludge deflocculation were problems in the pilot facility. Foaming could be prevented by a combination of continuous feeding of an anti-foaming agent and by making sure that the ammonia-stripping gave an influent ammonia concentration of 200 mg/L. A combintion of alum and lower strength wastewater curtailed filamentous bacteria growth, thereby inhibiting bulking sludge. Sludge deflocculation is the major limiting criterion in minimalization of dilution water, and is controlled by carefully controlling the concentration of nonbiodegradable materials in the influent stream.
W86-03318

5E. Ultimate Disposal Of Wastes

WASTEWATER APPLICATION BY SPRAY IRRIGATION ON A FIELD SOUTHEAST OF TALLAHASSEE, FLORIDA: EFFECTS ON GROUND-WATER QUALITY AND QUANTITY, 1980-82,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02929

RECONNAISSANCE OF WATER QUALITY AT A U.S. DEPARTMENT OF ENERGY SITE, PINELLAS COUNTY, FLORIDA,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02930

DESCRIPTION OF AQUIFER UNITS IN WESTERN OREGON,

Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02950

CONCEPTUAL HYDROLOGIC MODEL OF FLOW IN THE UNSATURATED ZONE, YUCCA MOUNTAIN, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02974

DESCRIPTION AND SOME HYDROGEOLOGIC IMPLICATIONS OF CORES FROM THE RADIOACTIVE WASTE MANAGEMENT COMPLEX, IDAHO,

Geological Survey, Denver, CO. Water Resources Div.
C. T. Rightmire.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4071, 1984. 51 p, 14 fig, 8 tab, 9 ref.

Descriptors: *Core analyses, *Radioactive waste burial ground, *Idaho, *Petrographic analyses, Interbedded sedimentary units, Fracture filling, Radioactive Waste Management Complex, Idaho National Engineering Laboratory, *Hydrogeology.

Samples of sedimentary material from interbeds between basalt flows and from fractures in the flows, taken from two drill cores at the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory were analyzed for (1) particle-size dribution, (2) bulk mineralogy, (3) clay mineralogy, (4) cation-exchange capacity, and (5) carbonate content. Thin sections of selected sediment material were made for petrographic examination. Preliminary interpretations indicate that (1) it may be possible to distinguish the various sediment interbeds on the basis of their mineralogy, (2) the presence of carbonate horizons in sedimentary interbeds may be utilized to approximate the time of exposure and the climate while the surface was exposed (which affected the hydrogeologic character of the sediment), and the type and orientation of fracture-filling material may be utilized to determine the mechanism by which fractures were filled. (USGS)
W86-02999

WATER-QUALITY DATA FOR 34 SITES, APRIL AND JUNE, 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03048

MEASUREMENT OF GROUND-WATER VELOCITY USING RHODAMINE WT DYE NEAR SHEFFIELD, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03051

REVIEW OF BURIED CRYSTALLINE ROCKS OF EASTERN STATES IN SELECTED HYDROGEOLOGIC ENVIRONMENTS POTENTIALLY SUITABLE FOR ISOLATING HIGH-LEVEL RADIOACTIVE WASTES,

Geological Survey, Louisville, KY. Water Resources Div.
R. W. Davis.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4091, 1984. 20 p, 6 fig, 34 ref.

Descriptors: *Radioactive waste disposal, *Nuclear wastes, *Saline water, Groundwater barriers, Crystalline rocks, *Cincinnati Arch Area, *North Carolina, Eastern US, Atlantic Coastal Plain.

Among the concepts suggested for the deep disposal of high-level radioactive wastes from nuclear power reactors is the excavation of a repository in suitable crystalline rocks overlain by a thick sequence of sedimentary strata in a hydrogeologic environment that would effectively impede waste transport. To determine the occurrence of such environments in the Eastern United States, a review was made of available sources of published or unpublished information, using the following hydrogeologic criteria: (1) the top of the crystalline basement rock is 1,000 to 4,000 feet below land surface; (2) the crystalline rock is overlain by sedimentary rock whose lowermost part, at least, contains groundwater with a dissolved-solids concentration of 10,000 milligrams per liter or more; (3) shale and or clay confining beds overlie the saline-water aquifer; and (4) the flow system in the saline-water aquifer is known or determinable from presently available data. All of these hydrogeologic conditions occur in two general areas: (1) parts of Indiana, Ohio, and Kentucky, underlain by part of the geologic structure known as the Cincinnati arch, and (2) parts of the Atlantic Coastal Plain from Georgia to New Jersey. (USGS)
W86-03127

REPORT ON LONG ISLAND SOUND DREDGED MATERIAL CONTAINMENT STUDY WORKSHOP PROJECT,

Long Island Sound Task Force, Stamford, CT.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-122607, Price codes: A07 in paper copy, A01 in microfiche. Final Report, Workshop Digest, 18-21 May 1981. 141 p, 1 append. DACW3381-M-0479.

Descriptors: *Dredging, *Ocean dumping, Ecosystems, Aquatic environment, Environment, Aquatic habitats, Marine environment, Marine sediments, Legal aspects, Legislation.

A compilation of papers from four public workshops on disposal of dredged materials in coastal containment facilities in the Long Island Sound, is presented. Major categories of information include: summaries of workshops held in New London, New Haven, and Stamford, Connecticut, and in Great Neck, New York; official statements and written communications from area legislators; composite narrative accounts of the workshops; a compilation of unresolved issues; a public information program; and media coverage generated by the workshop project. (Halterman-PTT)
W86-03270

SLUDGE - RECYCLING FOR AGRICULTURAL USE,

Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-164202, Price codes: A02 in paper copy, A01 in microfiche. 430-9-82-008, October 1982. 17 p.

Descriptors: *Sludge utilization, *Land disposal, *Land application, *Recycling, *Sludge disposal, Sludge digestion, Digested sludge, Sludge conditioning, Fertilizers, Municipal wastes, Solid waste disposal, Waste disposal, Soil amendments.

This brochure was prepared as one of a series of reports to supply data on current practices that are emphasized by the Clean Water Act involving the utilization and recycling of municipal effluents and sludges. It provides insight into how several communities have successfully developed sludge management programs that involved the recycling of municipal sludge for agricultural use. Sludge is the residue of materials removed from wastewater treatment that was traditionally disposed of by ocean dumping, landfilling, or incineration. The benefits of recycling municipal sludges for agricultural use are extensive. Sludge stabilization is essential before land disposal to achieve destruction of pathogens. Public education programs are also needed to assure community acceptance of sludge disposal practices. In Salem, Oregon, sludge disposal is handled through the BIOGRO Program in which sludge is applied as fertilizer to agricultural lands. In Madison, Wisconsin, stabilized sludge is applied to farmland under the METROGRO Program. In Rickmansworth, Great Britain, sludge is marketed to farmers under the name of HYDIG. In Los Angeles County, California, sludge solids are composted after stabilization by digestion, and the compost thus produced is sold to a local fertilizer company that further processes the material through screening and blending. The operating and performance features of sludge reuse and the future prospects for sludge recycling programs are discussed. (Geiger-PTT)
W86-03275

SELECTED HYDROLOGIC AND GEOCHEMICAL ISSUES IN SITE CHARACTERIZATION FOR NUCLEAR WASTE DISPOSAL: FLOOD BASALTS AT THE HANFORD RESERVATION,

California Univ., Berkeley. Lawrence Berkeley Lab.
C. L. Carnahan, J. M. Delany, J. C. S. Long, R. J. Silva, and D. J. Watkins.
Available from the National Technical Information Service, Springfield, VA 22161 as NUREG/CR-2983, Price codes: A08 in paper copy, A01 in microfiche. NUREG/CR-2983, LBL-15029, January 1983. 165 p, 22 fig, 2 tab, 130 ref, 4 append.

Descriptors: *Groundwater pollution, *Fate of pollutants, *Radioactive waste disposal, *Basalts, *Waste management, Groundwater movement, Numerical analysis, Models, Model studies, Mathematical models, Mathematical studies, Evaluation, Geochemistry, Waste dumps, Site selection, Radioactive wastes.

Four issues are considered that must be addressed by a site characterization program designed to evaluate the suitability of the flood basalts of the Pasco Basin in central Washington as a site for the construction of a repository for the disposal of high-level nuclear waste. The four issues are: identification of hydrostratigraphic units within a sequence of flood basalts, mechanisms and points of groundwater recharge and discharge, solubility of radionuclides, and phase transformation of fracture filling materials. Each issue is discussed in terms of its significance to waste isolation. Available approaches for resolving the issues are presented and their limitations identified. Where appropriate, research programs for overcoming these limitations are indicated. Basic data needed for identifying areas and mechanisms of groundwater recharge and discharge include bedrock geometry, hydraulic properties, initial conditions, and boundary conditions. Standard approaches used to acquire data include water budget, numerical analysis, and direct synthesis techniques. The identities and solubilities of compounds formed by radionuclides will depend on the oxidation states of the radionuclides, the redox properties of the groundwater and surrounding rock, and the nature and concentration of precipitating ions and complexing ligands in the groundwater system. A complete chemical characterization of down-hole samples of groundwater is necessary to detect radionuclide contaminants in groundwater. (Geiger-PTT)
W86-03282

COSTS OF ENVIRONMENTAL QUALITY TO THE WATER INDUSTRY,

Thames Water Authority, London (England).
W. R. Harper, and J. Moss.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd., Chichester, England, 1984. p 258-266, 8 ref.

Descriptors: *Environmental protection, *Drinking water, Potable water, Sewage sludge, Sewage treatment, Water quality standards, Hazards, Wastewater facilities, Environmental quality.

The costs associated with water related environmental quality is an important issue for those groups thus involved. The purpose of this paper is to identify costs to the water industry associated with water-related environmental quality, and to examine the recent economic background against which these costs have been incurred. Various aspects of possible chances in cost patterns are also discussed. Some costs associated with water qual-

ity-related activities, including improvement of potable supply rivers, estuarial waters and beaches, totaled 681.9 million pounds in 1982/1983. Future cost changes are predicted to arise from three main influences: the increasing recognition of the need for conservation of resources, sustained pressure to secure improved efficiency and effectiveness in public authority spending, and, finally, increasing stringency in externally imposed environmental quality standards. (Halterman-PTT)
W86-03360

5F. Water Treatment and Quality Alteration

QUALITY OF GROUND WATER USED FOR PUBLIC SUPPLY IN FLORIDA, 1983-84,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-02986

TOXIC SUBSTANCES IN SURFACE WATERS OF THE B. EVERETT JORDAN LAKE WATERSHED.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5B.
W86-03132

REMOVAL OF VOLATILE ORGANIC CONTAMINANTS FROM GROUND WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
G. G. Robeck, and O. T. Love.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-168617, Price codes: A02 in paper copy, A01 in microfiche. EPA-600/D-83-011, February 1983. 20 p, 7 fig, 1 tab, 30 ref.

Descriptors: *Aeration, *Organic compounds, *Groundwater pollution, *Activated carbon, *Adsorption, Water quality control, Water pollution control, Organic solvents, Filtration, Oxidation, Ozonation, Chlorination, Coagulation, Corrosion, Water treatment.

Because groundwater is a source of potable water for millions of people, an ecological means of removing volatile organic contaminants in essential. Laboratory, pilot-scale and full-scale studies are being carried out in the United States to determine the effect of various treatment processes on the removal of volatile organics from groundwater. To choose the most cost-effective treatment scheme, the organic quality of the raw water must be thoroughly characterized, the organic quality of the treated water must be decided, and the solution must not substitute the organic problem for microbiological or inorganic deterioration, or increased corrosion potential in the distribution system. Coagulation, sedimentation, precipitative softening, filtration, and chlorination are ineffective for reducing concentrations of trichloroethylene and related industrial solvents. Aeration, adsorption on granular activated carbon, or a combination of these processes are being used to remove volatile organic contaminants from groundwater. Preliminary findings using diffused-air, packed-tower, redwood slat, and spray aerators, and air lift pumps are discussed. Home treatment adsorption units are being studied for use in emergency situations or in area where a central treatment system is not feasible. Packed tower aeration is the least expensive alternative for the removal of volatile organic compounds. Aerator exhaust may have to be controlled by passage through an adsorbent. (Geiger-PTT)
W86-03254

EVALUATION OF THE ADSORPTION PROPERTIES OF SILICALITE FOR POTENTIAL APPLICATION TO ISOLATING POLAR LOW-MOLECULAR-WEIGHT ORGANICS FROM DRINKING WATER,
Ames Lab., IA.
C. D. Chriswell, D. T. Gjerde, G. Shultz-Sibbel, J. S. Fritz, and I. Ogawa.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-149502, Price codes: A02 in paper copy, A01 in microfiche. EPA-600/1-83-001, January 1983, 23 p, 1 fig, 7 tab, 14 ref.

Descriptors: *Organic compounds, *Drinking water, *Separation techniques, *Pollutant identification, *Adsorbents, Water analysis, Adsorption, Reverse osmosis.

Because of their high affinity for water, low-molecular weight polar organic compounds are difficult to isolate from drinking water as a prelude to their identification and determination. Conventional isolation techniques such as solvent extraction, absorption, gas purging and reverse osmosis yield only low recoveries when applied to small molecules with water-like chemical and physical properties. In this work the chemical and physical properties of the adsorbent known as Silicalite were explored, the characteristics of the molecular sieve for accumulating analytes from aqueous and from gaseous streams were elucidated, techniques were developed for recovering absorbed organic materials from the molecular sieve adsorbent, and an analytical protocol was developed for determining low-molecular weight analytes such as dichloroacetonitrile in standard samples. Accumulated organic materials were recovered from the molecular sieve by a simple, convenient and effective elution technique using a water-methanol gradient as the eluent. When adsorption and recovery procedures were combined to form an isolation protocol, it was found that compounds as diverse as phenol, acetic acid, ethyl acetate, chloroform, crotonaldehyde, propanal, acetaldehyde and butanol could be recovered from standard solutions in amounts in excess of 80% of the original concentration. When the procedure was optimized for the determination of dichloroacetonitrile, quantitative recoveries were obtained on standard samples. (Author)
W86-03266

KINETIC MODEL FOR THE CHLORINATION OF POWER PLANT COOLING WATERS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. D. Johnson, and R. G. Qualls.
Available from the National Technical Information Service, Springfield, VA 22161 as NUREG/CR-2806, Price codes: A05 in paper copy, A01 in microfiche. NUREG/CR-2806, January 1983. 83 p, 31 fig, 8 tab, 50 ref, 2 append. NRC-04-77-119.

Descriptors: *Cooling water, *Chlorination, *Residual chlorine, *Kinetics, *Water quality control, Powerplants, Condensers, Fouling, Chlorine, Models, Model studies, Humic acids, Fulvic acids, Organic acids, Models, Water treatment.

Kinetic expressions for the short term reactions of chlorine consumption by organic substances in natural freshwater were developed to use in a kinetic model to predict the free and total available chlorine discharged in cooling water from powerplant condensers. This model uses commonly available water quality data and assumes that most of the chlorine consuming substances are NH3, chloramine-forming organics-N, and humic substances. It uses the Morris-Wei model of chlorine-ammonia reactions. Chloramine formation from organic-N was represented by glycylglycine. About 10% of the dissolved organic-N formed chloramines in the river water samples. Isolated fulvic acid was used to model the kinetics of chlorine consumption by humic substances. The humic reactions were adequately described by the sum of two second order reactions. Concentrations of fulvic acid reaction sites were related to fulvic acid C concentration. Rates of chlorine consumption by fulvic acids from three diverse water sources were similar showing the general applicability of the model. Simulations of chlorine consumption in several river water samples matched the measured data reasonably well. Using conditions typical of once-through chlorination, the most important reactions consuming free residual chlorine were NH2Cl formation, and consumption by humic substances in those samples. Most total residual chlorine reduction was caused by humic substances. (Geiger-PTT)
W86-03283

PERFORMANCE CHARACTERISTICS OF PACKAGE WATER TREATMENT PLANTS,
Cincinnati Univ., OH.
J. M. Morand, and M. J. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-161018, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/2-82-101, December 1982. 73 p, 14 fig, 24 tab, 18 ref. CR806449.

Descriptors: *Water quality, *Performance evaluation, *Water treatment facilities, *Water analysis, *Water quality standards, Water treatment, Turbidity, Coliforms, Residual chlorine, Organic compounds, Drinking water, Potable water, Pollutant identification.

This study was undertaken to collect reliable on site information on the quality of treated water produced by package plants. Six plants in operation year round were selected to be representation of those serving small populations, and were monitored to assess their performance. Plants selected used surface water sources. Sampling trips were made over a 2 yr period. At each plant, samples were collected of the raw water, the treated water, and water from the distribution system. Turbidity, total coliform, and chlorine residual data were collected on all visits. Standard plate counts, chemical listed in the US EPA Drinking Water Regulations, and trihalomethanes were determined intermittently. Only one treated water sample, a distribution sample, showed any total coliforms. Sixty-eight percent of the treated water standard plate counts showed densities of 10 or less per milliliter. Three of the plants met the 1 ntu turbidity standard on nearly all occasions. The other three plants were meeting the standard during less than half of the sampling trips. Failure of these plants to perform well is attributed to the variability and quality of their sources and/or to the lack of skilled operators having sufficient time to devote to treatment. (Author)
W86-03285

COSTS OF ENVIRONMENTAL QUALITY TO THE WATER INDUSTRY,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5E.
W86-03360

5G. Water Quality Control

ESTIMATED PUBLIC-WATER SUPPLY AND INDUSTRIAL-COMMERCIAL WATER WITHDRAWALS AND RETURNS IN NASSAU COUNTY, LONG ISLAND, NEW YORK, 1973-79,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 6D.
W86-02957

DETERMINING THE EFFECTIVENESS OF HIGHWAY DRAINAGE SYSTEMS IN PREVENTING SALT CONTAMINATION OF GROUND WATER,
Geological Survey, Boston, MA. Water Resources Div.
S. J. Pollock.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4166, 1984. 22 p, 10 fig, 1 tab, 6 ref.

Descriptors: *Highway effects, *Environmental effects, *Snow removal, *Salts, Groundwater recharge, Highway icing, Road design, Salt balance, Water quality, Groundwater aquifers, Groundwater movement, Hydrogeology, *Massachusetts, Plymouth, Bourne, Wareham, *Water pollution sources.

A study to determine the relative effectiveness of specially designed highway drainage features in preventing salt contamination of ground water was

designed to compare four different drainage designs along a new highway in Massachusetts. At the control site, no attempt will be made to prevent salt from entering the ground. At the other three sites, different combinations of drains and impermeable berms have been designed to prevent salt contamination of ground water. To evaluate the effectiveness of the drainage designs, a salt balance will be prepared at each site over 5 years of highway use. The amount of salt applied to the highway will be compared to the amounts in the ground water or diverted to the drainage systems. Salt loads in ground water will be determined from sodium and chloride concentrations in water from about 80 wells and from aquifer porosity estimated from geophysical logs and lithologic samples. Salt loads in the drainage systems will be estimated from flow and specific conductance with the use of stage-to-discharge and conductance-to-concentrations rating curves. (USGS)
W86-03044

GEOHYDROLOGY OF TEST WELL USW-H1, YUCCA MOUNTAIN, NYE COUNTY, NEVADA,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03121

REVIEW OF BURIED CRYSTALLINE ROCKS OF EASTERN STATES IN SELECTED HYDROGEOLOGIC ENVIRONMENTS POTENTIALLY SUITABLE FOR ISOLATING HIGH-LEVEL RADIOACTIVE WASTES,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5E.
W86-03127

TRIORGANOTIN REGULATIONS IN NORTH CAROLINA.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
Water Quality Section Report, (July 1985). 119 p.

Descriptors: *Water pollution control, *Water quality standards, *North Carolina, *Triorganotin compounds.

A compilation of submittals and staff responses to proposals to establish water quality standards for triorganotins in fresh and saltwater in North Carolina. Portions of a public hearing held on June 27, 1984, are included. Also included are calculations for the numeric water quality standards for triorganotin compounds (0.002 microgram/l in saltwater and 0.008 microgram/l in freshwater). Those values are the first water quality standards for triorganotins and are designed to protect aquatic life from chronic effects of these compounds.
W86-03131

COASTAL DEVELOPMENT AND SHELLFISH WATERS,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5B.
W86-03133

WATER QUALITY CRITERIA FOR PRIMARY NURSERY AREAS IN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5C.
W86-03134

REMOVAL OF VOLATILE ORGANIC CONTAMINANTS FROM GROUND WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W86-03254

RECLAMATION OF ABANDONED MINED LANDS ALONG THE UPPER ILLINOIS WATERWAY USING DREDGED MATERIAL,
Argonne National Lab., IL. Energy and Environmental Systems Div.
A. Van Luik, and W. Harrison.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-015024, Price codes: A06 in paper copy, A01 in microfiche. ANL/ES-127, January 1982. 103 p, 17 fig, 22 tab, 27 ref, 1 append.

Descriptors: *Dredging, *Land reclamation, Sediments, *Illinois, Seneca River, Heavy metals, Metals, Pollutants, Legal aspects, Polychlorinated biphenyls.

Sediments were sampled and characterized from 28 actual or proposed maintenance-dredging locations in the Upper Illinois Waterway, that is, the Calumet-Sag Channel, the Des Plaines River downstream of its confluence with the Calumet-Sag Channel, and the Illinois River from the confluence of the Kankakee and Des Plaines Rivers to Havana, Illinois. Sufficient data on chemical constituents and physical properties were obtained to allow the classification of these sediments by currently applicable criteria of the Illinois Environmental Protection Agency for the identification of hazardous, persisted and potentially hazardous wastes. By these criteria, the potential dredged materials studied were not hazardous, persistent, or potentially hazardous; they are a suitable topsoil/reclamation medium. A study of problem abandoned surface-mined land sites ('problem' lands are defined as being acidic and/or sparsely vegetated) along the Illinois River showed that three sites were particularly well suited to the needs of the Corps of Engineers for a dredged material disposal/reclamation site. Reclamation disposal was found to be economically competitive as an alternative to near-source confined disposal for Upper Illinois Waterway dredged material. (Author)
W86-03280

KINETIC MODEL FOR THE CHLORINATION OF POWER PLANT COOLING WATERS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W86-03283

ENVIRONMENTAL PROTECTION: STANDARDS, COMPLIANCE AND COSTS,
For primary bibliographic entry see Field 5B.
W86-03344

POLLUTION CONTROL IN PRACTICE,
North West Water Authority, Warrington (England).
B. Alexander, and E. Harper.
IN: Enviromental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 198-208 p, 7 ref, 2 append.

Descriptors: *Aquatic enviroment, *Environmental protection, Environmental management, Standards, Environmental effects, Europe, United Kingdom, Toxicity, Hazards, Monitoring.

This paper deals with pollution controls as they relate to river pollution where issues such as recreation and amenity are important. It is principally concerned with the practice of pollution control and is, therefore, concerned with how to achieve results in the field. Several elements of successful pollution control that are listed, include identification of the problem, outlining the control option, deciding upon the preferred solution to the problem, and, finally, implementing the preferred solution. Enforcement of criteria includes fines and imprisonment. However, it is pointed out that the best control is actually the prevention of pollution, and several prevention related policies are discussed. The effectiveness of pollution control can best be determined by chemical and biological monitoring of aquatic environments. Although both chemical and biological monitoring techniques are approriate, biological monitoring is the better tool for seeking to prevent pollution. (Halterman-PTT)
W86-03356

SPILLAGES-AN OPERATIONAL APPROACH,
Wessex Water Authority, Bristol (England).
J. A. Young, and R. J. Whitaker.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 209-218 p, 2 fig, 3 ref.

Descriptors: *Aquatic environment, *Environmental protection, Accidents, Hazards, Monitoring, Transportation, Oil spills.

The increasing manufacture, transportation, storage, use and disposal of a wide range of oil and chemical products have made it inevitable that spillages of these materials will occur, and will continue to increase. The primary focus of this paper is the operational approach to responding to spills. One area discussed is the need for contingency planning, including a trained staff and the vehicles and equipment necessary for responding to spill situations. Examples of exercises and training techniques which would help ensure the success of contingency plans are discussed. (Halterman-PTT)
W86-03357

CONTINGENCY PLANNING FOR CHEMICAL ACCIDENTS,
World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
A. Gilad, and J. I. Waddington.
IN: Environmental Protection: Standards, Compliance and Costs, Ellis Horwood, Ltd, Chichester, England, 1984. 219-233 p, 5 fig.

Descriptors: *Aquatic environment, *Environmental protection, *Accidents, Monitoring, Chemical wastes, Oil spills, Contingency planning.

Toxic and potentially toxic chemicals are now a part of the daily life of most people in the world. Because of the ever-increasing volume of chemicals being manufactured, transported, stored and disposed of as wastes, it is inevitable that accidental spills will happen with increased frequency. The purpose of this paper is to described contingency planning for chemical accidents. First, the response approach should be based on the magnitude of the accident. Levels are categorized from the operator level to the international level. Second, the authors provide suggestions for a systematic approach to the establishment of emergency response systems. The structure and elements of response systems should include an alert system, means of evaluation of the situation and the classification to the accident, and the provision for the flow of information to appropriate groups, including outside help. Finally, the need for protection, and, if necessary, the rehabilitation, of water resources is discussed. (Halterman-PTT)
W86-03358

MODELING THE FATE OF CHEMICALS IN THE AQUATIC ENVIRONMENT.
For primary bibliographic entry see Field 5B.
W86-03417

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PLANNING REPORT FOR THE WESTERN GULF COAST REGIONAL AQUIFER SYSTEM ANALYSIS, GULF OF MEXICO COASTAL PLAIN, UNITED STATES,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03069

HABITAT SUITABILITY INDEX MODELS: LARGEMOUTH BASS,
Fish and Wildlife Service, Fort Collins, CO. West-

ern Energy and Land Use Team.
R. J. Stuber, G. Gebhart, and O. E. Maughan.
FWS/OBS-82/10.16, July 1982. 33 p, 2 fig, 3 tab, 83 ref.

Descriptors: *Habitats, *Aquatic habitats, Environment, Aquatic environment, *Fish, Bass, Model studies, Computer models, Environmental impact statement.

Largemouth bass habitat use information and habitat suitability index (HSI) models, used as an aid for impact assessment and habitat management activities, are discussed. Literature concerning the habitat requirements and preferences of the largemouth bass is reviewed and synthesized into HSI models. Assumptions used to transform habitat use information into these mathematical models are presented, and guidelines for model application are described. The models presented are complex hypotheses of species-habitat relationships. They are, however, not statements of proven cause and effect relationships. (Halterman-PTT)
W86-03244

PLANNING AND MANAGEMENT OF MINE-CUT LAKES AT SURFACE COAL MINES,

Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
R. W. Nelson, J. F. Orsborn, and W. J. Logan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-156422, Price codes: A09 in paper copy, A01 in microfiche. OSM/TR-82/1, May 1982, 199 p, 91 fig, 19 tab, 172 ref, 5 append.

Descriptors: *Strip mine lakes, *Planning, *Management planning, Lake rehabilitation, Economic aspects, Land management, Land use, Ecosystems, Biological samples.

Mine-cut lakes have been constructed in 14 of the 21 states where future (1980-1985) land disturbance from surface coal mining was projected to be at least 1,000 acres. Twelve of the 14 states indicated that mine-cut lakes will probably be constructed in Illinois, Indiana, Kentucky, Tennessee, Alabama, and Oklahoma. Ohio, Pennsylvania, Missouri, Wyoming and Montana indicated that the average annual production of new lakes would be five or less. Texas and Colorado indicated a small future potential as yet undetermined. As an alternative to restoring the pre-mining topography and land use at surface coal mine operations, mine-cut lakes can be planned as a valuable resource for fish and wildlife habitat, recreation, water supply, and allied purposes. The key to productive future use of these permanent water impoundments is careful planning and development of lake and surrounding watershed features aimed at producing physical, chemical and biological characteristics for the intended or potential uses. Many ideas or principles necessary to achieve this goal are presented. (Author)
W86-03245

UPDATE OF TEXAS LAND COVER MAPS BY COMPUTER-ASSISTED ANALYSIS OF LANDSAT DIGITAL DATA: SUPPORT ACTIVITIES REPORT,

Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 7B.
W86-03272

COMPUTER BASED MAPPING SYSTEM FOR STORAGE AND RETRIEVAL OF SOIL AND LAND USE DATA: SUPPORT ACTIVITIES REPORT,

Texas Natural Resources Information System, Austin.
For primary bibliographic entry see Field 10D.
W86-03279

6B. Evaluation Process

TOXIC SUBSTANCES IN SURFACE WATERS OF THE B. EVERETT JORDAN LAKE WATERSHED.

North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5B.
W86-03132

ENVIRONMENTAL COMPLIANCE GUIDE: GUIDANCE MANUAL FOR DEPARTMENT OF ENERGY COMPLIANCE WITH THE FISH AND WILDLIFE COORDINATION ACT.

Department of Energy, Washington, DC. Office of Environmental Compliance.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82022215, Price codes: A02 in paper copy, A01 in microfiche. DOE/EP-0059, July 1982. Volume 3D. 21 p, 2 fig, 5 tab, 25 ref, 1 append.

Descriptors: *Wildlife habitats, *Wildlife conservation, *Water resources development, *Project planning, *Environmental protection, Regulations, Habitats, Wildlife management, Legal aspects, Fisheries, Environmental impact statement, Standards, Aquatic habitats, Fish management, Environmental effects, Management planning, Environmental policy, Ecological effects.

This manual provides guidance for Department of Energy (DOE) officials who are responsible for complying with the Fish and Wildlife Coordination Act (FWCA). The FWCA requires that consideration be given to the conservation of fish and wildlife resources during the development of any DOE projects that affect water resources directly or indirectly. Early in project planning, DOE must cooperate with state and federal wildlife agencies in assessing project impacts to fish and wildlife. The FWCA directs wildlife agencies to make recommendations for mitigation of these impacts and requires DOE to plan its projects in such a way that equal weight is given to wildlife conservation and other project benefits. Since 1974, the Division of Ecological Services of FWS has been developing an assessment system called the Habitat Evaluation procedures (HEP). DOE managers should be aware of the effects the following elements of the HEP considerations have on mitigation recommendations: evalution species selected for impact assessment, the existing habitat value of the various areas affected by DOE project development, and the uniqueness and importance of the habitat types affected by project development on a national or ecoregional level. (Geiger-PTT)
W86-03251

ENVIRONMENTAL COMPLIANCE GUIDE: GUIDANCE MANUAL FOR DEPARTMENT OF ENERGY COMPLIANCE WITH CORPS OF ENGINEERS PERMITS ON DREDGING AND FILLING ACTIVITIES.

Department of Energy, Washington, DC. Office of Environmental Compliance.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82022216, Price codes: A02 in paper copy, A01 in microfiche. DOE/EP-0060, July 1982. Volume 3C. 17 p, 1 fig, 16 ref, 2 append.

Descriptors: *Standards, *Environmental effects, *Project planning, *Dredging, *Fill permits, Regulations, Wildlife habitats, Environmental impact statement, Aquatic habitats, Decision making, Water resources development, Management planning, Environmental policy, Navigable rivers, Navigable waters, Evaluation, Ecological effects.

This document provides general guidance for Department of Energy officials responsible for complying with Sections 9 and 10 of the River and Harbor Act of 1899 and with Section 404 of the Clean Water Act of 1977 (CWA) for issuing permits for dredging or erecting structures on navigable rivers. The Environmental Protection Agency Guidelines require that potential impacts on physical, chemical, and biological properties of the aquatic ecosystem, special aquatic sites, and human use be considered before any project is undertaken. Early planning meetings will establish both the level of existing information and the types of new data needed by DOE to process and review a Section 404 permit application. Guidance is provided in this document on general approaches for collecting, analyzing, and presenting information that addresses both abiotic and biotic impacts. Impacts on physical/chemical characteristics of the discharge site can be considered under the following general categories: substrate effects; suspended particulates/turbidity; water quality; current patterns, water circulation, and water-level fluctuations; and salinity gradients. Potential impacts on ecosystem biota that should be considered are: impacts to aquatic and terrestrial biota; threatened and endangered species; potential impacts on special aquatic sites; and potential impacts on human use. This data will provide the District Engineer with information to predict impacts of the proposed activity and evaluate possible alternatives (Geiger-PTT)
W86-03252

CROP-WATER PRODUCTION FUNCTIONS AND ECONOMIC IMPLICATIONS FOR THE TEXAS HIGH PLAINS REGION,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 3F.
W86-03255

WATER CONSERVATION ALTERNATIVES FOR CALIFORNIA AGRICULTURE: A MICROECONOMIC ANALYSIS,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 3F.
W86-03256

HANDBOOK FOR PROTECTION OF FISH AND WILDLIFE FROM CONSTRUCTION OF FARM AND FOREST ROADS,

Center for Natural Areas, South Gardiner, ME.
J. Hynson, P. Adamus, S. Tibbetts, and R. Darnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-150441, Price codes: A08 in paper copy, A01 in microfiche. FWS/OBS-82/18, July 1982. 152 p, 56 fig, 10 tab, 4 append.

Descriptors: *Best management practices, *Project planning, *Road construction, *Water quality management, *Farms, *Forest watersheds, Planning, Management planning, Decision making, Roads, Wildlife management, Evaluations, Erosion control, Fish.

This Handbook describes 54 best management practices which may be utilized by Federal and State agencies or private landowners and operators in the review of project plants and in the planning, construction, and maintenance of farm and forest roads. Best management practices (BMPs) for planning road and facility layout and design, erosion control, construction and maintenance operations, and restoration to natural conditions, identified through existing State water quality management plans and management practices of Federal agencies, were evaluated as to their environmental, institutional, technical, and economic effectiveness. Based on the results of the evaluation, BMPs were modified or augmented with other practices to enhance their overall effectiveness and to provide for protection and propagation of fish and wildlife resources. A discussion of purpose, description, performance and limitations is provided for each BMP, and an approach is developed which guides Handbook users in the selection of BMPs applicable to site-specific situations. (Author)
W86-03257

PROTECTING INSTREAM FLOWS IN CALIFORNIA: AN ADMINISTRATIVE CASE STUDY,

Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
S. W. Olive.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-169482, Price codes: A03 in paper copy, A01 in microfiche. Instream Flow Information Paper: No. 14, FWS/OBS-82/34, September 1981. 32 p, 2 fig, 40 ref.

Descriptors: *Decision making, *Water law, *Instream flow, *Case studies, *California, Judicial decisions, Administrative decisions, Water policy, Wildlife management, Environmental policy, Environmental protection, Water management.

This paper describes California water law and the attempts which have been made in the legal and institutional sphere to protect instream uses under that law. The reasons for the way decisions were made in California regarding the question of the protection of instream flows are given. Groups and individuals interested in establishing a system that protects instream flows should analyze the situation in their area before formulating plans. The first step in this analysis is to identify objectives. The second step is to reveal opportunities that permit the achievement of objectives. A careful review should be made of the laws in the area and opportunities sought for public support. The third step involves identifying the agencies and interest groups which will participate in policy formulation regarding instream flow protection. The relative strengths of the participating parties should be assessed so that too much time and effort is not spent trying to meet the needs of a weaker party when a stronger one's needs are ignored. The fourth step is to discover the roles-needs of the various agencies and groups. Using a proposed decision-making scheme, it is possible to ascertain the perceived needs and behavior patterns of the various parties involved and the degree to which a system protecting instream flows would affect those needs. The fifth and final step is the formulation of strategies based on local conditions and the previous four steps. (Geiger-PTT)
W86-03276

ROLE OF NATURAL RESOURCE INVENTORIES IN THE PASSAIC RIVER BASIN, NEW JERSEY,
Passaic River Coalition, Basking Ridge, NJ.
D. F. Leitner.
NSF/RA-800571, March 9, 1981. 152 p, 1 fig, 29 tab, 2 exhibits, 35 ref. OSS7723973.

Descriptors: *Natural resources, *River basins, *Surveys, *New Jersey, Water management, Passaic River Basin, Resources management, Public policy, Planning, Political aspects.

The impact of approximately 30 natural resource inventories (NRI) in the Passaic River Basin in New Jersey were evaluated. The inventories consist of compilations of data pertaining to the natural characteristics of geographic areas as ecological entities. Geology, geography, soils, hydrology, meteorology, vegetation, and wild life are specific components. Existing land use, cultural factors, and historic aspects are considered to provide perspectives on the man-made environment. The report includes descriptions of the NRI process and the Passaic River Basin; a survey of NRI's in the Passaic River Basin; interviews with Federal, state, county, and municipal officials and non-governmental individuals; and specific natural resource entities. The Handbook for Environmental Commissioners (N.J. Department of Environmental Protection, 1976) was used as a guide to recommend components in NRI's. These lists were then compared to the contents of 20 published NRIs from Passaic River Basin municipalities to demonstrate graphically the contents of each inventory. Existing NRI's in the Passaic River Basin have had a limited impact on land use decisions. Politics seem to be a significant factor in the preparation and use of NRI's.
W86-03321

STANDARDS AND LIMITS FOR WATER QUALITY CONTROL,
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5C.
W86-03350

MONITORING COMPLIANCE WITH STANDARDS,
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 5C.
W86-03351

RIVER WASTE HEAT ASSIMILATION VS. ORGANIC WASTE DISCHARGE,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5C.
W86-03381

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-02973

EVALUATION OF THE COST EFFECTIVENESS OF THE 1983 STREAM-GAGING PROGRAM IN KANSAS,
Geological Survey, Lawrence KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02992

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7A.
W86-03073

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN ORLANDO SUBDISTRICT, FLORIDA,
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03086

LONG-TERM MONITORING OF HABITAT DEVELOPMENT AT UPLAND AND WETLAND DREDGED MATERIAL DISPOSAL SITES, 1974-1982,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. J. Newling, and M. C. Landin.
Technical Report D-85-5, July 1985, Final Report. 226 p, 23 fig, 52 tab, 59 ref, 1 append.

Descriptors: *Wildlife habitats, *Dredging, *Environmental effects, *Wetlands, Marshes, Habitats, Vegetation, Plant populations, Comparison studies, Ecological effects.

During the Dredged Material Research Program, six wetland and three upland habitat development projects were established at seven sites to demonstrate the feasibility of creating productive habitat on dredged material deposits. Wetland sites studied were Windmill Point in the James River, Virginia; Buttermilk Sound near the Altamaha River, Georgia; Drake Wilson Island in Apalachicola Bay, Florida; Bolivar Peninsula in Galveston Bay Texas; Salt Pond 3 in South San Francisco Bay, California; and Miller Sands Island in the Columbia River, Oregon. The upland area sites examined included Nott Island in the Connecticut River, Connecticut; Bolivar Peninsula; and Miller Sands. These sites have been monitored since their construction (1975-1977) until 1982. In addition, three natural marsh upland reference sites were selected for comparison to the man-made sites. Results over an 8-yr period show that all of the sites have developed and stabilized, and that they have all been highly successful. Despite a complete lack of management since construction, the sites support plant communities generally comparable to or more productive than those of the reference areas. Wildlife use exceeds that occurring on reference areas, and the sites are compatible with and contributing to the ecosystems of which they are a part. (Geiger-PTT)
W86-03264

6D. Water Demand

MODEL PROJECTIONS, 1980-99, FOR ARKANSAS RIVER VALLEY, HAMILTON AND KEARNY COUNTIES, SOUTHWESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-02928

ESTIMATED PUBLIC-WATER SUPPLY AND INDUSTRIAL-COMMERCIAL WATER WITHDRAWALS AND RETURNS IN NASSAU COUNTY, LONG ISLAND, NEW YORK, 1973-79,
Geological Survey, Albany, NY. Water Resources Div.
D. S. Snavely, and J. Williams.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4246, 1985. 16 p, 9 fig, 2 tab, 20 ref.

Descriptors: *Water use, Water users, Groundwater budget, Water conveyance, *Water supply, Wastewater, Sewer systems, Storm sewers, *New York, Nassau County, Long Island, Public-water suppliers.

Nassau County, New York depends upon ground water for its freshwater supply. The primary water uses are for public-water supply and industrial-commercial purposes, which together accounted for 202 Mgal/d (million gallons per day) in 1975. Public-water suppliers withdrew 85 percent of their water from the Magothy Formation. About 133 Mgal/d was returned to the ground after use in 1975, and about 69 Mgal/d was discharged to tidewater. In addition, about 34 Mgal/d infiltrated into sewerlines in 1975 and was also discharged to tidewater. Because of the importance of this freshwater supply, the New York State Department of Environmental conservation reviews applications for the installation of wells and compiles data on pumpage throughout Long Island. It also reviews applications to discharge wastewater into the surface water and ground water of the State. This report summarizes the data filed with the New York State Department of Environmental Conservation for Nassau County during 1973-79. It presents data and estimates on withdrawals for public and industrial-commercial supply, returns to the ground, and discharges through sewer systems. It also includes information on population and land use. (USGS)
W86-02957

POTENTIAL HYDROLOGIC IMPACTS OF A TARSAND INDUSTRY IN 11 SPECIAL TAR SAND AREAS IN EASTERN UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. L. Lindskov.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4109, 1983. 130 p, 26 fig, 34 tab, 70 ref.

Descriptors: *Bituminous materials, *Utah, Water pollution sources, *Colorado River, *Water supply, Hydrology, Environmental effects, Tar sand.

About 93 percent of the Nation's estimated 30 billion barrels of crude oil in tar sand deposits is in 11 tar-sand deposits in eastern Utah that were chosen for leasing by the Federal government. The Tar Sand Triangle area, which contains about 15 billion barrels of oil, is the largest. This area and the Sunnyside and P R Springs areas contain more than three-fourths of the Utah reserves. About 88,000 acre-feet of water per year would be required for a commercial tar-sand industry producing about 365,000 barrels per day. At this rate, most of the recoverable oil would be mined within 30 years. About 22,000 acre-feet of water per year

would be required for a commercial tar-sand industry producing about 83,000 barrels per day. Impacts on local hydrology would be greatest in the Tar Sand Triangle, Sunnyside, and P R Springs areas. Impacts could be minimized with proper construction of surface facilities to decrease erosion, sediment transport, and impoundment of mining and retort water. Increases in salinity of the Colorado River at Imperial Dam, Ariz.-Calif., could be about 3 milligrams per liter, with a peak of 9 milligrams per liter, for a 365,000-barrel-per-day industry and less than 1 milligram per liter, with a peak of 2 milligrams per liter, for an 83,000-barrel-per-day industry. (USGS)
W86-03141

WATER USE IN HAWAII, 1980,
Geological Survey, Honolulu, HI. Water Resources Div.
R. Nakahara.
Hawaii Dept. of Land and Natural Resources, Honolulu, Report R71, 1984. 26 p, 10 fig, 10 tab, 1 ref.

Descriptors: Agricultural use, *Domestic use, Thermoelectric water use, Hydroelectric water use, *Industrial uses, Commercial, *Water utilization, *Hawaii.

Water is a very important natural resource found within a state. In Hawaii, significant quantities of water are withdrawn daily from streams or underground sources for different uses, such as for irrigating crops, raising livestock, providing for human domestic needs, generating hydroelectric power, carrying wastes, cooling, cleaning, and processing food and industrial commodities. This is the second in a series of water-use reports for Hawaii which will enable managers and planners to analyze the various uses and thereby aid them in the sound development and implementation of state water-management plans and programs. Letters and questionnaires were sent to principal water users throughout the State; 94 percent of these questionnaires for 1980 were returned. The remainder has been estimated, based on previous surveys. The 1980 water-use was included as a source of agriculture was the leading water user. When seawater was included as a source of water, industrial-thermoelectric became the major water user. The composite data, resulting from the 1980 survey, are shown in tabular and graphical forms. (USGS)
W86-03170

6E. Water Law and Institutions

TRIORGANOTIN REGULATIONS IN NORTH CAROLINA.
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5G.
W86-03131

REVISED SECTION 301 (H) TECHNICAL SUPPORT DOCUMENT,
Tetra Tech, Inc., Bellevue, WA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-153817, Price codes: A11 in paper copy, A01 in microfiche. 430/9-82-011, November 1982. 239 p, 11 fig, 20 tab, 63 ref, 1 append.

Descriptors: *Permits, *Regulations, *Effluent limitations, *Water law, Water quality, *Wastewater treatment, Legal aspects, Water quality standards, Water quality control, Monitoring, Marine environments.

Section 301(h) of the Clean Water Act provides publicly owned wastewater treatment works (POTWs) an opportunity to apply for variances from secondary treatment requirements for discharges to marine waters. This Technical Support Document supplements the section 301(h) regulations as amended in November, 1982. This document provides data which establishes a technical basis for understanding the major differences between the original section 301(h) regulations promulgated in 1979 and the 1982 amended regulations. It also provides a technical explanation of assessments required for obtaining section 301(h) modified discharge permits and guidance for both small and large POTWs to use in completing the appropriate application questionnaire. The assessments described are: physical assessment, water quality assessment, public water supply assessment, recreational activity assessment, biological assessment, toxic substances assessment, and monitoring programs for applicants granted section 301(h) modified discharge permits. A description of the small and large applicant questionnaires is given along with a marine biological assessment, toxic substance control programs, and plan of study for the applicant. (Geiger-PTT)
W86-03259

PROTECTING INSTREAM FLOWS IN CALIFORNIA: AN ADMINISTRATIVE CASE STUDY,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
For primary bibliographic entry see Field 6B.
W86-03276

ASSESSING CULTURAL ATTRIBUTES IN PLANNING WATER RESOURCES PROJECTS.
National Research Council, Washington, DC. Environmental Studies Board.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-113621, Price codes: A02 in paper copy, A01 in microfiche. Report of the Panel on Cultural Attributes in Water Resources Projects, August 30, 1982. 19 p, 2 app.

Descriptors: *Planning, *Water Resources Development, *Archaeology, *Cultural Resources, Historic buildings.

The Panel on Cultural Attributes in Water Resources Projects provided an evaluation of the procedures recommended by the U.S. Water Resources Council (WRC) for assessing the impact of proposed water resources projects on cultural attributes of the affected environment. (Environmental Quality Evaluation Procedures, or EQEP). The EQEP were deemed generally logical and valid. Recommendations were made to assure that the EQEP are consistent with the body of federal legislation dealing with cultural and historical preservation. It was concluded that both historical properties and traditional lifeways are properly considered cultural resources. The EQEP prepared by the MITRE Corporation (1981) for the Corps of Engineers was analyzed. It was concluded that the MITRE analysis was generally a useful elaboration of the EQEP although MITRE defined cultural resources and attributes in ways not consistent with either field use or other federal legislation. The MITRE analysis is more useful at the level of indicators and units of cultural resources although examples of procedures in the MITRE study seemed largely confined to prehistoric archaeology and historic buildings.
W86-03300

ROLE AND ACTIVITIES OF THE OSLO AND PARIS COMMISSIONS,
For primary bibliographic entry see Field 5B.
W86-03352

EUROPEAN COMMUNITY POLICY ON ENVIRONMENTAL MANAGEMENT,
Commission of the European Communities, Brussels (Belgium).
For primary bibliographic entry see Field 5C.
W86-03353

APPROACH OF THE FEDERAL GERMAN REPUBLIC-ANTICIPATING ENVIRONMENTAL EFFECTS,
Council of Experts on Environmental Matters, Bonn (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-03354

UK APPROACH - ENVIRONMENTAL QUALITY STANDARDS,
Department of the Environment, London (England).
For primary bibliographic entry see Field 5C.
W86-03355

6F. Nonstructural Alternatives

AUSTIN, TEXAS, FLOOD OF MAY 24-25, 1981,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-03260

6G. Ecologic Impact Of Water Development

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE HORSE CREEK AREA, SHERIDAN AND MOORHEAD COAL FIELDS, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02968

PRELIMINARY STUDY USING DIGITAL MODELING TECHNIQUES TO UNDERSTAND AND PREDICT THE TEMPERATURE REGIME IN A STREAM BELOW A MAJOR RESERVOIR--THE NORTH SANITIAM RIVER BELOW DETROIT DAM, OR,
Geological Survey, Portland, OR. Water Resources Div.
A. Laenen, and R. P. Hansen.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4105, 1985. 45 p, 16 fig, 10 tab, 3 ref.

Descriptors: *Stream temperature, *Digital models, *Oregon, Water quality, Dams, Reservoir effects, Lagrangian moving reference frame, North Santiam River, Detroit Dam, Model studies.

A riverine-temperature model and associated data-collection system were developed to help the Corps of engineers determine cost benefits of selective-withdrawal structures for future use with dams on the Willamette River System. A U.S. Geological Survey Lagrangian reference frame, digital computer model was used to simulate stream temperatures on the North Santiam River downstream of the multipurpose Detroit dam and a reregulating dam (Big Cliff), from river mile 45.6 to 2.9. In simulation, only available air-temperature and windspeed information from a nearby National Weather Service station at Salem, Oregon were used. This preliminary investigation found that the model predicted mean daily temperatures to within 0.4 C standard deviation. Analysis of projected selective-withdrawal scenarios showed that the model has the sensitivity to indicate water-temperature changes 42.7 miles downstream on the North Santiam River. (USGS)
W86-03022

IMPACTS OF THE TAMPA BYPASS CANAL SYSTEM ON THE AREAL HYDROLOGY, HILLSBOROUGH COUNTY, FLORIDA,
Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-03056

SIMULATED EFFECTS OF PROPOSED RESERVOIR-DEVELOPMENT ALTERNATIVES ON STREAMFLOW QUANTITY IN THE WHITE RIVER, COLORADO AND UTAH,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-03061

HABITAT SUITABILITY INDEX MODELS: LARGEMOUTH BASS,
Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
For primary bibliographic entry see Field 6A.
W86-03244

ENVIRONMENTAL COMPLIANCE GUIDE: GUIDANCE MANUAL FOR DEPARTMENT OF ENERGY COMPLIANCE WITH THE FISH AND WILDLIFE COORDINATION ACT.
Department of Energy, Washington, DC. Office of Environmental Compliance.
For primary bibliographic entry see Field 6B.
W86-03251

ENVIRONMENTAL COMPLIANCE GUIDE: GUIDANCE MANUAL FOR DEPARTMENT OF ENERGY COMPLIANCE WITH CORPS OF ENGINEERS PERMITS ON DREDGING AND FILLING ACTIVITIES.
Department of Energy, Washington, DC. Office of Environmental Compliance.
For primary bibliographic entry see Field 6B.
W86-03252

WYCOALGAS COAL GASIFICATION PROJECT: PRELIMINARY DRAFT ENVIRONMENTAL IMPACT STATEMENT, VOLUME 1,
Woodward-Clyde Consultants, San Francisco, CA.
For primary bibliographic entry see Field 5C.
W86-03271

BOSTON MAINTENANCE DREDGING, BOSTON HARBOR, BOSTON, MA: ENVIRONMENTAL ASSESSMENT.
Corps of Engineers, Waltham, MA. New England Div.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120053, Price codes: A04 in paper copy, A01 in microfiche. December 1981. 53 p, 10 tab, 8 fig, 4 app, 61 ref.

Descriptors: *Dredging, *Environmental effects, Turbidity, Harbors, Shoals, Water quality, Bioassay, Aquatic populations, Spoil banks, Mystic River, Boston Harbor, Chelsea River, *Massachusetts.

This Environmental Assessment discusses the need for and the environmental impacts of the proposed maintenance dredging of the Federal navigation channels in the Mystic and Chelsea rivers and the anchorage at President Roads. This action will involve removal of approximately 425,000 cubic yards of harbor sediments for ocean disposal. Major areas of concern include impacts to water quality and aquatic resources at the dredging and disposal sites. Impacts during dredging and disposal would include a temporary increase in turbidity and minor release of certain contaminants. No significant effect upon the water quality in the vicinity is expected. Bioassay tests indicate disposal would not cause any acute chemical impacts to organisms
W86-03297

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER, RIVER MILE 480 TO 530: REPORT 1, INTRODUCTION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
A. C. Miller.
Miscellaneous Paper E-80-1, U.S. Army Environmental and Water Quality Operational Studies, March 1981. 34 p, 2 fig, 2 tab, 57 ref.

Descriptors: *Ecological effects, *Environmental effects, *Dikes, *Channels, *Water quality management, *Navigable rivers, *Channel improvement, *Water resources development, Pilot studies, Surveys, Species, Composition, Species diversity, Environmental impact statement, Mississippi River, Rivers, Aquatic habitats, Benthos, Bank Stabilization, Aquatic populations, Aquatic life, *Mississippi River.

A pilot survey was carried out on river mile 480 to 530 of the Lower Mississippi River from April to October 1978 to collect data on fish, benthos, and water quality as they are effected by the placement and design of navigational structures such as dikes, bank revetments, and bendway cutoffs. Data obtained from these studies was used to design further waterway investigations. Fourteen different habitats were identified in the study area: main channel, permanent secondary channel, temporary secondary channel, natural sandbars, natural banks, revetted banks, dike field sandbars, dike field pool areas, abandoned river channels (not contiguous with main channel), oxbow lake, borrow pit, inundated floodplain, and sandbar slack water pools. The placement of dikes and revetments in rivers may alter the distribution, abundance, species composition and diversity of aquatic organisms. A complete discussion of the fisheries, benthos, and water quality investigations along the Lower Mississippi are found in Reports 2 through 8 of this series.
W86-03302

CONSIDERATIONS IN SELECTING BIOASSAY ORGANISMS FOR DETERMINING THE POTENTIAL ENVIRONMENTAL IMPACT OF DREDGED MATERIAL,
EG and G Bionomics, Pensacola, FL. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W86-03319

EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1981 REPORT OF FINDINGS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty, and J. J. Sartoris.
Report No REC-ERC-83-2, December 1982. 88 p, 43 fig, 17 tab, 2 app, 44 ref.

Descriptors: *Pumped storage, *Powerplants, *Ecological effects, *Aquatic environment, *Reservoirs, *Limnology, *Environmental effects, Chemical properties, *Lakes, Ecology, Phytoplankton, Fish, Shrimp, Twin Lakes, Colorado, Mt. Elbert Pumped-Storage Powerplant.

A series of studies is being performed to identify and quantify changes that occur in the aquatic ecology of Twin Lakes, Colorado, because of the Mt. Elbert Pumped-Storage Powerplant, which began operation in August 1981. The results presented here are part of the investigations being done by the Bureau of Reclamation on the ecological effects of pumped-storage construction and operation. These studies have been going on since 1971. The Twin Lakes and the powerplant are being used for the primary field investigations. Although it is too early to identify any ecological changes, this report presents results of studies done in 1981. These results, along with those from other studies done since 1971 when the project began, are being used to define the preoperational limnology of Twin Lakes. Twin Lakes are a pair of dimictic, connected, montane, drainage lakes of glacial origin. Based on seven limnological parameters, the lakes are classified as oligotrophic lakes. Maximum water temperature of 18 C were recorded in August 1981 for both lakes. The lowest measure dissolved oxygen concentration during 1981 was 1.7 mg/L at the bottom of the lower lake in October. Total phosphorus concentrations during 1981 ranged from 1 microgram/L, which has been the case most of the time during the past 6 years, to a high of 31 micrograms/L. Nitrate nitrogen concentrations ranged from <10 to 170 micrograms/L. Average daily primary productivity rates during 1981 ranged from a low of 84 mg C/(sq m.d) in the upper lake during March to a high of 126.6 mg C/(sq m.d) in the lower lake during May. Chlorophyll a concentrations during 1981 ranged from a mean concentration of 0.4 mg/cu m in the lower lake during May to a mean of 18.8 mg/cu m in the upper lake during September. Average phytoplankton and zooplankton densities reached maximums of just over 18,000 organisms/L (lower lake - Sept.) and 153 individuals/L (lower lake - June), respectively. Phytoplankton populations were dominated by diatoms and dinoflagellates, while zooplankton populations were dominated by copepods, opossum shrimp, and various species of rotifers. Large pelagic cladocerans are notably absent from Twin Lakes. The benthos includes chironomid larvae, oligochaetes, and fingernail clams.
W86-03336

COMMON PLANKTON OF TWIN LAKES, COLARADO,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. V. Lieberman.
Available from Engineering and Research Center, Denver, CO. Report No REC-ERC-82-21, February 1983. 17 p, 15 fig, 3 tab, 1 app, 16 ref.

Descriptors: *Phytoplankton, *Zooplankton, *Taxonomy, *Aquatic Life, Lakes, Powerplants, Pumping plants, Algae, Rotifers, Copepods, Shrimp, Chrysophyta, Chlorophyta, Diatoms, Cyanophyta, Twin Lakes, Colorado.

A series of studies is being performed to evaluate the effects of the Mt. Elbert Pumped-Storage Powerplant on the ecology of Twin Lakes. Twin Lakes are a pair of connected dimictic lakes, formed as the result of glacial action on alluvial deposits. This report presents a taxonomic species study of the common plankton collected since 1974 from Twin Lakes. A total of 11 zooplankters and 14 phytoplankters were identified from the limnetic zone of Twin Lakes and the associated Mt. Elbert Forebay. The four divisions of zooplankton included four species of Rotifer (rotifer), three species of Copepoda (copepod), three species of Cladocera (cladoceran), and one species of Mysidacea (opossum shrimp). The dominant zooplankters were the rotifers and copepods. The nocturnal opossum shrimp, Mysis relicta are abundant in Twin Lakes but were not collected in plankton samples. Cladocerans were rarely collected and made up less than 1% of the zooplankton population. The lower lake has a greater density of zooplankton than the upper lake. For example, in July 1981, average zooplankton densities in the lower lake reached a maximum of 116 individuals/L, as compared to 53 individuals/L in the upper lake. The four divisions of phytoplankton included three species of Chrysophyta (blue-green algae), three species of Chlorophta (green alg), six species of Bacillariophyta (diatom), and two species of Cyanophyta (yellow-brown algae). The phytoplankton was dominated by the yellow-brown algae, Dinobryon, and by the diatoms, asterionella and Synedra. During 1981, average density of phytoplankton reached a maximum of 4870 organisms/L during September in the upper lake; the average density in the lower lake peaked during March at 18,042 organisms/L.
W86-03337

INTERMEDIATE-DISTURBANCE HYPOTHESIS: AN EXPLANATION FOR BIOTIC DIVERSITY PATTERNS IN LOTIC ECOSYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
For primary bibliographic entry see Field 5C.
W86-03391

INVERTEBRATE DRIFT AND PARTICULATE ORGANIC MATERIAL TRANSPORT IN THE SAVANNAH RIVER BELOW LAKE HARTWELL DURING A PEAK POWER GENERATION CYCLE,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 5B.
W86-03392

7. RESOURCES DATA

7A. Network Design

HYDROLOGIC BENCH-MARK PROGRAM AS A STANDARD TO COMPARE AND EVALUATE TIME-SERIES TRENDS IN SELECTED

WATER-QUALITY CONSTITUENTS FOR STREAMS IN GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.
G. R. Buell, and S. C. Grams.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water Resources Investigations Report 84-4318, 1985. 36 p, 16 fig, 3 tab, 19 ref.

Descriptors: *Water quality, *Seasonal Kendall test, Land cover, Land use, Atmospheric deposition, *Georgia, Hydrologic Bench-Mark, *Temporal trends.

Significant temporal trends in monthly pH, specific conductance, total alkalinity, hardness, total nitrite-plus-nitrite nitrogen, and total phosphorus measurements at five stream sites in Georgia were identified using a rank correlation technique, the seasonal Kendall test and slope estimator. These sites include a U.S. Geological Survey Hydrologic Bench-Mark site, Falling Creek near Juliette, and four periodic water-quality monitoring sites. Comparison of raw data trends with streamflow-residual trends and, where applicable, with chemical-discharge trends (instantaneous fluxes) shws that some of these trends are responses to factors other than changing streamflow. Percentages of forested, agricultural, and urban cover with each basin did not change much during the periods of water-quality record, and therefore these non-flow-related trends are not obviously related to changes in land cover or land use. Flow-residual water-quality trends at the Hydrologic Bench-Mark site and at the Chattooga River site probably indicate basin reponses to changes in the chemical quality of atmospheric deposition. These two basins are predominantly forested and have received little recent human use. Observed trends at the other three sites probably indicate basin responses to various land uses and water uses associated with agricultural and urban land or to changes in specific uses. (USGS)
W86-02940

LONG-RANGE PLANS FOR HYDROLOGIC INVESTIGATIONS IN NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-02945

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NORTH CAROLINA,

Geological Survey, Raleigh, NC. Water Resources Div.
R. R. Mason, and N. M. Jackson.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4036, 1985. 109 p, 12 fig, 14 tab, 18 ref.

Descriptors: *Network design, *Time series analysis, *Research priorities, *Cost analysis, *Gaging stations, *North Carolina, Kalman filtering, *Cost effectiveness.

This report documents the results of a study of the cost-effectiveness of the stream-gaging program in North Carolina. Data uses and funding sources are identified for the 146 gaging stations currently operated in North Carolina with a budget of $777,600 (1984). As a result of the study, eleven stations are nominated for discontinuance and five for conversion from recording to partial-record status. Large parts of North Carolina's Coastal Plain are identified as having sparse streamflow data. This sparsity should be remedied as funds become available. Efforts should also be directed toward defining the efforts of drainage improvements on local hydrology and streamflow characteristics. The average standard error of streamflow records in North Carolina is 18.6 percent. This level of accuracy could be improved without increasing cost by increasing the frequency of field visits and streamflow measurements at stations with high standard errors and reducing the frequency at stations with low standard errors. A minimum budget of $762,000 is required to operate the 146-gage program. A budget less than this does not permit proper service and maintenance of the gages and recorders. At the minimum budget, and with the optimum allocation of field visits, the average standard error is 17.6 percent. (USGS)
W86-02973

GEOCHEMICAL SURVEY TO DETERMINE WATER-QUALITY CHARACTERISTICS OF THE BIG SIOUX AQUIFER IN EASTERN SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03019

DATA USES AND FUNDING OF THE STREAM-GAGING PROGRAM IN MISSOURI,

Geological Survey, Rolla, MO. Water Resources Div.
L. A. Waite.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-868, 1984. 32 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Cost analysis, *Hydrologic-data collection, Gaging stations, Surface water, Water quality, *Missouri.

This report documents the results of a study of the data uses and funding of the stream-gaging program in Missouri. Presently (1984), 100 continuous-record streamflow-gaging stations are operated in Missouri on a budget of $633,345. Data uses and funding sources are identified for each of the stations. Data from most stations have multiple uses. All stations presently have sufficient justification for continuation. (USGS)
W86-03070

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN NEW JERSEY,

Geological Survey, Trenton, NJ. Water Resources Div.
R. D. Schopp, and R. L. Ulery.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4108, 1984. 97 p, 15 fig, 18 tab, 23 ref.

Descriptors: *Cost analysis, Stream gages, *Optimization, *Streamflow, Synthetic hydrology, Multiple regression analysis, Data acquistion, Model studies, Network design, *New Jersey, *Stream-gaging program, Flow routing.

The results of a study of the cost-effectiveness of the stream-gaging program in New Jersey are documented. This study is part of a 5-year nationwide analysis undertaken by the U.S. Geological Survey to define and document the most cost-effective means of furnishing streamflow information. This report identifies the principal uses of the data and relates those uses to funding sources, applies, at selected stations, alternative less costly methods (that is flow routing, regression analysis) for furnishing the data, and defines a strategy for operating the program which minimizes uncertainty in the streamflow data for specific operating budgets. Uncertainty in streamflow data is primarily a function of the percentage of missing record and the frequency of discharge measurements. In this report, 101 continuous stream gages and 73 crest-stage or stage-only gages are analyzed. A minimum budget of $548,000 is required to operate the present stream-gaging program in New Jersey with an average standard error of 27.6 percent. The maximum budget analyzed was $650,000, which resulted in an average standard error of 17.8 percent. The 1983 budget of $569,000 resulted in a standard error of 24.9 percent under present operating policy. (USGS)
W86-03073

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN ORLANDO SUBDISTRICT, FLORIDA,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03086

STREAM-GAGING PROGRAM IN SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
J. R. Little, and D. K. Matthews.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-564, 1985. 29 p, 2 fig, 2 tab, 4 ref.

Descriptors: *Surface water, *Streamflow, *Gaging stations, Basic data collections, *South Dakota.

This report documents the results of a study of the uses, funding, and availability of the streamflow information program in South Dakota. In 1983, 107 continuous-record surface-water gaging stations were being operated in South Dakota on a budget of $607,050. Data from most stations have multiple uses. Data uses and funding sources are identified for each station. All stations have sufficient justification for continuation although 10 are primarily used to provide data for short-term research studies. The continued operation of these 10 stations should be evaluated when the studies have been completed. (USGS)
W86-03105

MANAGEMENT OF WATER QUALITY DATA WITHIN THE CORPS OF ENGINEERS, 1979,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. H. Smith, and P. L. Doiron.
Miscellaneous Paper E-80-2, U.S. Army Environmental and Water Quality Operational Studies, December 1980. Final Report. 70 p, 7 tab, 7 app.

Descriptors: *Surveys, *Water quality, *Data processing, *Data storage and retrieval, *Data transmission, *Data acquisition, *Computer programs, Water quality management, Automation, Data collections, Computers.

A survey of current practices, needs, and recommendations in water quality data management by the U.S. Army Corp of Engineers (CE) Districts and Divisions showed an awareness of the responsibility of the CE for the quality of water in all its Civil Works projects and for reporting the findings. Of the 37 Districts, 33 are already participating in the annual reporting system with 23 Districts using some kind of automated data analysis and/or data storage and retrieval. STORET is the most preferred system with the 13 Districts and 3 Divisions that use it. Modification of STORET for the CE, with its own data base maintained by the CE was recommended by several Districts. The increase in water management activities on over 500 CE Civil Works reservoirs will be accompanied by a demand for an efficient data management system to allow compliance with CE regulations. Other automated systems in use (AURAS, SIR, SAS and UPGRADE, WATSTORE and NAWDEX) are compared. Before the CE adopts a unified data management system it is recommended that candidate systems be evaluated in detail by experienced users and a CE panel of experts, and that the future data management needs and personnel capabilities within all Districts over the next 10 years be assessed.
W86-03313

7B. Data Acquisition

LONG-RANGE PLANS FOR HYDROLOGIC INVESTIGATIONS IN NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
H. L. Case, and G. E. Welder.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-696, 1983. 25 p, 9 fig, 1 tab.

Descriptors: *Water resources planning, Water supply, Groundwater, Surface water, Water quality, *Water requirements, *Data collections, Aquifers, Water pollution, *New Mexico, Mineral extraction, Basin assessment.

Objectives of the hydrologic-data-collection projects presented in this report include continuing to identify future data needs; conducting an analysis of the water-quality, ground-water, and surface-water observation networks; and entering all available current and historical hydrologic data into the U.S. Geological Survey Water Data Storage and Retrieval System (WATSTORE). Objectives of areal-appraisal studies include evaluating the water resources in the Gallup-Grants-Zuni-Acoma Sag area and on the eastern flank of the Sandi and Manzano Mountains in Bernalillo County. Potential projects for basin assessments include quantifying the ground-water/surface-water relationships on rivers with flows governed by compacts and an investigation of the water resources of the Estancia Basin. Projects that will assist in the evaluation of energy-related activities include describing the effects of restoration of coal mines and of milling operations on the quality and quantity of ground and surface water. Activities that need to be undertaken to assist in addressing waste-disposal problems include the evaluation of the hydrologic factors influencing the feasibility of cleanup at the Albuquerque South Valley 'superfund' site and the establishment of a monitoring network at the Waste Isolation Pilot Plant project near Carlsbad. Scientific methods that need to be developed include (1) the testing of analytical techniques for estimating site-specific conditions with the results of digital hydrologic models, and (2) the determination of the influence of recharge from ephemeral streams on alluvial aquifers. (USGS)
W86-02945

LOW-FLOW DATA FOR SELECTED PARTIAL-RECORD STATIONS IN OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
R. R. Schwarts.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-824, 1985. 13 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Low flow, *Streamflow, Data collections, *Ohio, Partial-record stations, Stream gaging.

Low-flow characteristics for 67 low-flow partial-record stations defined in Ohio since the 1978 water year are presented. Low-flow characteristics presented ar the 7-day 10-year low flow, the 7-day 2-year low flow, and the flow equalled or exceeded 90 percent of the time. The 7-day 10-year low-flow ranged from 0 ft3 to 239(3)/s. The methods used for estimating these characteristics also are discussed. (USGS)
W86-03003

PERFORMANCE OF ICE METER AND WEIGHT ASSEMBLIES,

Geological Survey, NSTL Station, MS. Water Resources Div.
V. R. Schneider, and J. C. Futrell.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4035, 1984. 26 p, 10 fig, 8 tab, 1 ref.

Descriptors: Discharge, Errors, *Flow measurement, Ice, Velocity, *Flow meters, *Flow under ice measurement, Van ice meter, Velocity measurement, WSC winter meter.

The performance of three ice meters and weight assemblies used by the U.S. Geological Survey and Environment Canada were compared in a towing tank. Each meter was rated individually on a rod suspension and then rerated on a cable suspension, with the appropriate weight assembly. Vertical and veer cable angles were measured along with meter yaw angle. The effect of the weight assembly on the rod-suspension rating for each meter was illustrated by computing a correction coefficient which ranged between 0.88 and 1.10 depending on the weight system used and the fluid velocity. A sluch-n-all type weight assembly least affected the meter rating and was the most stable in all flow conditions. (USGS)
W86-03004

BOUGUER GRAVITY ANOMALY MAP OF THE TWENTYNINE PALMS MARINE CORPS BASE AND VICINITY, CALIFORNIA,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
W. R. Moyle.
Available from OFSS, USGS, Box 25425, Lakewood. CO 80225. USGS Water-Resources Investigations Report 84-4005, 1984. 24 p, 2 fig, 1 tab, 43 ref.

Descriptors: *Groundwater barriers, *Gravity studies, Wells, Density, Water-level fluctuations, *California, Twentynine Palms, Landers, Joshua Tree, Sunfair.

A gravity study of the Twentynine Palms Marine Corps Base and vicinity, California, based on 495 gravity measurements, has been completed. The resulting contour map of the area shows that the ground-water basin ranges in depth from less than a foot at the edges of the basin to about 10,500 feet at the center of a gravity low near Deadman Lake. This study will aid in later studies to determine quantities of water in storage beneath the Marine Corps Base. (USGS)
W86-03006

MEASURING THE SURFACE AREA OF SEDIMENT-PARTICLES,

Geological Survey, Minneapolis, MN. Water Resources Div.
J. V. Skinner.
Available from Fed Inter-Agency Sed Proj, St. Anthony Falls Hyd Lab, Hennepin Is., 3rd Ave, SE Minneapolis, MN 55414. Report FF of A Study of Methods Used in Measurement and Analysis of Sediment Loads in Streams, U.S. Corps of Engineers, 1984. 28 p, 6 fig, 4 tab, 4 ref.

Descriptors: *Suspended sediments, *Measuring instruments, Physical properties, Turbidity, Light penetration, Radiation.

Light traveling through a suspension of water and fluvial sediment is scattered and absorbed by the particles. Several investigators have studied this attenuation process in an effort to devise optical techniques for measuring sediment concentration. Unfortunately, most of these efforts have not been successful because the relationship between attenuation and concentration is strongly influenced by the size distribution of the sediment particles. In this report, an analysis of experimental data shows that the attenuation of infrared light is closely correlated with the total 'geometric surface area' (GSA) of the particles suspended in a unit volume of the water. The GSA of an individual particle is defined as the area of a sphere having a diameter equal to the particles's diameter. The correlation between attenuation and total GSA holds for a broad range of particle diameters. The lower limit is about 2 micrometers; the upper limit is greater than 115 micrometers, the diameter of the largest particles tested. The range in GSA per unit volume extends from zero to more than 0.055 square meters per liter. The latter value is equivalent to full-scale deflection on the infrared light meter. (USGS)
W86-03007

WATER RESOURCES DIVISION WATER LEVEL RECORDER RENTAL PROGRAM - HISTORY AND OPERATION,

Geological Survey, NSTL Station, MS. Water Resources Div.
S. R. Jeffers, and C. R. Wagner.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-735, 1984. 16 p, 4 fig, 3 tab.

Descriptors: *Instruments, Equipment, *Water level recorder, Cost analysis, Optimization, Rent, Management planning.

The U.S. Geological Survey introduced a new water level recorder in the early 1960's to automate computation of streamflow records. At the same time it developed a rental program as a means of providing the recorders to field offices. This report documents the experience gained over the past 20 years and offers suggestions for operation of a rental program in the future, as preparation is made to introduce a third generation of water level recorders. (USGS)
W86-03009

RESULTS OF THE U.S. GEOLOGICAL SURVEY'S SECOND INTERNATIONAL INTERLABORATORY ANALYTICAL COMPARISON STUDY--STANDARD-REFERENCE WATER SAMPLES M-86 (MAJOR CONSTITUENTS), T-87 (TRACE CONSTITUENTS), AND P-5 (PRECIPITATION SNOWMELT),

Geological Survey, Denver, CO. Water Resources Div.
V. J. Janzer.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4049, 1985. 85 p, 13 tab, 2 ref.

Descriptors: *Reference samples, *Reference materials, *Standards, *Quality assurance, *Water analysis, Quality control, Statistical analysis, Water quality, Standard reference water samples.

The U.S. Geological Survey began an interlaboratory testing program of standard-reference water samples in 1962. Program objectives have been to provide a means for participating anaytical laboratories to: (1) Identify analytical problems, (2) ascertain the accuracy and precision of common water analyses and analytical methods, and (3) obtain reference samples for continuing quality-assurance testing. Participation in this continuing quality-assurance program is mandatory for all domestic laboratories providing water-analysis data for Survey use and storage in the WATSTORE data-storage system, if appropriate standard-reference water samples are available. The program was expanded in October 1982 to include laboratories in other countries. This report presents analytical data submitted by the 53 laboratories in other countries that analyzed the standard-reference water samples distributed in October 1983. Statistical evaluation of the data and performance ratings achieved by the laboratories for each determination are given in nine tables. Comparisons of the most probable values for the constituents determined by both other countries and domestic laboratories also are presented. (USGS)
W86-03013

DISCHARGE RATINGS AT GAGING STATIONS,

Geological Survey, Reston, VA. Water Resources Div.
E. J. Kennedy.
Available from Distribution Branch, USGS, 604 S. Pickett St., Alexandria, VA 22304. USGS Techniques of Water Resources Investigations, Book 3, Chapter 10, 1984. 59 p, 26 fig, 3 tab, 10 ref.

Descriptors: *Stage-discharge relations, *Stream gages, *Hydrometry, Channel flow, Water measurement, Discharge ratings, Streamflow measurement.

A discharge rating is the relation of discharge at a gaging station to stage and sometimes also to other variables. This chapter of 'Techniques of Water Resources Investigations' describes the common procedures used to develop simple ratings (stage-discharge) and the most frequently encountered types of complex ratings (stage-rate of change in stage-discharge, stage-fall-discharge, and stage-index velocity-discharge). Fundamental techniques of logarithmic plotting and simple storage routing applications to rating development are demonstrated. Computer applications, especially for handheld programmable calculators, and data handling are stressed. (USGS)
W86-03029

USES, FUNDING, AND AVAILABILITY OF CONTINUOUS STREAMFLOW DATA IN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, and M. K. White.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-862, 1985. 61 p, 3 fig, 2 tab, 6 ref.

Descriptors: Stream gages, *Streamflow data, *Hydrologic data, Data collections, *Streamflow-gaging program, *Montana.

This report documents the results of a study of the uses, funding, and availability of continuous streamflow data collected and published by the U.S. Geological Survey in Montana. Data uses and funding sources are identified for the 218 continuous streamflow gages currently (1984) being operated. These stations are supported by 18 different funding sources at a budget for the 1984 water year of $1,065,000. The streamflow-gaging program in Montana has evolved through the years as Federal, State, and local needs for surface-water data have increased. Continuous streamflow records for periods ranging from less than 1 year to more than 90 years have been collected. This report describes phase 1 of a cost-effectiveness study of the streamflow-gaging program in Montana. Evaluation of the program indicates that numerous agencies use the data for studies involving regional hydrology, hydrologic systems, and planning and design. They also use the data for operations of existing hydroelectric and irrigation dams, forecasting flood and seasonal flows, water-quality monitoring, research studies for fish habitat, and other uses such as recreational management. (USGS)
W86-03036

MAXIMUM KNOWN STAGES AND DISCHARGES OF NEW YORK STREAMS THROUGH SEPTEMBER 1981,

Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03038

SURFACE TOPOGRAPHY OF THE LOWER PART OF COLUMBIA GLACIER, ALASKA, 1974-1981,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W86-03039

FLUOROMETRIC PROCEDURES FOR DYE TRACING,

Geological Survey, Reston, VA. Water Resources Div.
J. F. Wilson, E. D. Cobb, and F. A. Kilpatrick.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-234, 1984. 53 p, 13 fig, 3 tab, 32 ref.

Descriptors: *Dyes, Dye concentrations, *Fluorometry, *Fluorescence, *Tracers, Streamflow, Groundwater movement, *Fluorometers, Rhodamine WT, Pontacyl pink, Acid yellow 7.

This manual describes the current fluorometric procedures used by the U.S. Geological Survey in dye tracer studies such as time of travel, dispersion, reaeration, and dilution-type discharge measurements. The outstanding characteristics of dye tracing are: (1) the low detection and measurement limits, and (2) the simplicity and accuracy of measuring dye tracer concentrations using fluorometric techniques. The manual contains necessary background information about fluorescence, dyes, and fluorometers and a description of fluorometric operation and calibration procedures as a general guide for laboratory and field use. The background information should be useful to anyone wishing to experiment with dyes, fluorometer components, or procedures different from those described. In addition, a brief section is included on aerial photography because of its possible use to supplement ground-level fluorometry. (USGS)
W86-03043

STREAM-GAGING PROGRAM IN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Kircher, and H. E. Petsch.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-451, 1984. 48 p, 2 fig, 8 ref.

Descriptors: Stream discharge, *Gaging stations, Hydrologic data collection, *Colorado, *Streamgaging program, Cooperators, Funding.

This report documents the results of a study of the streamflow information program in Colorado. Presently (1983), 353 continuous surface-water stations are operated in Colorado on a budget of $2,005,786. Data uses and funding sources are identified for each of the 353 stations. Data from most stations have multiple uses. (USGS)
W86-03057

FIELD GUIDELINES FOR COLLECTION, TREATMENT, AND ANALYSIS OF WATER SAMPLES, MONTANA DISTRICT,

Geological Survey, Helena, MT. Water Resources Div.
J. R. Knapton.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-409, 1985. 86 p, 7 fig, 8 tab, 12 ref.

Descriptors: Bacteria, Dissolved oxygen, Field tests, Sample preparation, Sample preservation, Samplers, Specific conductance, Water analyses, *Data collections, *Sampling, *Water quality, *Montana, Hydrogen ion concentration.

This manual provides a set of standardized guidelines and quality-control procedures for the collection and preservation of water samples and defines procedures for field analyses of unstable constituents or properties. Seldom is the water being samples of such uniformity that a single grab sample is representative of the whole. For this reason a variety of sampler types and sampling methods have been devised. Descriptions and procedures for field use are given for a number of sampler types. Several methods of sampling are described for which these samplers can be used. Sample-processing devices such as sample splitters and filtration apparatus are discussed along with methods of cleaning. Depending on the type of analysis to be performed in the laboratory, samples may need to be preserved shortly after collection. Various types of preservation are described in detail. Analyses for unstable constituents or properties are of necessity accomplished in the field. This manual addresses analytical techniques and quality assurance for: (1) Water temperature, (2) specific conductance, (3) pH, (4) alkalinity, (5) dissolved oxygen, and (6) bacteria. Examples of field report forms are given as attachments. Information pertinent to certain field calculations is also presented. (USGS)
W86-03060

TEST WELLS IN CENTRAL WASHINGTON, 1977-79: DESCRIPTION AND RESULTS,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03062

ANNUAL YIELD AND SELECTED HYDROLOGIC DATA FOR THE ARKANSAS RIVER BASIN FOR THE ARKANSAS RIVER BASIN COMPACT, ARKANSAS OKLAHOMA, 1984 WATER YEAR,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03074

GROUND-WATER RESOURCES OF BOTTINEAU AND ROLETTE COUNTIES, NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03075

GROUND-WATER QUALITY APPRAISAL OF SURFICIAL SAND-PLAIN AQUIFERS IN HUBBARD, MORRISON, OTTER TAIL, AND WADENA COUNTIES, MINNESOTA,

Geological Survey, Grand Rapids, MN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03080

HYDROLOGIC INSTRUMENTATION FACILITY OF THE U.S. GEOLOGICAL SURVEY,

Geological Survey, NSTL Station, MS. Water Resources Div.
C. R. Wagner, and S. Jeffers.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-227, 1984. 18p, 9 fig.

Descriptors: *Instruments, Equipment, Facilities, *Instrumentation support, Centralized facility.

The U.S. Geological Survey Water Resources Division has improved support to the agencies field offices by the consolidation of all instrumentation support services in a single facility. This facility known as the Hydrologic Instrumentation Facility (HIF) is located at the National Space Technology Laboratory, Mississippi, about 50 miles east of New Orleans, Louisiana. The HIF is responsible for design and development, testing, evaluation, procurement, warehousing, distribution and repair of a variety of specialized hydrologic instrumentation. The centralization has resulted in more efficient and effective support of the Survey's hydrologic programs. (USGS)
W86-03164

TOTAL PRECIPITABLE WATER AND RAINFALL DETERMINATIONS FROM THE SEASAT SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR),

National Environmental Satellite, Data, and Information Service, Washington, DC.
For primary bibliographic entry see Field 2B.
W86-03238

HCMM HYDROLOGICAL ANALYSIS IN UTAH,

Brigham Young Univ., Provo, UT. Dept. of Civil Engineering.
A. W. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as N83-13520, Price codes: A08 in paper copy, A01 in microfiche. E83-10026, May 1982. Final Report. 166 p, 72 fig, 26 tab, 62 ref. NAS5–26473.

Descriptors: *Satellite technology, *Mapping, *Water quality, *Lakes, *Model studies, Hydrologic models, Infrared imagery, Remote sensing, Models, Nutrients, Eutrophication, Water temperature, Reflectance, Algae, Plankton, Evaporation, Wind velocity, Groundwater.

The NASA Heat Capacity Mapping Mission (HCMM) Satellite was applied to a study of Utah Lake to develop an accurate model for predicting land and water surface temperatures and to examine the relationship among HCMM sensed surface temperature, reflectivity and water quality factors. The study results indicate that the appropriate offset to be applied to calibrate the HCMM model to the Utah Valley area is +5 degrees Celsius. The statistical analyses performed on the data obtained from the HCMM and the water quality measurements made in Utah Lake in 1978 and 1979 yielded several significant relationships. The strong correlations identified between the day infrared, visual reflectivity measurements, and plankton concentration measurements provided the foundation for the use of the color prints to locate areas of algae growth in Utah Lake. Relationships developed between algae concentrations in the lake and nutrient levels were inconclusive. Comparisons of wind and wind speed functions derived from HCMM data

failed to yield a significant correlations. Utah Lake monthly modeled evaporation and pan evaporation correlated well with HCMM day and night temperatures. For short time intervals (days), the night data might be useful in estimating evaporation while for monthly evaporation either night or day data appears useful. The study relating off-season groundwater depth to HCMM sensed thermal IR intensity yielded a mode with a very good correlation to ground truth. (Geiger-PTT)
W86-03241

NEW INSTRUMENTATION FOR AIRBORNE ACID-RAIN RESEARCH,
Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
R. L. Tanner, P. H. Daum, and T. J. Kelly.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019543, Price codes: A02 in paper copy, A01 in microfiche. BNL–31596, April 1982. 20 p, 4 fig, 3 tab, 13 ref. DE-AC02-76CH00016.

Descriptors: *Chemical analysis, *Acid rain, Air pollution, Chemical properties, Acidity, Acids, Sulfuric acid, Sulfides, Sulfur, Nitrogen.

Instrumental methods developed for continuously measuring sulfur dioxide, aerosol sulfur, nitrogen oxides, nitric acid, and ammonia from an aircraft sampling platform are described. Emphasis is on modifications to reduce limits of detection to allow sampling at ambient concentrations in the vicinity of clouds. The use of these data in conjunction with data on cloud water composition and knowledge of the interphase behavior of nitrogen and sulfur oxides and oxyacides, for quantitative evaluation of species contributions to the ionic content of precipitation, is described. Specific instrumentation that is discussed includes a flame photometer with enhanced sensitivity for sulfur compounds; modified ozone-chemiluminescence detectors for nitric acid and nitrous oxides; and a fluoresence derivatization technique for ammonia analysis. (Halterman-PTT)
W86-03242

SATELLITE OBSERVATION OF GREAT LAKES ICE: 1980-81,
National Environmental Satellite, Data, and Information Service, Washington, DC.
For primary bibliographic entry see Field 2C.
W86-03258

UPDATE OF TEXAS LAND COVER MAPS BY COMPUTER-ASSISTED ANALYSIS OF LANDSAT DIGITAL DATA: SUPPORT ACTIVITIES REPORT,
Texas Natural Resources Information System, Austin.
TNRIS-025, April 1981. 23 p, 3 fig, 1 append.

Descriptors: *Natural resources, *Texas, *Information systems, Information exchange, Information retrieved, Geography, Computers, Automation, Computer programs, Mapping, Geologic mapping, Hydrologic maps.

In response to a request by the Texas Department of Water Resources (TDWR), the Texas Natural Resources Information System has utilized computer-assisted digital image processing techniques to map Land Cover/Land Use of the Austin Quadrangle Area from Landsat digital data. The objective of the project was to determine the feasibility of using a computer-assisted approach for updating the land use/land cover maps of the state previously compiled by the TDWR from Landsat paper enlargements to satisfy requirements of the Federal Water Pollution Control Act of 1972. Results of the computer-assisted analysis consisted of a 1:250,000 scale land cover map with categories based on the U.S. Geological Survey's recommendations as outlined in Professional Paper 964. Accuracy of the computer-generated product was determined to be 93% compared to 84% for the visually-interpreted map. Despite encouraging results, however, further studies in other physiographic regions of the State will be necessary to determine if the computer-assisted techniques can be successfully applied on a statewide basis for this particular application. (Author)
W86-03272

LIMNOLOGICAL APPLICATIONS OF MULTISPECTRAL REMOTE SENSING,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. P. Verdin.
REC-ERC-84-2, June 1984. 51 p, 58 fig, 18 tab, 38 ref, 1 append.

Descriptors: *Remote sensing, *Limnologic data collection, Satellite technology, Sensors, Reservoirs, Resource management, Eutrophication, Water quality, Water sampling, Regression analyses, Chlorophyll a.

Results are reported for a 3-year study to assess the utility of multispectral remote sensing for characterizing reservoir water quality conditions. The essence of the approach employed was the relation by regression methods of simultaneously acquired water quality measurements and digital imagery values. Application of the regression equations to entire scenes achieved a spatial extrapolation of the point measurements of water quality. Secchi transparency and chlorophyll a concentration were the water quality variables modeled with greatest success. Both Landsat and airborne multispectral scanner data were employed. In addition, an atmospheric correction was made to account for date-to-date variations in Landsat imagery. This made possible the development of water quality predictive regression equations using data from several dates at once. It also permitted the estimation of reservoir conditions for scenes without concurrent surface sampling data available. A comparison of corrected and uncorrected Landsat image formats is provided, and data processing problems discussed. (Author)
W86-03277

WORKSHOP ON RIVERINE WATER QUALITY MODELING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
L. S. Johnson, D. E. Ford, and D. L. Robey.
Miscellaneous Paper E-81-1, U.S. Army Environmental and Water Quality Operational Studies, February 1981. Final Report. 29 p, 2 tab, 2 app, 10 ref.

Descriptors: *Model studies, *Models, *Rivers, *Water quality, *Hydrologic models, *Symposiums, *Technology transfer, *Mathematical models, Reservoir releases, Dredging, Water quality management, Sediment transport, Data collections, Suspended solid.

A Riverine Water Quality Modeling Workshop held at the U. S. Army Engineer Waterways Experiment Station in April of 1980 defined environmental/water quality problems in large rivers encountered by Corp of Engineer Offices, discussed the adequacy of state-of-the art river models for addressing these problems, and identified possible areas for further improvement of the models under the Environmental and Water Quality Operational Studies Program. Problems associated with water quality were subdivided into three groups: reservoir release, dredging related problems, and several general problems. Modeling problems encompassed such factors as the limitations of one-dimensional steady-state models and problems of model application and costs. Workshop participants recommended collecting data sets for a one-dimensional unsteady flow water quality model and for a two-dimensional vertically averaged model. Other recommendations included improvements for technology transfer and the development and verification of a mathematical algorithm for the transport of fine suspended sediments.
W86-03293

INTERNATIONAL COMPARISON OF NATIONAL PRECIPITATION GAUGES WITH A REFERENCE PIT GAUGE,
World Meteorological Organization, Geneva (Switzerland).
B. Sevruk, and W. R. Hamon.
Instruments and Observing Methods, Report No 17, WMO/TD-No 38, October 1984. 155 p, 9 fig, 14 tab, 55 ref, 6 append.

Descriptors: *Data acquisition, *Measuring instruments, *Rain gages, *Precipitation, Gages.

The average differences between the semidaily amounts of rain as measured by national gages elevated above the ground, and the ground level pit gage were studied at 60 locations throughout the world. Differences ranged from zero to 20%, with an average of 3%. The plots of percentage differences against wind speed at the level of the gage orifice for six evaluation stations showed a considerable scatter. The effect of wind speed was more evident at stations with small rainfall intensities or large values of the percentage proportion (N) of rain falling at intensity equal or smaller than 0.03 mm/min. The evaporation loss estimated at four stations was negligible, 0.2 to 0.9% for the national gages and 0 to 1.3% for the pit gage. The wetting loss was 1 to 9%. The systematic error of point precipitation measurement was 3.5% for the Australian gage, up to 22.3% for the Hellmann gage in Denmark, and 11.7% for the Finnish gage. This report confirms the fact that rainfall as measured by the standard gages elevated above ground is subject to a systematic error which can be corrected. The countries or regions where these corrections are most important are identified. Procedures for introducing corrections into standard practice are described. (Cassar-PTT)
W86-03414

7C. Evaluation, Processing and Publication

RAINFALL-RUNOFF DATA IN THE ALBUQUERQUE, NEW MEXICO, METROPOLITAN AREA, 1976-83,
Geological Survey, Albuquerque, NM. Water Resources Div.
E. E. Fischer, J. J. Rote, and J. P. Borland.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-448, 1984. 306 p, 10 fig, 15 tab, 3 ref.

Descriptors: *Urban hydrology, *Rainfall-runoff relationships, Unit-value data, Daily-value data, Gaging stations, Data collections, *Hydrologic data, Albuquerque, *New Mexico.

Rainfall and discharge data from 13 flood-hydrograph stations in the Albuquerque, New Mexico, metropolitan area are presented. The period of record is from 1976, when the first three stations were installed, through 1983. The data include daily mean values for discharge for the period of record at each station, monthly rainfall totals, and selected rainfall-discharge unit values. Unit-value data are presented at 5-minute intervals; where there is more than one raingage in a drainage basin, the data from all the gages are presented together. Maps of the respective drainage basins are furnished. (USGS)
W86-02933

HISTORICAL WATER-QUALITY DATA FOR THE CLARK FORK (RIVER) AND THE MOUTHS OF SELECTED TRIBUTARIES, WESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-02937

COMPUTER PROGRAM FOR THE COMPUTATION OF TOTAL SEDIMENT DISCHARGE BY THE MODIFIED EINSTEIN PROCEDURE,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02964

CHANGES IN CHANNEL GEOMORPHOLOGY OF SIX ERUPTION-AFFECTED TRIBUTARIES OF THE LEWIS RIVER, 1980-82, MOUNT ST. HELENS, WASHINGTON,

Geological Survey, Vancouver, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-02979

SELECTED TEST-WELL DATA FROM THE MX-MISSILE SITING STUDY, TOOELE, JUAB, MILLARD, BEAVER, AND IRON COUNTIES, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
J. L. Mason, J. W. Atwood, and P. S. Buettner.
Available from OPSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-347, 1985. 13 p, 2 fig, 2 tab, 1 ref.

Descriptors: *Observation wells, *Utah, Great Basin, *Water-level measurements, Lithologic logs, MX-missile drilling program, Well data, Western Utah desert basins.

Ground-water data obtained from the MX-missile siting study in western Utah are presented in this report. The test drilling was divided into two phases, verification and water resources. In the verification phase, numerous borings ranging in depth from 92 to 205 feet were made to obtain data necessary for the design of the MX-basing system. Test wells drilled for the water resources phase ranged in depth from 310 to 1,399 feet; they were designed to determine ground-water availability and to estimate the effects of ground-water withdrawals planned for construction of the MX-basing system. This report includes: well-completion data, water-level measurements, and lithologic logs of selected wells. (USGS)
W86-02980

MAPS TO ESTIMATE AVERAGE STREAMFLOW AND HEADWATER LIMITS FOR STREAMS IN U.S. ARMY CORPS OF ENGINEERS, MOBILE DISTRICT, ALABAMA AND ADJACENT STATES,

Geological Survey, Montgomery, AL. Water Resources Div.
G. H. Nelson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4274. 2 sheets (map), 2 fig, 3 ref.

Descriptors: *Average streamflow, Runoff, Headwaters, Stream gaging stations, *Maps, Army Corps of Engineers, Alabama, Mississippi, Tennessee, Georgia, Florida, *Southeastern U.S.

U.S. Army Corps of Engineers permits are required for discharges of dredged or fill-material downstream from the 'headwaters' of specified streams. The term 'headwaters' is defined as the point of a freshwater (non-tidal) stream above which the average flow is less than 5 cu ft/s. Maps of the Mobile District area showing (1) lines of equal average streamflow, and (2) lines of equal drainage areas required to produce an average flow of 5 cu ft/s are contained in this report. These maps are for use by the Corps of Engineers in their permitting program. (USGS)
W86-02981

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, SEPTEMBER 1984,

Geological Survey, Orlando, FL. Water Resources Div.
L. A. Bradner.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-813, 1984. 1 sheet (map), 1 fig.

Descriptors: *Potentiometric level, *Groundwater, Hydrologic aspects, Aquifer, *Hydrogeology, Sumter County, *Florida, *Maps.

This map presents the potentiometric surface of the Upper Floridan aquifer in central Sumter County, Florida, for September 1984. The Floridan aquifer system is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 feet in the southeastern part of the county to less than 40 feet northwest of Lake Panasoffkee in the west-central area. (USGS)
W86-02985

QUALITY OF GROUND WATER USED FOR PUBLIC SUPPLY IN FLORIDA, 1983-84,

Geological Survey, Tallahassee, FL. Water Resources Div.
G. A. Irwin, R. T. Kirkland, and J. B. Pruitt.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-804, 1985. 1 sheet (map), 1 fig, 5 ref.

Descriptors: *Public water supply, *Groundwater, Priority pollutants, Safe drinking water, Water quality regulations, Trace elements, Organic compounds, *Water quality, Municipal water, *Florida, *Potable water.

From October 1983 through March 1984, a chemical sampling reconnaissance was made of ground water used for public supply for 91 communities throughout Florida. Public supply wells present an excellent network for collecting baseline water-quality information on the quality of ground water prior to any treatment because they are located throughout the State, are in the most populated areas, usually have continuous and often high pumpage, and have great health and economic significance. The reconnaissance was part of several project tasks sponsored by the Florida Department of Environmental Regulation to develop guidelines and data bases for use in the design and implementation of a statewide ground-water monitoring network as mandated by the recent enactment of Florida's Water Quality Assurance Act of 1983. (USGS)
W86-02986

GEOHYDROLOGY OF THE VALLEY AQUIFER IN THE COHOCTON AREA, UPPER COHOCTON RIVER, STEUBEN COUNTY, NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
D. B. Terry, T. S. Pagano, M. L. Shaw, and A. W. Ingram.
Available from OPSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4040, 1985. 7 sheets (map), 7 fig, 5 ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater movement, Geologic mapping, Infiltration capacity, Land use, Well yield, Groundwater levels, Steuben County, *New York, Soil permeability, *Geohydrology.

The Cohocton valley-fill aquifer, composed of outwash, kame, and alluvial sand and gravel, is highly productive and is in hydraulic contact with the Cohocton River. Potential well yields range from 50 to more than 1,000 gallons per minute. Most of the aquifer is under shallow water-table conditions and vulnerable to surface contamination. Thickness ranges from 20 to 100 feet. The aquifer lies in an area containing only small communities and therefore is not heavily pumped. Geohydrologic data are compiled on six maps at 1:24,000 scale and in geologic sections. The maps depict surficial geology, soil-infiltration capacity, potentiometric surface, aquifer thickness, well yields, and land use. The maps are designed to help planners evaluate developments that may affect the aquifer, particularly potential contamination sources. This set is one in a series of four that depict selected aquifers in western New York. It supplements a series that is being done by the U.S. Geological Survey in cooperation with State agencies. The maps are based largely on published reports, file data in several State agencies, and field notes. (USGS)
W86-02987

SYNOPSIS OF SALTWATER INTRUSION IN DADE COUNTY, FLORIDA, THROUGH 1984,

Geological Survey, Miami, FL. Water Resources Div.
H. Klein, and B. G. Waller.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 85-4101, 1985. 1 sheet (map), 8 fig, 12 ref.

Descriptors: *Saline-water intrusion, Permeability, *Water management, Drainage, Withdrawals, *Dade County, *Biscayne aquifer, *Florida, South Florida Water Management District.

The inland position of saltwater at the base of the highly permeable limestone of the Biscayne aquifer in Dade County in 1984 is a consequence of: (1) years of adjustment to lowered water levels resulting from regional drainage for flood control and land reclamation; (2) increased freshwater withdrawals; and (3) water-control and water-management practices implemented at the south part of the hydrologic system as well as in upgradient areas. As water demands in southeast Florida continue to increase, further intrusion could be related to increased pumping from well fields. Implementation of additional management practices to further reduce canal discharge to the ocean would tend to sustain water levels high enough to retard intrusion during dry seasons. (USGS)
W86-02988

ESTIMATION OF INCOMPLETE STREAMFLOW FOR SELECTED SITES ON THE CARSON AND TRUCKEE RIVERS IN CALIFORNIA AND NEVADA, 1944-80,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02990

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, BASIN AND RANGE PROVINCE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
K. A. Sargent, and K. Roggensack.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4119-D, 1983. 81 p, 3 fig, 1 map, 167 ref.

Descriptors: *Granitic rocks, Geology, Hydrogeology, *Maps, Basin and Range province, *Nevada.

Outcrops of granitic rocks have been delineated in Nevada as part of a study by the U.S. Geological Survey of the Basin and Range province of the western United States. The litholigic character, thickness, geologic age, distribution, and sources of data of the granitic rocks, are described. (USGS)
W86-02991

EVALUATION OF THE COST EFFECTIVENESS OF THE 1983 STREAM-GAGING PROGRAM IN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-02992

STREAMFLOW AND BASIN CHARACTERISTICS AT SELECTED SITES IN KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
N. B. Melcher, and K. J. Ruhl.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-704, 1984. 77 p, 2 fig, 14 tab, 12 ref.

Descriptors: *Basin characteristics, *Streamflow characteristics, Hydrologic data, *Kentucky, *Data collections.

Common basin and streamflow characteristics for sites in Kentucky are presented. Basin characteristics include quantified drainage basin parameters

and statistics on areal rainfall. Streamflow characteristics include tables for mean, high and low flow frequencies and partial duration discharge. The data listed in this report are for continuous and low-flow partial-record sites. (USGS)
W86-02993

WATER-LEVEL HYDROGRAPHS FOR OBSERVATION WELLS IN VIRGINIA, 1982,

Geological Survey, Richmond, VA. Water Resources Div.
S. Farrington, N. Carrington, and W. V. Daniels.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-134, 1984. 175 p, 2 fig, 1 tab.

Descriptors: *Observation wells, *Hydrographs, *Hydrologic data, Water wells, Groundwater, *Virginia, Monitoring.

Water-well data for 1982 are presented from 147 observation wells in Virginia. Historical data from two wells are also included. A description of each observation well is provided that gives the well location, site identification number, hydrologic unit, owner, aquifer, well characteristics, general remarks, period of record, and extreme measurements for the period of record. A hydrograph for the period of record is presented for each well. The method and frequency of water-level measurements at each well are presented in tabular format. (USGS)
W86-02996

LOW-FLOW CHARACTERISTICS OF KENTUCKY STREAMS, 1983,

Geological Survey, Louisville, KY. Water Resources Div.
J. N. Sullavan.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-705, 1984. 1 p, 1 map, 2 tab, 3 ref.

Descriptors: *Streamflow, *Low flow, *Kentucky, Data collections, Hydrologic data.

Low-flow data at 84 continuous-record sites and the 7-day 2-year and 7-day 10-year flow at 204 partial-record sites in Kentucky are presented. The station identifier, 7-day 10-year discharge in cubic feet per second and the drainage area in square miles are shown on the map. Other data are shown in tabular form. (USGS)
W86-02998

INDEX OF GROUND-WATER QUALITY DATA FOR FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
P. R. Seaber, and O. O. Williams.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-177, 1985. 478 p, 9 fig, 12 tab, 33 ref.

Descriptors: Groundwater, *Groundwater quality, *Chemical analysis, Water quality, *Indexing, *Information retrieval, Hydrologic data, Aquifers, Geochemistry, Water quality management, Water sampling, *Florida, Water quality data index.

The Master Water Data Index of the U.S. Geological Survey contains records and information for 13,925 ground-water quality collection sites in Florida as follows: 2,180 active and 11,559 inactive well sites, and 39 active and 147 inactive spring sites. Ground-water quality data have been and are being collected at more sites in Florida than are other types of ground- and surface-water hydrologic data. Information available from the Master Water Data Index includes location (county, hydrologic unit, and latitude-longitude); reporting agency; agency identifying number; period and frequency of record; types of data (parameter sampled); and for wells, the principal aquifer sampled and well depth. This information may be retrieved, upon request, in a variety of formats. This report contains an index of the information available, not the actual water-quality data itself. The actual data may be obtained from the reporting agency that collected and stored the data. (USGS)
W86-03002

MAP SHOWING OUTCROPS OF GRANITIC ROCKS, ASH-FLOW TUFF, AND LAHARIC BRECCIA, BASIN AND RANGE PROVINCE, IDAHO,

Geological Survey, Lakewood, CO. Water Resources Div.
K. A. Sargent, and J. E. Jenness.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4117-C, 1984. 7 p, 1 tab, 22 ref.

Descriptors: *Granitic rocks, Ash-flow tuff, Laharic breccia, Geology, *Maps, Hydrogeology, Basin and Range Province, *Idaho.

Outcrops of granitic rocks, ash-flow tuff, and laharic breccia have been delineated within the Basin and Range Province of Idaho as part of a study by the U.S. Geological Survey to evaluate possible repository rocks for disposal of high-level radioactive waste within the Basin and Range Province, western United States. The distribution, lithologic character, geologic age, thickness (where appropriate), the sources of data of the geologic units are described. (USGS)
W86-03005

HYDROGEOLOGIC DATA RELATED TO THE POTENTIAL FOR STOCK-WATER DEVELOPMENT ON FEDERALLY OWNED RANGELAND NEAR DILLON, MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
J. F. Levings.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 85-170, 1985. 22 p, 1 pl, 11 ref.

Descriptors: Groundwater potential, Aquifer evaluation, On-site investigations, *Hydrologic data, Site selection, *Potential water supply, Data collections, Dillon, *Montana, Beaverhead County.

Existing hydrogeologic data and information were synthesized for 20 sites on federally owned rangeland near Dillon, Montana. The purpose was to assist the U.S. Bureau of Land Management in evaluating the potential for developing additional stock-water supplies. Hydrologic and geologic conditions at most of the sites were verified by onsite inspection during the summer of 1984. Each site is described in terms of location, altitude of land surface, inferred aquifer(s), estimated depth to water, estimated drilling depth, estimated yield, estimated dissolved-solids concentration, hydrogeologic setting, and development. A plate shows the location of wells and springs, dissolved-solids concentrations and chemical-constituent diagrams for water samples, ownership status for selected rangeland areas near Dillon. (USGS)
W86-03016

WATER-RESOURCES APPRAISAL OF THE UPPER ARKANSAS RIVER BASIN FROM LEADVILLE TO PUEBLO, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03025

COMPILATION OF GROUND WATER QUALITY DATA IN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
J. L. Barker.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-706, 1984. 102 p, 39 fig, 32 tab, 24 ref.

Descriptors: *Groundwater, *Water quality, Well water, Groundwater pollution, *Geohydrologic units, Geology, Geologic formations, Hydrogeology, *Pennsylvania, *Hydrologic data.

The U.S. Geological Survey's water-quality file of 4,671 wells and springs in Pennsylvania provided the basis for a statistical appraisal of ground-water quality data in Pennsylvania. The data was assembled into computer readable format and sorted into 15 major aquifer groups based on principal lithology, physiographic province, and age. Nineteen variables in each group were analyzed by the Statistical Analysis Systems UNIVARIATE procedure to produce descriptive statistics including detail on the extreme values, quartiles, frequency distribution plots, and tables. Water-quality data are available for the important acquifers in the unconsolidated Coastal Plain sediments, the Triassic sedimentary rocks, the igneous and metamorphic rocks, and the carbonate rocks. On the other hand, water-quality data for aquifer groups in the Appalachian Plateau and Valley and Ridge Province are generally sparse. Statewide, only six wells provide sufficient long-term data for trend analysis. Water quality in Pennsylvania is highly variable. High concentrations of dissolved solids, iron, manganese, sulfate, and nitrate are prevalent forms of natural and manmade contamination. The unconsolidated Coastal Plain aquifers have been most severely degraded. On the other hand, some of the best quality water is found in the quartzite, sandstone, and conglomerate rock units in thee Cambrian and Precambrian rocks. (USGS)
W86-03026

POTENTIOMETRIC SURFACES ON LONG ISLAND, NEW YORK–A BIBLIOGRAPHY OF MAPS,

Geological Survey, Syosset, NY. Water Resources Div.
D. A. Smolensky.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-070, 1983. 31 p, 9 fig, 1 tab, 19 ref.

Descriptors: *Potentiometric level, Water table, Groundwater movement, Water-level fluctuations, *Maps, *Bibliographies, Nassau County, Suffolk County, Kings County, Queens County, Long Island, *New York, *Long Island (NY).

Historic water-level records form a major basis for ground-water investigations and water-management decisions on Long Island. Potentiometric-surface maps, one of the major sources of historic data, are scattered within the literature or are available only through the publisher or sponsoring agency. This report presents a comprehensive list of available water-table and potentiometric-surface maps from the 19th century through 1979 with the scale, years represented, and area depicted; complete bibliographic citations are included to facilitate retrieval. The bibliography is preceded by a summary of the hydrologic system and a short history of ground-water development on Long Island, with emphasis on the effects of urbanization as reflected in ground-water levels. A series of six water-table maps from before 1900 through 1979 is presented to illustrate the major historic ground-water trends. (USGS)
W86-03030

ANNUAL WATER-RESOURCES REVIEW, WHITE SANDS MISSILE RANGE, NEW MEXICO 1983,

Geological Survey, Albuquerque, NM. Water Resources Div.
R. R. Cruz.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-720, 1984. 25 p, 14 fig, 6 tab, 3 ref.

Descriptors: *Hydrologic data, Groundwater, Potentiometric level, Water quality, Slope-area measurement, Peak flow, White Sands Missile Range, *New Mexico.

Ground-water data were collected at White Sands Missile Range in 1983. The total amount of water pumped from White Sands Missile Range supply wells in 1983 was 713,557,500 gallons. The Post Headquarters well field accounted for 686,499,200 gallons of the total. Seasonal water-level fluctuations in the supply wells ranged from a 3.00-foot rise in Stallion Range Well-2 (SRC-2) to a 51.00 foot decline in Post headquarters supply well 11 (SW-11). All of the test wells and observation

wells up to 2 miles east of the Post Headquarters well field showed a decline for the period 1973-1983. Only one test well and one borehole west of the Post Headquarters well field showed a decline in water level; the other five showed a rise in water level for the period 1973-1983. (USGS)
W86-03031

RECORDS OF WELLS, DRILLERS' LOGS, WATER-LEVEL MEASUREMENTS, AND CHEMICAL ANALYSES OF GROUND WATER IN HARRIS AND GALVESTON, COS., TEXAS, 1975-79,
Geological Survey, Austin, TX. Water Resources Div. ,
For primary bibliographic entry see Field 2F.
W86-03045

GROUND-WATER LEVELS IN WYOMING, 1974 THROUGH 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03046

WATER-QUALITY DATA FOR 34 SITES, APRIL AND JUNE, 1984, NEAR THE Y-12 PLANT, THE OAK RIDGE RESERVATION, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03048

WATER BUDGET FOR MAJOR STREAMS IN THE CENTRAL VALLEY, CALIFORNIA, 1961-77,
Geological Survey, Tahoe City, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03050

SUMMARY OF WATER-RESOURCES ACTIVITIES OF THE UNITED STATES DEPARTMENT OF INTERIOR, GEOLOGICAL SURVEY-FISCAL YEAR 1984, SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03067

SELECTED HYDROGEOLOGIC DATA FOR THE BIG MUDDY CREEK VALLEY NEAR PLENTYWOOD, NORTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-03068

GEOHYDROLOGIC SECTIONS, NORTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. D. Whiteman, and A. Martin.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Rresources Investigations Map Report 84-4211, 1984. 1 p, 3 fig, 1 tab, 15 ref.

Descriptors: *Geohydrologic sections, *Aquifer systems, Cenozoic era, *Cross-sections, *Regional analysis, Geohydrology, Maps, *Louisiana, *Mississippi embayment, West Gulf Coastal Plain, *RASA.

Two geohydrologic sections in northern Louisiana were mapped as an initial step to define the flow paths of water in major aquifer systems. This effort is part of the Regional Aquifer System Analysis (RASA) program. One section is a strike along the western part of the Mississippi embayment and the other is a dip section across the Monroe uplift and the western part of the Mississippi embayment. In northern Louisiana, major aquifer systems and confining beds correspond closely to hydrologically as a single confining bed subdividing the Cenozoic sediments into two major aquifer systems. The lower major aquifer system consists of three aquifers--the Wilcox-Carrizo, the Sparta, and the Cockfield--and two confining beds--the Cane River and Cook Mountain Formations. The upper major aquifer system comprises all of the sediments above the clays of the Jackson and Vicksburg Groups. To the north the upper aquifer system serves as a source of recharge to the lower aquifer system. Southward and eastward both aquifer systems are isolated from each other, thicken, and are the sources of freshwater supply throughout much of central and southern Louisiana. (USGS)
W86-03083

ALTITUDE OF WATER TABLE, SURFICIAL AQUIFER, PALM BEACH COUNTY, FLORIDA, APRIL 24-26, 1984,
Geological Survey, Miami, FL. Water Resources Div.
W. L. Miller.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-336, 1985. 1 p (map), 1 fig.

Descriptors: *Water levels, *Water-level fluctuations, *Florida, Palm Beach County, Surficial aquifer.

Water levels in Palm Beach County, Florida, were measured in April 1984 to determine the altitude of the water table in the surficial aquifer. A total of 104 wells and 50 surface-water measurement sites were used to contour the altitude of the water table at 2 and 4-foot intervals. The water-level measurements made in April represent low-water levels near the end of south Florida's dry season. Contours of the water table at this time ranged from 22 feet above sea level in the north-central part of the county to 2 feet near the coast. (USGS)
W86-03085

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1985,
Geological Survey, Orlando, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report (Map) 85-491, 1985. 1 sheet (map).

Descriptors: *Potentiometric surface, *Groundwater, Hydrologic aspects, Aquifers, Hydrogeology, Water levels, *Florida, St. Johns River Water Management District.

This map shows the potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity for May 1985. The Upper Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area of Nassau County a 30-foot interval is used to show a deep cone of depression. The potentiometric surface ranged from 125 feet above sea level in Polk County to 74 feet below sea level in Nassau County. Water levels in key wells ranged from 1 to 8 feet below average for May in response to lack of rainfall and an attendant increase in pumpage. Many levels in the district were considerably below the levels of May 1984. Declines of 5 to 7 feet from May 1984 levels were common in the western and northern parts of the district. However, the largest declines from May 1984 levels were mostly in well fields along the coastline. Levels in some wells reached record lows. (USGS)
W86-03095

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1984,
Geological Survey, Orlando, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open File Report (Map) 84-865, 1984. 1 sheet (map).

Descriptors: *Potentiometric surface, *Groundwater, Hydrologic aspects, Aquifers, Hydrogeology, Water levels, *Florida, St. Johns River Water Management District.

This map shows the potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity for September 1984. The Upper Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area of Nassau County a 40-foot interval is used to show a deep cone of depression. The potentiometric surface ranged from 130 feet above sea level in Polk County to 83 feet below sea level in Nassau County. Water levels in key wells ranged from slightly above average to several feet below average for September in response to diverse area rainfall patterns. Most levels in the district were about the same as the levels of September 1983. However, in Nassau County levels were generally below those of September 1983, and levels in Volusia County were mostly higher than September 1983 levels. (USGS)
W86-03096

POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER SYSTEM IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1984,
Geological Survey, Orlando, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report (Map) 84-801, 1984. 1 sheet (map).

Descriptors: *Potentiometric surface, *Groundwater, Hydrologic aspects, Aquifer, Hydrogeology, Water levels, *Florida, St. Johns River Water Management District.

This map shows the potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity for May 1984. The Upper Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area a 40-foot interval is used to show a deep cone of depression. The potentiometric surface ranged from 126 feet above sea level in Polk County to 84 feet below sea level in Nassau County. Water levels in key wells were mostly above, or less frequently, slightly below averages for May in response to diverse area rainfall patterns. Most levels in the district were about the same, or more commonly, 1 to 2 feet lower than May 1983 levels. (USGS)
W86-03097

URBAN WATER-QUALITY DATA AND STATISTICAL SUMMARIES FOR SELECTED SITES IN THE SHUNGANUNGA CREEK BASIN, TOPEKA, KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-03099

MAY 1984-APRIL 1985 WATER BUDGET OF REELFOOT LAKE WITH ESTIMATES OF SEDIMENT INFLOW AND CONCENTRATIONS OF PESTICIDES IN BOTTOM MATERIAL IN TRIBUTARY STREAMS--BASIC DATA REPORT,
Geological Survey, Nashville, TN. Water Re-

sources Div.
For primary bibliographic entry see Field 5B.
W86-03100

HYDROGRAPHS FROM SELECTED OBSERVATION WELLS AND TOTAL ANNUAL PUMPAGE FROM MUNICIPAL SUPPLY WELLS, 1950-83, SANTA FE, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
S. F. Richey.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-152, 1985. 1 sheet (map), 1 fig.

Descriptors: *Water level fluctuations, *Well hydrographs, Municipal water, *Water use, Groundwater levels, Santa Fe, *New Mexico, *Maps.

Total annual pumpage from seven municipal supply wells for 1950-83 is depicted by a bar graph. Water-level hydrographs for 16 observation wells located throughout the Santa Fe metropolitan area are shown. The period of record for the observation wells is variable; the longest is from 1951 to 1984. All wells are located on a map of the Santa Fe area. (USGS)
W86-03101

HYDROLOGIC DATA FOR URBAN STUDIES IN THE HOUSTON, TEXAS, METROPOLITAN AREA, 1982,

Geological Survey, Austin, TX. Water Resources Div.
F. Liscum, J. P. Bruchmiller, J. S. Hutchison, and E. M. Paul.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 85-407, 1985. 252 p, 20 fig, 19 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, Streamflow, *Texas, *Hydrologic data, Data collections, *Urban hydrologic, *Houston, San Jacinto River basin.

This report contains rainfall and runoff data collected during the 1982 water year for drainage basins in the Houston, Texas, metropolitan area. The information will be useful in determining the extent to which progressive urbanization will affect the yield and mode of occurrence of storm runoff. Rainfall-runoff computations are presented for 16 storm periods during the 1982 water year. (USGS)
W86-03106

GENERALIZED POTENTIOMETRIC SURFACE OF THE EVANGELINE AND EQUIVALENT AQUIFERS IN LOUISIANA, 1980,

Geological Survey, Baton Rouge, LA. Water Resources Div.
A. Martin, and C. D. Whiteman.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4359, 1985. 1 sheet (map), 1 fig, 1 tab, 13 ref.

Descriptors: *Water levels, *Aquifers, *Aquifer systems, Artesian aquifers, Water table, *Louisiana, Pliocene age, Miocene age, West Gulf Coastal Plain, *RASA, Evangeline aquifer, Chicot aquifer, *Maps.

A generalized potentiometric-surface map defines the altitude of water levels for 1980 in wells in the Evangeline aquifer in southwestern Louisiana and stratigraphically equivalent aquifers in southeastern Louisiana. The Evangeline and equivalent aquifers increase in thickness from zero at the northern edge of the outcrop/subcrop belt to more than 2,000 feet along the southern limit of fresh water. The aquifers are recharged by rainfall on the overlying upland terrace deposits of south-central Louisiana, southeastern Louisiana, and southwestern Mississippi. The aquifers are under artesian conditions except locally in the recharge areas. The regional flow direction is primarily southward. Water levels in wells in the Evangeline aquifer are lowered by heavy pumping from the overlying Chicot aquifer in Evangeline and Acadia Parishes. Areally definable cones of depression result from pumpage from the Evangeline and equivalent aquifers in and near Baton Rouge, Eunice, and Ville Platte. Water levels may differ vertically within the aquifer near pumping centers. The map does not account for localized distortion of the regional flow pattern near these centers. (USGS)
W86-03107

HYDROLOGIC DATA FOR THE LARIMER-WELD REGIONAL WATER-MONITORING PROGRAM, COLORADO, 1975-1982,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03110

HYDROGEOLOGIC DATA FROM THE U.S. GEOLOGICAL SURVEY TEST WELLS NEAR WAYCROSS, WARE COUNTY, GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03113

HYDROLOGIC-DATA STATIONS AND LAKE LEVELS, KENAI-NIKISKI AREA, ALASKA, 1983,

Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03115

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
M. E. Cooley.
USGS Open-File Report 83-935, 1983. 6 p, 1 fig (map), 7 ref.

Descriptors: *Satellite technology, *Remote sensing, Geologic faults, Geologic joints, *Maps, *Linear trends, *Lineaments, *Northern Great Plains, Regional aquifers, Landsat imagery, *Wyoming.

The report consists of a map (scale 1:500,000) that shows the linear features determined from Landsat imagery in Wyoming. The linear features, sometimes called linear trends or lineaments, are not identified as to type or origin. Most probably represent fractures or fracture zones, which may affect the movement of water or other fluids through the rocks. The linear features are classified as to length--less than 30 miles, 30 to 200 miles, 200 to 500 miles, and more than 500 miles. (USGS)
W86-03120

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1984,

Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03130

GENERALIZED THICKNESS AND CONFIGURATION OF THE TOP OF THE INTERMEDIATE AQUIFER, WEST-CENTRAL FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03137

GROUND-WATER DATA FOR GEORGIA, 1983,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03139

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN NORTH DAKOTA,

Geological Survey, Cheyenne, WY. Water Resources Div.
M. E. Cooley.
USGS Open-File Report 83-937, 1983. 6 p, 1 fig (map), 7 ref.

Descriptors: *Satellite technology, *Remote sensing, Geologic faults, Geologic joints, *Maps, *Linear trends, *Lineaments, *Northern Great Plains, Regional Aquifer System Analysis, Landsat imagery, High Plains, North Dakota.

The report consists of a map (scale 1:500,000) that shows the linear features determined from Landsat imagery in North Dakota. The linear features, sometimes called linear trends or lineaments, are not identified as to type or origin. Most probably represent fractures or fracture zones, which may affect the movement of water or other fluids through the rocks. The linear features are classified as to length--less than 30 miles, 30 to 200 miles, 200 to 500 miles, and more than 500 miles. (USGS)
W86-03144

WATER RESOURCES DATA, ALASKA WATER YEAR 1981.

Geological Survey, Anchorage, AK. Water Resources Div.
USGS Water-Data Report AK-81-1, 1982. 395 p, 4 fig, 1 tab. Prepared in cooperation with the State of Alaska and with other agencies.

Descriptors: *Alaska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1981 water year for Alaska consist of records of stage, discharge, and water quality of streams; stage and water quality of lakes; and water levels and water quality in wells and springs. This report contains discharge records for 121 gaging stations; stage only record for 1 gaging station; water quality for 63 stations; and water levels for 30 observation wells. Also included are 50 low-flow, 71 crest-stage, and 20 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements of discharge, lake stage, or water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alaska. (USGS)
W86-03146

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN,

Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and R. D. Steger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-123859, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report CO-83-1, 1984. 379 p, 6 fig, 6 tab. Prepared in cooperation with the State of Colorado and with other agencies.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for Colorado for the 1983 water year consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 400 gaging stations, stage and contents of 23 lakes and reservoirs, 6 partial-record low-flow stations, peak flow information for 19 crest-stage partial-record stations, and 20 miscellaneous sites; water quality for 132 gaging stations and 291

miscellaneous sites; and water levels for 55 observation wells. Six pertinent stations in bordering States also are included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W86-03147

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 3. DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN,

Geological Survey, Lakewood, CO. Water Resources Div.
J. T. Steinheimer, R. C. Ugland, H. E. Burch, and E. A. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-210946, Price codes: A12 in paper copy, A01 in microfiche. USGS Water-Data Report CO-83-3, 1984. 270 p, 6 fig, 6 tab. Prepared in cooperation with the State of Colorado and with other agencies.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for Colorado for the 1983 water year consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 400 gaging stations, stage and contents of 23 lakes and reservoirs, 6 partial-record low-flow stations, peak flow information for 19 crest-stage partial-record stations, and 20 miscellaneous sites; water quality for 132 gaging stations and 291 miscellaneous sites; and water levels for 55 observation wells. Six pertinent stations in bordering States also are included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W86-03148

WATER RESOURCES DATA, COLORADO WATER YEAR 1983, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,

Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and R. G. Kretschman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-123867, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report CO-83-2, 1984. 287 p, 6 fig, 6 tab. Prepared in cooperation with the State of Colorado and with other agencies.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for Colorado for the 1983 water year consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 400 gaging stations, stage and contents of 23 lakes and reservoirs, 6 partial-record low-flow stations, peak flow information for 19 crest-stage partial-record stations, and 20 miscellaneous sites; water quality for 132 gaging stations and 291 miscellaneous sites; and water levels for 55 observation wells. Six pertinent stations in bordering States also are included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W86-03149

WATER RESOURCES DATA, LOUISIANA WATER YEAR 1983, VOLUME 1. CENTRAL AND NORTHERN LOUISIANA,

Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, G. R. Stallworth, L. J. Dantin, and C. L. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127751, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report LA-83-1, 1983. 392 p, 18 fig. Prepared in cooperation with the State of Louisiana and with other agencies.

Descriptors: *Louisiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in two volumes, contains records for water discharge at 79 gaging stations (including stage for 69 of these stations); stage only for 50 gaging stations and 11 lakes; contents for 1 reservoir; water quality for 110 surface-water stations (including 33 gaging stations), 10 miscellaneous sites, 12 lakes, and 213 wells; and water levels for 679 observation wells. Also included are data for 195 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W86-03150

WATER RESOURCES DATA, LOUISIANA WATER YEAR 1983, VOLUME 2, SOUTHERN LOUSIANA,

Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, G. R. Stallworth, L. J. Dantin, and C. L. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-169985/AS, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report LA-83-2, 1983. 360 p, 26 fig. Prepared in cooperation with the State of Louisiana and with other agencies.

Descriptors: *Louisiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in two volumes, contains records for water discharge at 79 gaging stations (including stage for 69 of these stations); stage only for 50 gaging stations and 11 lakes; contents for 1 reservoir; water quality for 110 surface-water stations (including 33 gaging stations), 10 miscellaneous sites, and 12 lakes, and 213 wells; and water levels for 679 observation wells. Also included are data for 195 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W86-03151

WATER RESOURCES DATA, NEW MEXICO WATER YEAR 1983,

Geological Survey, Albuquerque, NM. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-169902/AS, Price codes: A22 in paper copy, A01 in microfiche. USGS Water-Data Report NM-83-1, 1984. 525 p, 8 fig, 2 tab. Prepared in cooperation with the State of New Mexico and with other agencies.

Descriptors: *New Mexico, *Hydrologic data, *Surface water, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, Groundwater levels, *Data collections.

Water-resoures data for the 1983 water year for New Mexico consist of records of discharge and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 178 gaging stations; stage and contents for 25 lakes and reservoirs; water quality for 78 gaging stations; and 87 observation wells. Also included are 139 crest-stage partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in New Mexico. (USGS)
W86-03152

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1982, VOLUME 1. DELAWARE RIVER BASIN,

Geological Survey, Harrisburg, PA. Water Resources Div.
A. Voytik, T. E. White, D. W. Speight, and K. P. Gillepsie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-161579, Price codes: A12 in paper copy, A01 in microfiche. USGS Water-Data Report PA-82-1, 1982. 252 p, 9 fig. Prepared in cooperation with the State of Pennsylvania and with other agencies.

Descriptors: *Pennsylvania, *Hydrologic data, *Groundwater, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites.

Water-resources data for the 1982 water year for Pennsylvania consist of records of discharge and water quality of streams; elevation and contents of lakes and reservoirs; and elevation of tides; and water levels of ground-water wells. This volume contains records for water discharge at 66 gaging stations; elevation and contents at 11 lakes and reservoirs; elevation of tides at 1 gaging stations; water quality at 33 gaging stations; and water levels at 16 observation wells. Also included are data for 34 crest-stage, 80 low-flow, and 43 water-quality partial-record stations. Locations of these sites are shown on figures 6 through 9. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W86-03153

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 1. DELAWARE RIVER BASIN,

Geological Survey, Harrisburg, PA. Water Resources Div.

T. E. White, D. W. Speight, K. P. Gillespie, and R. L. Druther.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-210920, Price codes: A12 in paper copy, A01 in microfiche. USGS Water-Data Report PA-83-1, 1984. 261 p, 9 fig. Prepared in cooperation with the State of Pennsylvania and with other agencies.

Descriptors: *Pennsylvania, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites.

Water-resources data for the 1983 water year for Pennsylvania consist of records of discharge and water quality of streams; elevation and contents of lakes and reservoirs; and elevation of tides; and water levels of ground-water wells. This volume contains records for water discharge at 68 gaging stations; elevation and contents at 11 lakes and reservoirs; elevation of tides at 5 gaging stations; water quality at 33 gaging stations; and water levels at 16 observation wells. Also included are data for 33 crest-stage, 62 low-flow, and 43 water-quality partial-record stations. Location of these sites are shown on figures 6 through 9. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 2 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local and Federal agencies in Pennsylvania. (USGS)
W86-03154

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS,

Geological Survey, Harrisburg, PA. Water Resources Div.
J. W. Buchanan, W. C. Loper, W. P. Schaffstall, and R. A. Hainly.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128007, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report PA-83-2, 1984. 283 p, 10 fig. Prepared in cooperation with the State of Pennsylvania and with other agencies.

Descriptors: *Pennsylvania, *Hydrologic data, *Groundwater, *Surface waters, *Water Quality, Gaging Stations, Streamflow, Flow Rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, Data collections, Sites.

Water-resources data for the 1983 water year for Pennsylvania consist of records of discharge and water quality of streams; contents of lakes and reservoirs; and water levels, and water quality of ground-water wells. This volume contains records for water discharge at 84 stations; contents at 13 lakes and reservoirs, water quality at 18 gaging stations; and water levels at 26 network observation wells. Also included are data for 12 crest-stage, 98 low flow, and 3 water-quality, and 85 ground water-quality partial-record stations. Locations of these sites are shown on figures 7-10. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analysis. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W86-03155

WATER RESOURCES DATA, PENNSYLVANIA WATER YEAR 1983, VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASINS,

Geological Survey, Harrisburg, PA. Water Resources Div.
J. B. Lescinsky, M. B. Coll, and R. W. Siwicki.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128015, Price codes: A09 in paper copy, A01 in microfiche. USGS Water-Data Report PA-83-2, 1984. 183 p, 5 fig. Prepared in cooperation with the State of Pennsylvania and with other agencies.

Descriptors: *Pennsylvania, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites.

Water-resources data for the 1983 water year for Pennsylvania consist of records of discharge and water quality of streams; elevation and contents of lakes and reservoirs; and water levels of ground-water wells. This volume contains records for water discharge at 83 gaging stations; elevations and contents at 3 lakes and reservoirs; and water levels at 31 observation wells. Also included are data for 3 crest-stage and 5 low-flow stations. Locations of these sites are shown on figures 4 and 5. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analysis. These data together with the data in Volumes 1 and 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local and Federal agencies in Pennsylvania. (USGS)
W86-03156

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 2. LONG ISLAND,

Geological Survey, Syosset, NY. Water Resources Div.
A. G. Spinello, J. H. Nakao, W. J. Flipse, and J. G. Carcaci.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127983, Price codes: A11 in paper copy, A01 in microfiche. USGS Water-Data Report NY-83-2, 1984. 248 p, 14 fig, 1 tab. Prepared in cooperation with the State of New York and with other agencies.

Descriptors: *New York, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites.

Water-resources data for the 1983 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water quality of precipitation; and water levels and water quality of ground water wells. This volume contains records for water discharge at 17 gaging stations; water quality at 17 gaging stations, 647 wells; and water levels at 136 observation wells. Also included are data for 79 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey in cooperation with State, Federal, and other agencies in New York. (USGS)
W86-03157

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 3. WESTERN NEW YORK,

Geological Survey, Ithaca, NY. Water Resources Div.
J. B. Hood, W. H. Johnston, H. J. Zajd, and H. L. Dixson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127991, Price codes: A10 in paper copy, A01 in microfiche. USGS Water-Data Report NY 83-3, 1984. 206 p, 5 fig, 1 tab. Prepared in cooperation with the State of New York and with other agencies.

Descriptors: *New York, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water analysis, Water temperature, Water levels, Water wells, *Data collections, Sites, Seepage investigations.

Water-resources data for the 1983 water year for New York consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of ground-water wells. This volume contains records for water discharge at 84 gaging stations; stage only at 14 gaging stations; stage and contents at 6 gaging stations; water quality at 14 gaging stations; and water levels at 20 observation wells. Also included are data for 63 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and seepage investigations. These data together with the data in Volumes 1 and 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in New York. (USGS)
W86-03158

WATER RESOURCES DATA, HAWAII AND OTHER PACIFIC AREAS WATER YEAR 1983. VOLUME 1, HAWAII,

Geological Survey, Honolulu, HI. Water Resources Div.
S. S. Chinn, G. A. Tateishi, and J. J. S. Yee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-125623. Price codes: A11 in paper copy, A01 in microfiche. USGS Water-Data Report HI-83-1, 1984. 243 p, 14 fig. Prepared in cooperation with the State of Hawaii and with other agencies.

Descriptors: *Hawaii, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Hawaii and other Pacific Areas consist of records of stage, discharge, and water quality of streams and springs; and water levels and water quality in wells. This report, volume 1, contains discharge records for 97 gaging stations; water quality for 13 gaging stations, 92 partial-record flow stations, and 159 wells; and water levels for 24 observation wells. Also included are 108 crest-stage partial-record stations and 24 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W86-03159

WATER RESOURCES DATA, HAWAII AND OTHER PACIFIC AREAS WATER YEAR 1983. VOLUME 2,

Geological Survey, Honolulu, HI. Water Resources Div.
S. S. Chinn, G. A. Tateishi, and J. J. S. Yee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127769, Price codes: A08 in paper copy, A01 in microfiche. USGS Water-Data Report HI-83-2, 1984. 162 p, 15 fig. Prepared in cooperation with the Governments of Guam, Northern Mariana Islands, Federated States of Micronesia, Palau Islands, American Samoa, and with other agencies.

Descriptors: *Pacific area, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Reservoirs, Water temperatures, Sampling sites, Water levels, *Data collections.

Volume 2 of the water-resources data for the 1983 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams and springs; stage of a lake and a reservoir; and water levels and water quality in wells. This

report contains discharge records for 37 gaging stations; stage only record for 2 gaging stations; water quality for 9 gaging stations; 12 partial-record stations; water temperature for 36 gaging stations; and water levels for 30 observation wells and water quality for 78 ground-water sites. Also included are 43 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating Governments and Federal agencies in other Pacific areas. (USGS)
W86-03160

WATER RESOURCES DATA, KENTUCKY WATER YEAR 1983,

Geological Survey, Louisville, KY. Water Resources Div.
J. M. Bettandorff, N. B. Melcher, D. W. Leist, and D. V. Whitesides.
USGS Water-Data Report KY-83-1, 1984. 519 p, 12 fig, 3 tab. Prepared in cooperation with the State of Kentucky and with other agencies.

Descriptors: *Kentucky, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Gaging stations, Streamflow, Flow rates, Lakes, Wells, Chemical analyses, Suspended sediments, Water temperature, Water levels, *Data collections.

Water-resources data for the 1983 water year for Kentucky consist of records of stage, discharge, and water quality of streams; stage and contents of lakes; and water levels and water quality of wells and springs. This report contains discharge records from 108 gaging stations; stage and contents for 15 lakes; suspended-sediment data for 34 stations (10 daily); daily temperature records for 17 stations, daily specific conductance for 10 stations; groundwater levels for 72 continuous-record wells and 104 partial-record wells; water-quality data from 27 surface-water stations sampled at regular intervals, and from 60 wells and 16 springs; and miscellaneous temperature and specific conductance data from 107 gaging stations. Also included are data from 102 partial-record crest-stage sites. Data collected at various miscellaneous sites are also published. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kentucky. (USGS)
W86-03161

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY FOR THE RICHFIELD 1 DEG. BY 2 DEG. QUADRANGLE AND ADJACENT PART OF SOUTHWESTERN UTAH,

M. E. Cooley.
USGS Open-File Report (Map) 83-934, 1984. 4 p, 1 fig (map), 4 ref.

Descriptors: *Satellite technology, *Remote sensing, Geologic faults, Geologic joints, *Maps, *Linear trends, Lineaments, Landsat imagery, *Colorado Plateau, Basin and Range Province, Utah.

The report consists of a map (scale 1:500,000) that shows the linear features determined from Landsat imagery in southwestern Utah. The area extends across the boundary between the Colorado Plateau and the Basin-and-Range physiographic provinces. The linear features, sometimes called linear trends or lineaments, are not identified as to type or origin. Most probably represent fractures or fracture zones, which may affect the movement of water or other fluids through the rocks. (USGS)
W86-03165

INDEX OF HYDROLOGIC DATA FOR SELECTED SITES IN DADE COUNTY, FLORIDA, 1923-80,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03175

DESCRIPTIVE, GEOLOGIC, AND BOREHOLE GEOPHYSICAL LOGS FOR 23 TEST HOLES IN SOUTH-CENTRAL NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03176

DRAINAGE AREAS IN NEW JERSEY: ATLANTIC COASTAL BASINS, SOUTH AMBOY TO CAPE MAY,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03178

WATER RESOURCES DATA, SOUTH DAKOTA WATER YEAR 1983,

Geological Survey, Huron, SD. Water Resources Div.
E. B. Hoffman, N. F. Leibbrand, D. R. Winter, and R. D. Benson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127850, Price codes: A12 in paper copy, A01 in microfiche. USGS Water-Data Report SD-83-1, 1984. 269 p, 7 fig, 5 tab. Prepared in cooperation with the State of South Dakota and with other agencies.

Descriptors: *South Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for South Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 107 gaging stations, stage and contents for 13 lakes and reservoirs; water quality for 26 gaging stations; and water levels for 7 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Dakota. (USGS)
W86-03179

WATER RESOURCES DATA, TENNESSEE WATER YEAR 1983,

Geological Survey, Nashville, TN. Water Resources Div.
J. F. Lowers, P. H. Counts, H. L. Edmiston, and F. D. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127462, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Rept TN-83-1, 1984. 327 p, 6 fig, 1 tab. Prepared in cooperation with the Tennessee Dept of Health and Environment, Div of Water Management; Tennessee Valley Authority; and other State, municipal, and Fed agencies.

Descriptors: *Tennessee, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment analyses, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 96 gaging stations; stage only records for one lake gaging station; elevation and contents for 28 lakes and reservoirs; water quality for 25 stations and 49 wells; and water levels for 33 observation wells. Also included are 116 crest-stage partial-record stations and 83 low-flow partial-record stations. Additional water data were collected at various stream and spring sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses, or as seepage investigations of discharge and water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Tennessee. (USGS)
W86-03180

WATER RESOURCES DATA, IDAHO WATER YEAR 1983,

Geological Survey, Boise, ID. Water Resources Div.
R. W. Harper, H. G. Sisco, I. O'Dell, and S. C. Cordes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-169555/AS, Price codes: A22 in paper copy, A01 in microfiche. USGS Water-Data Report ID-83-1, 1984. 515 p, 30 fig, 3 tab. Prepared in cooperation with the State of Idaho and with other agencies.

Descriptors: *Idaho, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 170 gaging stations; stage only records for 2 gaging stations; stage only for 8 lakes and reservoirs; contents only for 17 lakes and reservoirs; water quality for 21 gaging stations and 37 wells; and water levels for 433 observation wells. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho, adjacent States, and Canada. (USGS)
W86-03181

WATER RESOURCES DATA, IOWA WATER YEAR 1983,

Geological Survey, Iowa City, IA. Water Resources Div.
I. L. Burmeister, V. L. Spiers, P. J. Soenksen, and W. J. Matthes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-126019, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report IA-83-1, 1984. 292 p, 12 fig, 2 tab. Prepared in cooperation with the State of Iowa and with other agencies.

Descriptors: *Iowa, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Streamflow, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, *Data collections, Water wells.

Water-resources data for the 1983 water year for Iowa consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 116 gaging stations; stage and contents for 7 lakes and reservoirs; water quality for 17 gaging stations; and water levels for 90 observation wells. Also included are 125 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. The data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Iowa. (USGS)
W86-03182

WATER RESOURCES DATA, KANSAS WATER YEAR 1983,

Geological Survey, Lawrence, KS. Water Resources Div.
C. O. Geiger, D. L. Lacock, L. R. Shelton, M. L. Penny, and C. E. Merry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-167740/AS, Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Data Report KS-83-1, 1984. 483 p, 8 fig, 6 tab. Prepared in cooperation with the State of Kansas and with other agencies.

Descriptors: *Kansas, Sampling sites, *Hydrologic data, *Surface water, *Groundwater, Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water level, Water analysis, *Data collections.

Water-resources data for the 1983 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells. This report contains discharge records for 141 gaging stations; stage and contents for 24 lakes and reservoirs; water quality for 52 gaging stations; and water levels for 471 observation wells and water quality for 212 wells. Also included are data for 91 crest-stage partial-record stations. All data in this report represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kansas. (USGS)
W86-03183

WATER RESOURCES DATA, GEORGIA WATER YEAR 1983,

Geological Survey, Doraville, GA. Water Resources Div.
W. R. Stokes, T. W. Hale, J. L. Pearman, and G. R. Buell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-168748/AS, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report GA-83-1, 1984. 365 p, 7 fig, 1 tab. Prepared in cooperation with the State of Georgia and with other Federal agencies.

Descriptors: *Georgia, Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Wells, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Georgia consist of records of state, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and ground-water levels. This report contains discharge records of 104 gaging stations; stage for 11 gaging stations; stage and contents for 17 lakes and reservoirs; water quality for 14 continuous stations, 107 periodic stations and miscellaneous sites; peak stage and discharge only for 122 crest-stage partial-record stations and 4 miscellaneous sites; and water levels of 28 observation wells. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Georgia. (USGS)
W86-03184

WATER RESOURCES DATA, NEW JERSEY WATER YEAR 1983, VOLUME 1: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY,

Geological Survey, Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and F. L. Schaefer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127330, Price codes: A14 in paper copy, A01 in microfiche. USGS Water-Data Report NJ-83-1, 1984. 320 p, 7 fig, 3 tab. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *New Jersey, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume of the report contains discharge records for 80 gaging stations; tide summaries for 1 station; stage and contents for 15 lakes and reservoirs; water quality for 68 surface-water sites and 82 wells; and water levels for 50 observation wells. Also included are data for 41 crest-stage partial-record stations, 17 tidal crest-stage gages, and 47 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in New Jersey. (USGS)
W86-03185

WATER RESOURCES DATA, NEW YORK WATER YEAR 1983, VOLUME 1: EASTERN NEW YORK EXCLUDING LONG ISLAND,

Geological Survey, Albany, NY. Water Resources Div.
R. Lumia, P. M. Burke, R. J. Archer, and F. N. Dalton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127975, Price codes: A11 in paper copy, A01 in microfiche. USGS Water-Data Report NY-83-1, 1984. 240 p, 5 fig, 1 tab. Prepared in cooperation with the State of New York and with other agencies.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water analyses, Water temperature, Water levels, Water wells, *Data collections, Sites.

Water-resources data for the 1983 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels of ground-water wells. This volume contains records for water discharge at 96 gaging stations; stage only at 5 gaging stations; and stage and contents at 4 gaging stations, and 19 other lakes and levels at 24 observation wells. Locations of these sites are shown on figures 4A and 4B. Also included are data for 52 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data, together with the data in Volumes 2 and 3, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in New York. (USGS)
W86-03186

WATER RESOURCES DATA, ARKANSAS WATER YEAR 1983,

Geological Survey, Little Rock, AR. Water Resources Div.
T. E. Lamb, J. E. Porter, B. F. Lambert, and J. Edds.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-168722/AS, Price codes: A24 in paper copy, A01 in microfiche. USGS Water-Data Report AR-83-1, 1984. 561 p, 5 fig, 3 tab. Prepared in cooperation with the State of Arkansas and with other agencies.

Descriptors: *Arkansas, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Arkansas consist of records of gage height, discharge, and water quality of streams; elevation, contents, and water quality of lakes; water levels and water quality of observation wells. This report contains discharge records for 53 gaging stations; water quality for 148 stations, 49 partial-record stations, 25 observation wells; and water levels for 97 observation wells. Also included are data for 100 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Arkansas. (USGS)
W86-03187

WATER RESOURCES DATA, OREGON, WATER YEAR 1983, VOLUME 2: WESTERN OREGON,

Geological Survey, Portland, OR. Water Resources Div.
L. L. Hubbard, T. D. Parks, D. L. Weiss, and L. E. Hubbard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-168714/AS, Price codes: A18 in paper copy, A01 in microfiche. USGS Water-Data Report OR-83-2, 1984. 412 p, 4 fig, 1 tab. Prepared in cooperation with the State of Oregon and with other agencies.

Descriptors: *Oregon, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Oregon consist of records of stage, discharge, annd water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 254 gaging stations; stage only records for 6 gaging stations; stage and contents for 27 lakes and reservoirs; water quality for 81 stations, water levels for 56 observation wells; and water quality for 1 precipitation station. Also included are 33 crest-stage, partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W86-03188

WATER RESOURCES DATA, INDIANA WATER YEAR 1983,

Geological Survey, Indianapolis, IN. Water Resources Div.
R. L. Miller, R. E. Hoggatt, and G. E. Nell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127355, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report IN-82-1, 1984. 292 p, 6 fig, 3 tab. Prepared in cooperation with the State of Indiana and with other agencies.

Descriptors: *Indiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Water levels, Water analyses, *Data collections, Sampling sites.

Water-resources data for the 1983 water year for Indiana consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 174 gaging stations, stage and contents for 9 lakes and reservoirs, releases from 7 flood control reservoirs, water quality for 5 gaging stations, and water levels for 84 observation wells. Also included are 23 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey

and cooperating State and Federal agencies in Indiana. (USGS)
W86-03189

WATER RESOURCES DATA, NEW HAMPSHIRE AND VERMONT WATER YEAR 1983,
Geological Survey, Boston, MA. Water Resources Div.
F. E. Blackey, J. E. Cotton, and K. W. Toppin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-210938, Price codes: A07 in paper copy, A01 in microfiche. USGS Water-Data Report NH-VT-83-1, 1984. 145 p, 3 fig, 1 tab. Prepared in cooperation with the States of New Hampshire and Vermont and with other agencies.

Descriptors: *New Hampshire, *Vermont, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for New Hampshire and Vermont consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and ground-water levels. This report contains discharge records for 78 gaging stations, stage records for 4 lakes, monthend contents for 25 lakes and reservoirs, water-quality data for 3 gaging stations, and water levels for 30 observation wells. Also included are data for 4 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Locations of gaging stations, partial-record stations (not included above) in bordering States and Province of Quebec are also included in this report. These data represent that portion of the National Water Data System operated by the U.S. Geological Survey and by the cooperating State and Federal agencies in New Hampshire and Vermont. (USGS)
W86-03190

WATER RESOURCES DATA, SOUTH CAROLINA WATER YEAR 1983,
Geological Survey, Columbia, SC. Water Resources Div.
C. S. Bennett, R. D. Hayes, J. W. Gissendanner, and H. E. Herlong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-210573, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report SC-83-1, 1984. 342 p, 5 fig. Prepared in cooperation with the State of South Carolina and with other agencies.

Descriptors: *South Carolina, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 77 gaging stations, stage only at 5 gaging stations, stage and contents at 11 lakes and reservoirs, water quality at 39 gaging stations, and water levels at 67 observation wells. Also included are data for 40 crest-stage partial-record stations. Locations of these sites are shown on figures 3, 4, and 5. Additional water data were collected at various sites not invloved in the systematic data-collection program. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and federal agencies in South Carolina. (USGS)
W86-03191

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 4. NORTHERN CALIFORNIA VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman, J. R. Mullen, W. F. Shelton, and R. G. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-225127, Price codes: A14 in paper copy, A01 in microfiche. USGS Water-Data Report CA-82-4, 1984. 319 p, 12 fig. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 4 contains discharge records for 163 gaging stations; stage and contents for 27 lakes and reservoirs; precipitation data for 2 stations; water quality for 7 stations; and water levels for 54 observation wells. Also included are 4 crest-stage partial-record stations and 4 low-flow partial-record stations. Additional water data are collected at various sites, not part of the systematic data collection program, and are published as special investigations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W86-03192

WATER RESOURCES DATA, CALIFORNIA, WATER YEAR 1982, VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogleman, T. C. Hunter, J. R. Mullen, and R. G. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-223726, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report CA-82-3, 1984, 379 p, 12 fig. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for California consist of records of stage, discharge, gage-height, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels of wells. Volume 3 contains discharge records for 157 gaging stations; stage and contents for 39 lakes and reservoirs; gage height records for two lakes; water quality for 11 stations; and water levels for 54 observation wells. Also included are 11 crest-stage partial-record stations and one water-quality partial-record station. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W86-03193

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY,
Geological Survey, Sacramento, CA. Water Resources Div.
K. L. Markham, V. Piro, W. F. Shelton, and M. W. Weston.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-224708, Price codes: A18 in paper copy, A01 in microfiche. USGS Water-Data Report CA-82-2, 1984, 407 p, 3 fig. Prepared in cooperation with California Department of Water Resources and with other agencies.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 2 contains discharge records for 153 gaging stations; stage and contents for 12 lakes and reservoirs; water quality for 19 stations; water levels for 73 observation wells. Also included are 1 low-flow partial-record station and 13 water-quality partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W86-03194

WATER RESOURCES DATA, CALIFORNIA WATER YEAR 1982, VOLUME 1. SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER,
Geological Survey, Sacramento, CA. Water Resources Div.
J. C. Bowers, M. T. Butcher, C. E. Lamb, J. A. Singer, and G. B. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-220870, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report CA-82-1, 1984. 363 p, 6 fig. Prepared in cooperation with the California Department of Water Resources and with other agencies.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for California consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality in wells. Volume 1 contains discharge records for 160 gaging stations; stage and contents for 19 lakes and reservoirs; water quality for 20 streams and 20 wells; water levels for 174 observation wells. Also included are 10 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W86-03195

WATER RESOURCES DATA, ILLINOIS WATER YEAR 1983, VOLUME 2: ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
K. K. Fitzgerald, P. D. Hayes, T. E. Richards, and R. L. Stahl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-127363, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report IL-83-2, 1984. 385 p, 4 fig. Prepared in cooperation with the State of Illinois and with other agencies.

Descriptors: *Illinois, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 75 gaging stations; stage only at 2 gaging stations; stage only at 3 lake stations, water quality at 95 gaging stations; and water levels at 3 observation wells. Also included are data for 15 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W86-03196

WATER RESOURCES DATA, ILLINOIS WATER YEAR 1983, VOLUME 1: ILLINOIS EXCEPT ILLINOIS RIVER BASIN,

Geological Survey, Urbana, IL. Water Resources Div.
R. L. Stahl, K. K. Fitzgerald, T. E. Richards, and P. D. Hayes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-125755, Price codes: A20 in paper copy, A01 in microfiche. USGS Water-Data Report II-83-1, 1984, 452 p, 4 fig. Prepared in cooperation with the State of Illinois and with other agencies.

Descriptors: *Illinois, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1983 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 76 gaging stations; stage at 15 gaging stations; stage and contents at 3 lakes and reservoirs; and water quality at 115 gaging stations. Also included are data for 13 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W86-03197

WATER RESOURCES DATA, NORTH DAKOTA WATER YEAR 1983,

Geological Survey, Bismarck, ND. Water Resources Div.
R. E. Harkness, and N. D. Haffield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-236305, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report ND-83-1, 1984, 382 p, 18 fig, 2 tab. Prepared in cooperation with the State of North Dakota and with other agencies.

Descriptors: *North Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for North Dakota consist of records of stage, discharge, and water quality of streams; contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 112 gaging stations; stage only records for 17 gaging stations; stage and contents for 10 lakes and reservoirs; water quality for 109 gaging stations; 5 lakes, 29 wells, and water levels for 31 observation wells. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in North Dakota. (USGS)
W86-03198

WATER RESOURCES DATA, NEVADA WATER YEAR 1983,

Geological Survey, Carson City, NV. Water Resources Div.
H. R. Frisbie, R. J. LaCamera, M. M. Riek, and D. B. Wood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-210953, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report NV-83-1, 1984, 328 p, 6 fig. Prepared in cooperation with several Federal, State, and local agencies.

Descriptors: *Nevada, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling siites, Water levels, Water analyses, *Data collections.

Water-resources data published herein for the 1983 water year comprise the following records: water discharge for 109 gaging stations on streams, canals, and drains; discharge data for 35 peak-flow stations and 5 low-flow stations on streams; stage and contents for 21 lakes and reservoirs; water levels for 316 observation wells; water-quality data for 85 stream, canal, and drain sites, 12 lake and reservoir sites, and 3 wells. Additional water data, collected at various sites that are not part of the systematic data-collection program, are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nevada. (USGS)
W86-03199

WATER RESOURCES DATA, OREGON WATER YEAR 1983, VOLUME 1: EASTERN OREGON,

Geological Survey, Portland, OR. Water Resources Div.
L. L. Hubbard, T. D. Parks, and D. L. Weiss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-168706, Price codes: A10 in paper copy, A01 in microfiche. USGS Water-Data Report OR-83-1, 1984. 202 p, 4 fig, 1 tab. Prepared in cooperation with the State of Oregon and with other agencies.

Descriptors: *Oregon, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 254 gaging stations; stage only records for 6 gaging stations; stage and contents for 27 lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 254 gaging stations; stage only records for 6 gaging stations; stage and contents for 27 lakes and reservoirs; water quality for 81 stations, water levels for 56 observation wells; and water quality for 1 precipitation station. Also included are 33 crest-stage, partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W86-03200

WATER RESOURCES DATA, UTAH WATER YEAR 1983,

Geological Survey, Salt Lake City, UT. Water Resources Div.
M. D. ReMillard, G. A. Birdwell, R. B. Garrett, and G. W. Sandberg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128387, Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Data Report UT-83-1, 1984, 489 p, 13 fig, 4 tab. Prepared in cooperation with the State of Utah and with other agencies.

Descriptors: *Utah, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 228 gaging stations; stage and contents for 17 lakes and reservoirs; water quality for 48 hydrologic stations and 106 wells; miscellaneous temperature measurements and field determinations for 155 stations; and water levels for 36 observation wells. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (USGS)
W86-03201

WATER RESOURCES DATA, FLORIDA WATER YEAR 1981, VOLUME 4, NORTHWEST FLORIDA.

Geological Survey, Tallahassee, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-162569, Price codes: A99 in paper copy, A01 in microfiche. USGS Water-Data Report FL-81-4, 1981, 652 p, 46 fig, 1 tab. Prepared in cooperation with the State of Florida and with other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water-resources data for the 1981 water year in Florida consist of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, peak discharge for 78 streams and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous groundwater levels for 488 wells, periodic ground-water levels for 575 wells, and miscellaneous water-level measurements for 2,317 wells; quality of water data for 444 surface-water sites and 613 wells. The data for northwest Florida include continuous or daily discharge for 64 streams, periodic discharge for 19 streams, peak discharge for 41 streams, and continuous or daily stage for 8 streams; continuous elevations for 4 lakes and periodic elevations for 26 lakes; continuous ground-water levels for 38 wells, periodic ground-water levels for 154 wells, and miscellaneous water-level measurements for 264 wells; quality of water for 36 surface-water sites and for 113 wells. (USGS)
W86-03202

WATER RESOURCES DATA, WEST VIRGINIA WATER YEAR 1981, APPENDIX - COAL AREAS AND SPECIAL PROJECTS,

Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-124726, Price codes: A09 in paper copy, A01 in microfiche.

USGS Water-Data Report WV-81-4, 1982. 192 p, 11 fig, 12 tab. Prepared in cooperation with the State of West Virginia and with other agencies.

Descriptors: *West Virginia, Hydrologic data, Surface water, Ground water, Water quality, Flow rate, Chemical analyses, Sediments, Water temperature, Water levels, Water analyses, Sampling sites, *Data collections.

The first section of this report contains data collected during the 1981 water year for the West Virginia Coal Hydrology monitoring project. Records consist of discharge and water-quality data collected at 246 sites in July, at 29 sites in August, and sediment data for 235 sites collected in July. The second section of this report contains data collected during the period January 1978 to December 1981 for the water resources study of the Tug Fork and Twelvepole Creek basins. Records consist of physical data for 347 wells, water level data for two wells, quality analyses of water from 328 wells, and discharge, chemical and biological data for 91 sites sampled several times. (USGS)
W86-03203

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1982,
Geological Survey, Towson, MD. Water Resources Div.
R. W. James, R. H. Simmons, and B. F. Strain.
USGS Water-Data Report MD-DE-82-1, 1983. 382 p, 4 fig, 1 tab. Prepared in cooperation with the States of Maryland and Delaware and with other agencies.

Descriptors: *Maryland, *Delaware, *District of Columbia, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Maryland and Delaware consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 108 gaging stations; stage and contents at 1 reservoir; water quality at 43 gaging stations and 129 wells; and water levels at 27 observation wells. Also included are data for 12 crest-stage, 59 low-flow, and 4 tidal crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Maryland and Delaware. (USGS)
W86-03204

WATER RESOURCES DATA, MAINE WATER YEAR 1982,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Morrill, C. R. Haskell, G. C. Prescott, and T. J. Maloney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-227348, Price codes: A08 in paper copy, A01 in microfiche. USGS Water-Data Report ME-82-1, 1983. 172 p, 3 fig, 1 tab. Prepared in cooperation with the State of Maine and with other agencies.

Descriptors: *Maine, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Maine consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 70 gaging stations; stage only for 1 gaging station; contents for 17 lakes and reservoirs; water quality for 19 gaging stations; and water levels for 32 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W86-03205

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER,
Geological Survey, Tampa, FL. Water Resources Div.
R. T. Mycyk, L. D. Fayard, W. L. Fletcher, and J. K. Ogle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-220862, Price codes: A20 in paper copy, A01 in microfiche. USGS Water-Data Report FL-82-3B, 1983. 468 p, 19 fig, 1 tab. Prepared in cooperation with the State of Florida and with other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water-resources data for the 1982 water year in Florida consist of continuous or daily discharge for 264 streams, periodic discharge for 41 streams, miscellaneous discharge for 71 streams, continuous or daily stage for 102 streams, periodic stage for 15 streams, peak discharge for 83 streams and peak stage for 8 streams; continuous or daily elevations for 102 lakes, periodic elevations for 111 lakes; continuous ground-water levels for 420 wells, periodic ground-water levels for 587 wells, and miscellaneous water-level measurements for 2,794 wells; quality-of-water data for 327 surface-water sites and 791 wells. The data for southwest Florida include continuous or daily discharge for 72 streams, periodic discharge for 28 streams, miscellaneous discharge for 19 streams, peak discharge for 10 streams, continuous or daily stage for 15 streams and periodic stage for 7 streams; continuous elevations for 42 lakes and periodic elevations for 68 lakes; continuous ground-water levels for 229 wells, periodic ground-water levels for 238 wells, and miscellaneous water-level measurements for 1,211 wells; quality of water for 132 surface-water sites and for 228 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W86-03206

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 1A: NORTHEAST FLORIDA SURFACE WATER,
Geological Survey, Orlando, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-162338, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report FL-82-1A, 1983. 287 p, 18 fig, 1 tab. Prepared in cooperation with the State of Florida and with other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water-resources data for the 1982 water year in Florida consists of continuous or daily discharge for 264 streams, periodic discharge for 41 streams, miscellaneous discharge for 71 streams, continuous or daily stage for 102 streams, periodic stage for 15 streams, peak discharge for 83 streams and peak stage for 8 streams; continuous or daily elevations for 102 lakes, periodic elevations for 111 lakes; continuous ground water levels for 420 wells, periodic ground water levels for 587 wells, and miscellaneous water level measurements for 2,794 wells; quality of water data for 327 surface water sites and 791 wells. The data for northeast Florida includes continuous or daily discharge for 61 streams, periodic discharge for 8 streams, miscellaneous discharge for 21 streams, peak discharge for 29 streams, low-flow discharge for 2 streams, continuous or daily stage for 73 streams; continuous elevations for 40 lakes and periodic elevations for 15 lakes; continuous ground water levels for 32 wells, periodic ground water levels for 91 wells, and miscellaneous water level measurements for 779 wells; quality of water for 23 surface water sites and for 173 wells. (USGS)
W86-03207

WATER RESOURCES DATA, TEXAS, WATER YEAR 1982, VOLUME 3; COLORADO RIVER, LAVACA RIVER, GUADALUPE RIVER, NUECES RIVER, RIO GRANDE BASINS AND INTERVENING COASTAL BASINS,
Geological Survey, Austin, TX. Water Resources Div.
B. C. Massey, H. D. Buckner, E. R. Carrillo, and H. J. Davidson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-131820, Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Data Report TX-82-3, 1983. 491 p, 1 fig, 1 tab. Prepared in cooperation with the State of Texas and with other agencies.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collections.

Surface-water data for the 1982 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W86-03208

WATER RESOURCES DATA, MISSOURI WATER YEAR 1983,
Geological Survey, Rolla, MO. Water Resources Div.
L. A. Waite, D. O. Hatten, and P. W. Cross.
Available from the National Technical Information Service, Springfield. VA 22161 as PB85-168730/AS, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report MO-83-1, 1984. 292 p, 5 fig, 3 tab. Prepared in cooperation with the State of Missouri and with other agencies.

Descriptors: *Missouri, *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, *Data collections, Sites.

Water-resources data for the 1983 water year for Missouri consist of records of stage, discharge, and water quality of lakes and reservoirs; contains records for water discharge at 110 gaging stations; stage and contents at 9 lakes and reservoirs; water quality at 24 gaging stations (including 1 lake) and data for 35 crest-stage, and 30 water-quality partial-record stations. (USGS)
W86-03209

WATER RESOURCES DATA, WYOMING WATER YEAR 1983,
Geological Survey, Cheyenne, WY. Water Resources Div.
S. A. Druse, J. R. Schuetz, and S. J. Rucker.
Available from the National Technical Information

Service, Springfield, VA 22161 as PB85-127371, Price codes: A22 in paper copy, A01 in microfiche. USGS Water-Data Report WY-83-1, 1984. 508 p, 6 fig, 2 tab. Prepared in cooperation with the State of Wyoming and with other agencies.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Wyoming consist of records of stage, discharge and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 193 gaging stations; stage and contents for 14 lakes and reservoirs; water quality for 83 gaging stations, and 63 ungaged stations; and water levels for 35 observation wells. Also included are 32 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (USGS)
W86-03210

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER,

Geological Survey, Tampa, FL. Water Resources Div.
R. T. Mycyk, L. D Fayard, W. L. Fletcher, and J. K. Ogle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-223080, Price codes: A25 in paper copy, A01 in microfiche. USGS Water-Data Report FL-82-3A, 1983. 616 p, 15 fig, 1 tab. Prepared in cooperation with the State of Florida and with other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water-resources data for the 1982 water year in Florida consist of continuous or daily discharge for 264 streams, periodic discharge for 41 streams, miscellaneous discharge for 71 streams, continuous or daily stage for 102 streams, periodic stage for 15 streams, peak discharge for 83 streams and peak stage for 8 streams; continuous or daily elevations for 102 lakes, periodic elevations for 111 lakes; continuous ground-water levels for 420 wells, periodic ground-water levels for 587 wells, and miscellaneous water-level measurements for 2,794 wells; quality-of-water data for 327 surface-water sites and 791 wells. The data for southwest Florida include continuous or daily discharge for 72 streams, periodic discharge for 28 streams, miscellaneous discharge for 19 streams, peak discharge for 10 streams, continuous or daily stage for 15 streams and periodic stage for 7 streams; continuous elevations for 42 lakes and periodic elevations for 68 lakes; continuous ground-water levels for 229 wells, periodic ground-water levels for 238 wells, and miscellaneous water-level measurements for 1,211 wells; quality of water for 132 surface-water sites and for 228 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State, and Federal agencies in Florida. (USGS)
W86-03211

WATER RESOURCES DATA, FLORIDA WATER YEAR 1982, VOLUME 1B: NORTHEAST FLORIDA GROUND WATER,

Geological Survey, Orlando, FL. Water Resources Div.
L. D. Fayard, D. M. Bonnet, and R. G. Belles.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-161876, Price codes: A10 in paper copy, A01 in microfiche. USGS Water-Data Report FL-82-1B, 1983. 221 p, 24 fig, 1 tab. Prepared in cooperation with the State of Florida and with other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water-resources data for the 1982 water year in Florida consist of continuous or daily discharge for 264 streams, periodic discharge for 41 streams, miscellaneous discharge for 71 streams, continuous or daily stage for 102 streams, periodic stage for 15 streams, peak discharge for 83 streams and peak stage for 8 streams; continuous or daily elevations for 102 lakes, periodic elevations for 111 lakes; continuous ground-water levels for 420 wells, periodic ground-water levels for 587 wells, and miscellaneous water level measurements for 2,794 wells; quality of water data for 327 surface water sites and 791 wells. The data for northeast Florida includes continuous or daily discharge for 61 streams, periodic discharge for 8 streams, miscellaneous discharge for 21 streams, peak discharge for 29 streams, low-flow discharge for 2 streams, continuous or daily stage for 73 streams; continuous elevations for 40 lakes and periodic elevations for 15 lakes; continuous ground-water levels for 32 wells, periodic ground-water levels for 91 wells, and miscellaneous water level measurements for 779 wells; quality of water for 23 surface water sites and for 173 wells. (USGS)
W86-03212

WATER RESOURCES DATA, VIRGINIA WATER YEAR 1983,

Geological Survey, Richmond, VA. Water Resources Div.
B. J. Prugh, F. J. Easton, and D. D. Lynch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-2244542, Price codes: A19 in paper copy, A01 in microfiche. USGS Water-Data Report VA-83-1, 1984. 442 p, 6 fig, 4 tab.

Descriptors: *Virginia, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1983 water year for Virginia consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 196 gaging stations; stage only at 1 gaging station; stage and contents at 10 lakes and reservoirs; water quality at 47 gaging stations and 2 wells; and water levels at 60 observation wells. Also included are data for 77 crest-stage partial-record stations. Locations of these sites are shown on Figures 5 and 6. Additional water data were collected at various sites not involved in the systematic data-collection program. Discharge measurements were made at 220 low-flow partial-record stations. Miscellaneous data were collected at 215 measuring sites and 51 water-quality sampling sites. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Virginia. (USGS)
W86-03213

WATER RESOURCES DATA, MAINE WATER YEAR 1983,

Geological Survey, Augusta, ME. Water Resources Div.
R. A. Morrill, C. R. Haskell, J. T. Adamik, and W. B. Higgins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-225143, Price codes: A08 in paper copy, A01 in microfiche. USGS Water-Data Report ME-83-1, 1984. 152 p, 3 fig, 1 tab. Prepared in cooperation with the State of Maine and with other agencies.

Descriptors: *Maine, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1983 water year for Maine consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 56 gaging stations; stage only for 2 gaging stations; contents for 17 lakes and reservoirs; water quality for 11 gaging stations; and water levels for 32 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W86-03214

WATER RESOURCES DATA, WISCONSIN WATER YEAR 1983,

Geological Survey, Madison, WI. Water Resources Div.
B. K. Holmstrom, C. A. Harr, and R. M. Erickson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128379, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report WI-83-1, 1984. 352 p, 5 fig. Prepared in cooperation with the State of Wisconsin and with other agencies.

Descriptors: *Wisconsin, *Hydrologic data, *Surface water, *Groundwater, *Water quality, *Acid deposition, Flow rate, Gaging stations, Lakes, Chemical analyses, Microbiological analyses, Sediment, Water levels, *Data collections.

Water-resources data for the 1983 water year for Wisconsin include records of streamflow at gaging stations, partial-record stations, and miscellaneous sites; records of chemical, biological and physical characteristics of surface and ground water. Records of chemical analysis of precipitation, surface and ground water associated with acid deposition are included. In addition water levels in observation wells are reported. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and local agencies and for other Federal agencies in Wisconsin. (USGS)
W86-03215

WATER RESOURCES DATA, WEST VIRGINIA WATER YEAR 1983,

Geological Survey, Charleston, WV. Water Resources Div.
W. N. Embree, E. A. Friel, F. M. Taylor, and T. A. Ehlke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128023, Price codes: A11 in paper copy, A01 in microfiche. USGS Water-Data Report WV-83-1, 1984. 234 p, 5 fig. Prepared in cooperation with the State of West Virginia and with other agencies.

Descriptors: *West Virginia, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for West Virginia consist of records of stage, discharge, and water quality of streams and springs, and water levels in wells. This report contains discharge records for 83 gaging stations; stage only records for 15 gaging stations; water quality for 27 gaging stations; and water levels for 31 observation wells. Also included are 2 crest-stage partial-record stations, and 1 low-flow partial record station. Additional water data were collected at various sites, not part of the systematic data-collections

program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in West Virginia. (USGS)
W86-03216

WATER RESOURCES DATA, OKLAHOMA WATER YEAR 1982,
Geological Survey, Oklahoma City, OK. Water Resources Div.
L. D. Hauth, J. K. Kurklin, D. M. Walters, and D. M. Ferree.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-166668/AS, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report OK-82-1, 1983. 336 p, 6 fig. Prepared in cooperation with the State of Oklahoma and with other agencies.

Descriptors: *Oklahoma, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Oklahoma consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes or reservoirs. This report contains discharge records for 125 gaging stations; stage and contents for 26 lakes or reservoirs; water quality for 38 gaging stations and 3 lakes. Also included are 39 crest-stage partial-record stations and 3 low-flow stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oklahoma. (USGS)
W86-03217

WATER RESOURCES DATA, NEBRASKA WATER YEAR 1982,
Geological Survey, Lincoln, NE. Water Resources Div.
G. B. Engel, R. A. Engberg, and M. S. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-223668, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report NE-82-1, 1984. 369 p, 5 fig, 3 tab. Prepared in cooperation with the State of Nebraska and with other agencies.

Descriptors: *Nebraska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Nebraska consist of both surface water and ground water. This report contains water-discharge records for 157 streamflow gaging stations, 27 partial-record or miscellaneous streamflow stations, and 5 crest-stage, partial-record streamflow stations; stage and content records for 10 lakes and reservoirs; water-quality records for 47 streamflow stations, 29 ungaged streamsites, and 57 wells; and water-level records for 59 observation wells. Additional water-discharge data were collected at various sites, not part of the systematic data-collection program, to determine surface-water/ground-water relationships and are published under low-flow investigations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (USGS)
W86-03218

WATER RESOURCES DATA, MICHIGAN WATER YEAR 1983,
Geological Survey, Lansing, MI. Water Resources Div.
J. B. Miller, J. L. Oberg, and T. Sieger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-225176, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report MI-83-1, 1984. 289 p, 9 fig. Prepared in cooperation with the State of Michigan and with other agencies.

Descriptors: *Michigan, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1983 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water temperature of ground water. This report contains discharge records for 143 gaging stations; stage only records for 3 gaging stations; stage and contents for 5 lakes and reservoirs; water quality for 33 continuous-record stations; and water levels for 53 observation wells. Also included are 74 crest-stage partial-record stations and 8 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Michigan. (USGS)
W86-03219

WATER RESOURCES DATA, ALABAMA WATER YEAR 1983,
Geological Survey, Tuscaloosa, AL. Water Resources Div.
H. C. Rollins, F. C. Sedberry, E. G. Ming, and J. W. Tucker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-123842, Price codes: A20 in paper copy, A01 in microfiche. USGS Water-Data Report AL-83-1, 1984. 458 p, 7 fig, 1 tab. Prepared in cooperation with the Alabama Department of Environmental Management, Geological Survey of Alabama, the Alabama Highway Department, and with other State, municipal, and Federal agen

Descriptors: *Alabama, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 86 gaging stations; stage only for 18 gaging stations, stage and contents for 13 lakes and reservoirs; water quality for 78 gaging stations, 47 wells, 2 precipitation stations, and water levels for 53 observation wells. Also included are 5 crest-stage partial-record stations, 6 flood hydrograph partial-record stations and 55 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W86-03220

WATER RESOURCES DATA, MINNESOTA WATER YEAR 1982, VOLUME 1. GREAT LAKES AND SOURIS-RED-RAINY RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
K. T. Gunard, J. H. Hess, J. L. Zirbel, and C. E. Cornelius.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-163047, Price codes: A10 in paper copy, A01 in microfiche. USGS Water-Data Report MN-82-1, 1983. 212 p, 8 fig. Prepared in cooperation with the State of Minnesota and with other agencies.

Descriptors: *Minnesota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Minnesota consist of records of stage, discharge and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 47 gaging stations; stage-only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 15 gaging stations, 2 stage stations, 20 partial-record stations, and 5 wells; and water levels for 47 observation wells. Also included are 43 high-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. (USGS)
W86-03221

WATER RESOURCES DATA, MINNESOTA WATER YEAR 1982, VOLUME 2: UPPER MISSISSIPPI AND MISSOURI RIVER BASINS,
Geological Survey, St. Paul, MN. Water Resources Div.
K. T. Gunard, J. H. Hess, J. L. Zirbel, and C. E. Cornelius.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-163054, Price codes: A19 in paper copy, A01 in microfiche. USGS Water-Data Report MN-82-2, 1983. 449 p, 9 fig. Prepared in cooperation with the State of Minnesota and with other agencies.

Descriptors: *Minnesota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Minnesota consist of records of stage, discharge and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 83 gaging stations; stage and contents for 9 lakes and reservoirs; water quality for 27 stream stations, 19 partial-record stations, 1 precipitation station, and 63 wells; and water levels for 238 observation wells. Also included are 108 high-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. (USGS)
W86-03222

WATER RESOURCES DATA, OHIO WATER YEAR 1983, VOLUME 1. OHIO RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, L. L. Stewart, and J. R. Kolva.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-224690, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report OH-83-1, 1984. 339 p, 3 fig. Prepared in cooperation with the State of Ohio and with other agencies.

Descriptors: *Ohio, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, Streamflow, Water wells, Benthic fauna, *Data collections, *Ohio River Basin.

Water-resources data for the 1983 water year for Ohio consist of records of stage discharge and water quality of streams; stage and contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 135 gaging stations; stage and contents at 35 lakes and reservoirs; water quality at 24 gaging stations, 117 wells and 6 synoptic sites; and water levels at 168 observation wells. Also

included are data from 70 crest-stage partial-record stations, 42 low-flow partial-record stations, and 10 miscellaneous sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (USGS)
W86-03223

WATER RESOURCES DATA, OHIO WATER YEAR 1983, VOLUME 2. ST. LAWRENCE RIVER BASIN STATEWIDE PROJECT DATA,

Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, L. L. Steward, and J. R. Kolva.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-223676, Price codes: A09 in paper copy, A01 in microfiche. USGS Water-Data Report OH-83-2, 1984. 182 p, 3 fig. Prepared in cooperation with the State of Ohio and with other agencies.

Descriptors: *Ohio, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, Streamflow, Water wells, Benthic fauna, *Data collections.

Water-resources data for the 1983 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 135 gaging stations; stage and contents at 35 lakes and reservoirs; water quality at 24 gaging stations, 117 wells and 6 synoptic sites; and water levels at 168 observation wells. Also included are data from 70 crest-stage partial-record stations, 42 low-flow partial-record stations, and 10 miscellaneous sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Ohio. (USGS)
W86-03224

WATER RESOURCES DATA, NEBRASKA WATER YEAR 1983,

Geological Survey, Lincoln, NE. Water Resources Div.
G. B. Engel, R. A. Engberg, and M. S. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-170371/AS, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report NE-83-1, 1984. 391 p, 5 fig, 4 tab. Prepared in cooperation with the State of Nebraska and with other agencies.

Descriptors: *Nebraska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Nebraska consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and wter quality in wells. This report contains discharge records for 159 streamflow gaging stations, 30 partial-record or miscellaneous streamflow stations, and 5 crest-stage, partial-record streamflow stations; stage and content records for 10 lakes and reservoirs; water-quality records for 46 streamflow stations, 34 ungaged streamsites, and 104 wells; and water-level records for 58 observation wells. Additional discharge and water-quality data were collected at various sites, not part of the systematic data-collection program, to determine surface-water/ground-water relationships and are published under low-flow investigations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (USGS)
W86-03225

WATER RESOURCES DATA, MARYLAND AND DELAWARE WATER YEAR 1983,

Geological Survey, Towson, MD. Water Resources Div.
R. W. James, R. H. Simmons, and B. F. Strain.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-225135, Price codes: A16 in paper copy, A01 in microfiche. USGS Water-Data Report MD-DE-83-1, 1984. 365 p, 3 fig, 1 tab. Prepared in cooperation with the States of Maryland and Delaware and with other agencies.

Descriptors: *Maryland, *Delaware, *District of Columbia, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1983 water year for Maryland and Delaware consist of records of stage, discharge, and water quality of streams, stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 98 gaging stations; stage and contents at 1 reservoir; water quality at 33 gaging stations and 325 wells; and water levels at 24 observation wells. Also included are data for 13 crest-stage and 4 tidal crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Maryland and Delaware. (USGS)
W86-03226

WATER RESOURCES DATA, ARIZONA WATER YEAR 1982,

Geological Survey, Tucson, AZ. Water Resources Div.
N. D. White, and W. B. Garrett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128361, Price codes: A19 in paper copy, A01 in microfiche. USGS Water-Data Report AZ-82-1, 1984. 0 p, 8 fig. Prepared in cooperation with the State of Arizona and with other agencies.

Descriptors: *Arizona, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1982 water year for Arizona consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water levels of observation wells; and quality of ground water. This report contains discharge records for 212 gaging stations, annual peaks for 16 crest-stage partial-record stations, and discharge measurements at 11 miscellaneous sites; contents only records for 8 lakes and reservoirs; stage and contents for 1 lake; elevation and discharge for 1 streamflow station; elevation only for 1 streamflow station; 16 supplementary records, included with gaging-station records, consisting of month-end or monthly stage, contents, and evaporation of lakes and reservoirs, diversions, and return flows; water-quality records for 60 continuous-record stations and 3 miscellaneous sites; water levels for 97 observation wells; and water-quality data for water from 247 wells. The data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating Federal and State agencies in Arizona. (USGS)
W86-03227

WATER RESOURCES DATA, MONTANA WATER YEAR 1983, VOLUME 1: HUDSON BAY AND MISSOURI RIVER BASINS,

Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, M. A. Jacobson, and M. L. Kasman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128031, Price codes: A25 in paper copy, A01 in microfiche. USGS Water-Data Report MT-83-1, 1984. 585 p, 10 fig, 8 tab. Prepared in cooperation with the State of Montana and with other agencies.

Descriptors: *Montana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses. Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. Volume 1 of this report contains discharge records for 206 gaging stations; stage only records for 1 lake station; stage/contents for 5 lakes and reservoirs; water quality for 101 stations; water levels for 6 observation wells. Also included are 141 crest-stage partial-record stations and 33 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. Specific conductance determinations are also published for each discharge measurement made during the year. (USGS)
W86-03228

WATER RESOURCES DATA, MONTANA WATER YEAR 1983, VOLUME 2, COLUMBIA RIVER BASIN,

Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, M. A. Jacobson, and M. L. Kasman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB85-128411, Price codes: A09 in paper copy, A01 in microfiche. USGS Water-Data Report MT-83-2, 1984. 12 p, 7 fig, 6 tab. Prepared in cooperation with the State of Montana and with other agencies.

Descriptors: *Montana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1983 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. Volume 2 of this report contains discharge records for 54 gaging stations; stage/contents for 3 lakes and reservoirs; water quality for 24 stations, 3 lakes; water levels for 13 observations wells. Also included are 22 crest-stage partial-record stations and 20 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W86-03229

QUEBEC: SURFACE WATER DATA, 1984,

Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 2E.
W86-03235

PROJECT SKYWATER 1983-84 SCPP DATA INVENTORY: SIERRA COOPERATIVE PILOT PROJECT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 2B.
W86-03278

MANITOBA: SURFACE WATER DATA, 1984,
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 2E.
W86-03287

8. ENGINEERING WORKS

8A. Structures

SAFETY TREATMENT OF ROADSIDE PARALLEL-DRAINAGE STRUCTURES,
Texas Transportation Inst., College Station.
H. E. Ross, T. J. Hirsch, and D. Sicking.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-172684, Price codes: A08 in paper copy, A01 in microfiche. Research Report 280-2F, June 1981. 162 p, 19 fig, 4 tab, 9 ref, 2 append.

Descriptors: *Drainage ditches, *Culverts, *Safety, *Highways, *Design criteria, Roads, Hydraulic structures, Models, Simulation analysis, Shoulder ditches, Cost-benefit analysis, Slopes, Computer models.

Research was conducted to develop traffic-safe end treatments for parallel-drainage structures that would not appreciably restrict water flow. Parallel-drainage culverts are used to convey water under driveways, side roads, or median crossovers. Preliminary designs were evaluated using a computer simulation program and a full-scale test program. From these studies, tentative design parameters were selected. The end treatment developed in the preliminary studies was then subjected to full-scale prototype testing. These tests involved evaluation of the end treatment on a 6.7 to 1 driveway slope with a subcompact automobile. The end treatment was subjected to tests at 40 and 50 miles/hr. A benefit/cost analysis was conducted to determine warrants for the use of the treatment. To achieve a traffic-safe driveway/culvert design the following conditions should be met: the roadway sideslope and driveway slope should be 6 to 1 or flatter; the transition area between the roadway sideslope and the driveway slope should be rounded or smoothed as opposed to an abrupt transition; safety treatment of the culvert opening should include an end section cut to match the driveway slope with grates spaced about every 2 ft perpendicular to the direction of water flow and strong enough to support a load of about 10,000 pounds. Based on the benefit/cost analysis, guidelines were developed that identify conditions that warrant safety treatment of parallel drainage culverts on rural high-speed highways. (Geiger-PTT)
W86-03250

REHABILITATION OF A CALCIUM CARBONATE CLOGGED DRAINAGE SYSTEM USING SULFAMIC ACID,
Bureau of Reclamation, Billings, MT. Upper Missouri Region.
For primary bibliographic entry see Field 4B.
W86-03268

IN SITU SEISMIC INVESTIGATION OF COYOTE DAM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Geotechnical Lab.
R. E. Wahl, J. L. Llopis, and R. F. Ballard.
Miscellaneous Paper GL-81-1, March 1981. Final Report. 48 p, 28 fig.

Descriptors: *Seismic investigation, *Seismic waves, Compression waves, Shear waves, Velocity, On-site investigations, Coyote Dam, California.

An in situ seismic investigation consisting of surface refraction seismic, downhole, and crosshole tests was conducted at Coyote Dam, near Ukiah, California. Compression- and shear-wave (P- and S-wave) velocities as a function of depth were determined at two cross sections of the dam (sta 118+00 and 126+00). P- and S-wave velocity profiles were also determined for the materials which comprise the left abutment. The profiles constructed for the dam showed that P-wave velocities in the core increased from 2100 to 4600 fps with depth. The random fill section of the dam was determined to have a velocity of 3600 fps. A horizontal gravel blanket drain underlying the random section was determined to have a velocity of 4800 fps. The P-wave velocity of the dam's foundation materials had velocities ranging between 4100 and 7600 fps. The S-wave velocity profiles showed that velocities ranging between 41 and 7600 fps. The S-wave velocity profiles showed that velocities in the dam's core increased from 850 to 1250 fps except at sta 126+00 where a velocity of 950 fps was noted for the lower 50 ft of core material. The random fill section of the dam had a velocity of 1400 fps, with its underlying horizontal gravel drain having a velocity of 1600 fps. The materials on the left abutment displayed P-wave velocities ranging between 1600 and 5500 fps. The S-wave velocities for these materials ranged betwen 850 and 1950 fps.
W86-03296

PAWCATUCK RIVER AND NARRAGANSETT BAY DRAINAGE BASINS WATER AND RELATED LAND RESOURCES STUDY: BLACKSTONE RIVER WATERSHED,
Corps of Engineers, Waltham, MA. New England Div.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120073, Price codes: A05 in paper copy, A01 in microfiche. Main Report, August 1981. 92 p, 3 fig, 8 tab, 5 plates + Environmental Assessment.

Descriptors: *Flood control, *Flood protection, Flood damage, Pawtucket River Basin, Narragansett Bay, Environmental impact statement, Planning, Financing, Economic evaluation, Cost sharing, Massachusetts.

The Blackstone River Watershed Study, a component of the overall Pawtucket River and Narragansett Bay Drainage Basins (PNB) Study, reviewed some 40 potential projects to meet the flood control and other water resource needs in the study area. This report describes the area under study and its problems, needs and opportunities with regard to flooding. The investigation determined that local flood protection plans for the Berkeley Industrial Park in Cumberland, Rhode Island were the only plans to produce net economic and environemtnal benefits. Although the town of Cumberland supported the $6.1 million structural solution for Berkeley involving 5,100 feet of dike and walls, the non-Federal costs under the proposed cost sharing policies was beyond the financial resources of the town. The town therefore requested the Army Corps of Engineers to pursue the $1.2 million non-structural solution involving 1,290 feet of ringwalls and flood proofing for three buildings and the town pumping station. The report also contains the Environmental Assessment of the Berkeley Local Protection Project.
W86-03301

DISSOLVED NITROGEN MEASUREMENTS AT CLARKS HILL RESERVOIR GEORGIA-SOUTH CAROLINA,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. H. Merritt, and D. Leggett.
Miscellaneous Paper E-81-3, U.S. Army Environmental and Water Quality Operational Studies, September 1981. Final Report. 20 p, 4 fig, 9 plates, 7 ref.

Descriptors: *Dissolved oxygen, *Nitrogen, *Reservoirs, *Oygenation, *Dissolved nitrogen, *Reservoir operation, *Aeration, *Denitrification, Water quality, On-site investigations, *Gas chromatography, Oxygen depletion, Sediments, Water quality management, Water analysis, Georgia, South Carolina.

Several oxygen injection systems have been investigated to enhance the dissolved oxygen distribution in the withdrawal zone of a reservoir, thereby increasing the dissolved oxygen concentration in the downstream area. Additionally, oxygen injection could result in nitrogen stripping in the water column as a result of the induced changes in the relative partial pressures. A short-term field study was conducted to investigate the effect of oxygen injection on dissolved nitrogen concentrations. An innovative portable gas chromatograph system was used to measure dissolved nitrogen and the results were compared with data obtained from simpler, but less accurate systems. In the immediate vicinity of the oxygen-injection site, the nitrogen released far overshadowed the nitrogen stripped and a net increase was observed. The maximum nitrogen concentration observed in the reservoir was 111 percent of surface saturation. The increase in nitrogen concentration was apparently due to denitrification of entrained anoxic sediments. (Author)
W86-03304

BUFFALO METROPOLITAN AREA, NEW YORK WATER RESOURCES MANAGEMENT: INTERIM REPORT ON FEASIBILITY OF FLOOD MANAGEMENT IN TONAWANDA CREEK WATERSHED,
Corps of Engineers, Buffalo, NY. Buffalo District.
Final Feasibility Report, Main Report, November 1981. 125 p, 11 tab, 22 photos, 15 plates, 2 app, addendum.

Descriptors: *Flood control, *Reservoir capacity, *Tonawanda Creek, Batavia, *New York, Dams, Earth dams, Spillways, Flood protection.

This report recommends construction of the Batavia Reservoir Compound modified alternative to provide flood damage reduction in the Tonawanda Creek Watershed, New York. The alternative consists of two shallow detention reservoirs (normally dry) arranged in series. The reservoirs would be formed by construction of two earth dams. Each dam would have principal outlet works comprised of side-by-side conduits; five for the upper dam and four for the lower, with dimensions of 11 ft. by 11 ft. Each conduit would be equipped with an electrically operable gate and provisions for manual operation. The spillways of both dams would be riprapped on the upstream and downstream and crests. The amount of reservoir flood control storage and operation of the selected plan were developed to meet the planning objectives of the study. The degree of protection afforded by the plan is approximately 500-years in the city of Batavia and variable downstream.
W86-03305

SUMMARY REPORT: MODEL-PROTOTYPE COMPARISON STUDY OF DIKE SYSTEMS, MISSISSIPPI RIVER; POTAMOLOGY INVESTIGATIONS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
J. J. Franco.
Technical Report HL-82-11, May 1982. Final Report. 85 p, 30 plates.

Descriptors: *Model studies, *Comparison studies, *Dikes, *Spur dikes, *Channel improvement, *Stream stabilization, *Mississippi River, *Prototype tests, Levees, Models, Stream improvement, Unstable channels, Hydrologic models, Rivers, Performance evaluation, Prototypes, Hydraulic models.

In conjunction with the Mississippi River Commission Potamology Program, movable-bed model studies were conducted of seven of the most complex and troublesome reaches of the Mississippi River to assess the effectiveness of plans proposed for the improvement and stabilization of those reaches. Due to the limited size and shape of the test facility, only a relatively short reach of the river including the problem could be reproduced in each model with little or no overbank areas. Model results showed that qualitative predictions could be made of most of the principal trends in the river using the plans tested. The degree of

accuracy of the models varied and depended on the model adjustment, characteristics of the reach, flow conditions, and similarity between plans tested and actual construction. Analyses of model and prototype data allowed an evaluation to be made of the performance of various types of dikes and dike systems and some of the principles involved in the developments within alluvial streams.
W86-03307

ASSESSMENT OF IMPLANTED SUBSTRATE SAMPLERS FOR MACROINVERTEBRATES INHABITING STONE DIKES OF THE LOWER MISSISSIPPI RIVER,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W86-03309

SACO RIVER-CAMP ELLIS HARBOR, SACO, MAINE: SMALL NAVIGATION PROJECT, DETAILED PROJECT REPORT AND ENVIRONMENTAL ASSESSMENT,

Corps of Engineers, Waltham, MA. New England Div.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA120063, Price codes: A09 in paper copy, A01 in microfiche. December 1981, 200 p, 13 fig, 5 tab, 5 app, 17 ref.

Descriptors: *Dredging, *Harbors, *Ice breakup, Commercial fishing, Benthic environment, Sediments, Navigation, Cost-benefit analysis, Piers, Economic justification, Government finance, Saco River, Maine.

The paramount navigation need identified at Saco, Maine, is the protection of the harbor from ice flows in the Saco River, to give year-round use of the harbor. Evaluation of the alternatives indicated that the optimum plan consists of dredging a 3-acre 6-ft deep anchorage protected by a series of 11 icebreaker structures, to be located to the east of the existing city pier and adjacent of the existing Federal navigation channel in the Saco River, as well as two icebreaker structures to be located to the west of the city pier and placed to protect that structure. Based on projected waterway use, the selected plan is economically justified. Total cost would be $237,700. Annual charges of $29,000 when compared to annual project benefits of $121,700 yield a benefit-cost ratio of 4.2:1. Due to the commercial nature of the project, the cost would be borne totally by the Federal government. It is anticipated that maintenance of the anchorage will be required every 6 years, and replacement of the icebreakers will be required every 25 years. Maintenance of the project will be a Federal responsibility.
W86-03322

8B. Hydraulics

FLOODFLOW CHARACTERISTICS OF FILBIN CREEK AT PROPOSED INTERSTATE HIGHWAY 526, NORTH CHARLESTON, SC,

Geological Survey, Columbia, SC. Water Resources Div.
For primary bibliographic entry see Field 4C.
W86-02969

VIRDEN CREEK PUMPING STATION AND GRAVITY-FLOW OUTLET STRUCTURE, WATERLOO, IOWA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
E. D. Rothwell.
Technical Report HL 81-1, March 1981. Final Report. 42 p, 7 fig, 7 tab, 4 photos, 11 plates.

Descriptors: *Hydraulic models, *On-site investion, *Pumping plants, *Gravity flow, *Outlets, *Surveys, Hydraulic design, Conduits, Hydraulics, Flow, Fluid flow, Virden Creek, Cedar River, Iowa.

The model study was conducted to evaluate the characteristics of the pumped and gravity flows through the proposed structures from Virden Creek into the Cedar River and to develop practical modification if required to improve the hydraulic performance of the structures. Hydraulic performance of the original design four-conduit gravity-flow structure was inadequate with unsymmetrical flow. This was attributed to the existing structures and the indirect approach to the gravity structure. This unsymmetrical flow through the original four-conduit gravity-flow structure was improved by a three-conduit structure which enhanced the hydraulic and structural adequacy of the gravity-flow outlet structure. Hydraulic performance of the original converging-sidewall, low-submergence pump sump indicated that air-entraining surface vortices would occur intermittently in the vicinity of the pump intakes. A modified pump sump with rounded approach pier noses and a hydraulic performance. Sediment deposition expected during gravity-flow operations was simulated with results indicating that normal sand and gravel deposits should not affect performance of the pumping station with the gates to the pump sump closed during gravity-flow conditions.
W86-03299

HYDRAULIC MODEL STUDIES OF BARTLETT DAM,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
P. H. Burgi, and K. L. Houston.
Available from Engineering and Research Center, Denver, CO. Report No GR-81-3, May 1981. 63 p, 30 fig, 3 tab, 2 app.

Descriptors: *Dam design, *Model studies, *Hydraulic models, *Models, *Dam construction, *Spillway gates, *Buttress dams, Dams, Dam stability, Flood discharge, Arizona.

Hydraulic model studies were conducted to investigate recommended plunge pool design changes for protection of the Bartlett Dam spillway chute. The model was also used to study spillway gate sequencing for low discharges, overtopping of the five center bays of the buttress dam during flood discharges, and calibration of the free flow and gate-controlled spillway discharges. The initial topography which resulted from the March 1978 spillway discharges, and two proposed plunge pool design modifications were tested in the model. Based on impact pressure data and visual observations, the Concrete Dams Section staff designed a concrete mat to prevent further upstream erosion of the rock at the base of the spillway chute. An operational procedure was developed for spillway gate sequencing to prevent overtopping of the left training wall during low discharges. The sequencing of gates was also studied to deflect the flow away from the right side of the plunge pool during repairs in 1979. Two river channel modifications downstream from the plunge pool were studied in the model. To pass flood discharges greater than 6031 cu m/sec, the five center bays of the buttress dam will be overtopped.
W86-03343

FLOW MEASUREMENT FLUMES: APPLICATIONS TO IRRIGATION WATER MANAGEMENT,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
J. A. Replogle, and M. G. Bos.
IN: Advances in Irrigation, Volume 1, 1982. p 147-217, 23 fig, 12 tab, 20 ref.

Descriptors: *Flumes, *Weirs, *Irrigation engineering, *Irrigation design, *Irrigation ditches, Irrigation canals, Hydraulic design, Hydraulic equipment, Hydraulic engineering, Hydraulic structures, Theoretical analysis, Models, Numerical analysis, Canal design, Flow measurement.

The design, theory, and application of long-throated flumes, particularly the hydraulically related broad-crested weirs, to irrigation flow measurements in delivery-system canals and farm ditches, both lined and unlined are considered. The use of long-throated flumes is recommended for measuring flows in open channels whenever the water surface at the control section must remain free. Types of long-throated flumes include the trapezoidal flumes, complex shape flumes, and the broad-crested weirs. Flow in long-throated flumes is governed by the principles of critical flow. Modular limits vary widely for various weirs and flumes and is usually related to the degree of parallel flow achieved in the throat section and the friction and eddy losses caused by the structure and the associated downstream expansion section, if one is used. A numerical example for a trapezoidal flume in a trapezoidal channel is given along with a discussion of the mathematical modeling of long-throated flumes. Factors which influence calibration include dimensional errors of construction, errors in zeroing the readout device, roughness changes with time, seasonal temperature effects on fluid viscosity, and sensitivity of the readout device. Selection of flume style and site are considered along with numerical examples for the selection of flume dimensions for trapezoidal lined canals. Structures and adaptations to fit flumes into unlined canals are examined. (Geiger-PTT)
W86-03404

FLUID FLOWS: PUMPS, PIPES AND CHANNELS,

Exxon Research and Engineering Co., Florham Park, NJ.
N. P. Cheremisinoff.
Ann Arbor Science, Ann Arbor, MI. 1982. 623 p, 3 append.

Descriptors: *Hydraulics, *Fluid flow, *Pumping, Pipes, *Channel flow, Flow, Pressure-measuring instruments, Manometers, Viscosity, Laminar flow, Capillarity, Shear stress, Turbulent flow, *Pipe flow, Dimensional analysis, Friction, Hydraulic valves, Pumps, Flow rates, Drag, Roughness coefficient, Reynolds number, Network design, Valves, Flow measurement, Flow around objects, Flow characteristics, Flowmeters, Cavitation, Weirs, Flumes, Nonnewtonian flow, *Open-channel flow.

An introductory and practical reference text to standard process flow problems is directed to engineering students in fluid mechanics, engineers reviewing principles and calculations, and process engineers in first job positions. The first of the book's two sections is a review of basic fluid mechanics principles. Chapters include systems of units (including the International System), fluid statics and pressure measurement, properties of fluids, motion and energy equations, laminar flow, turbulence, and dimensional analysis. In the second section these principles are applied to specific design practices for handling incompressible flows (liquids), particularly handling and transportation aspects. Chapters on piping systems discuss calculation methods for pressure drop and flow parameters through piping and devices for flow control and measurement. Chapters on pumping operations include pump classifications, pump performances and characteristics, pump selection, oscillating displacement pumps, mechanical seals for pumps, and cavitation. Flow, usually turbulent, of Newtonian fluids past immersed bodies relates to heat exchangers and cooling towers. Flow of non-Newtonian fluids deals with laminar flow conditions. Open channel flow characteristics and control principles are applied to flow through sluice gates and flumes, over weirs, and in sewers. (Cassar-PTT)
W86-03415

8C. Hydraulic Machinery

AUTOMATED PLUGGING FACTOR MONITOR: SPECIFICATIONS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W86-03325

AUTOMATIC GENERATION CONTROLLER FOR FLATIRON DISPATCH CENTER-LARAMIE RIVER POWER STATION REMOTE TERMINAL UNIT,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. C. Stitt, and G. Brown.
Available from Engineering and Research Center, Denver, CO. Report No. REC-ERC-81-11, November 1981. 102 p, 1 tab, 7 app, 6 ref.

Descriptors: *Computers, *Control systems, *Automation, *Computer programs, *Data transmission, *Electric powerplants, Data processing, Powerplants, Electric power production, Monitoring.

The operation and maintenance of the Flatiron Automatic Generation Controller (AGC) Interim Controller (FAIC) remote terminal units (RTU) installed at Laramie River Powerplant are described. One RTU is provided for each of the three generators with the fourth unit provided as a spare. Two of the RTU's will be used to monitor and control the two Laramie River generators which will render power to the Flatiron AGC control area or the west area. These RTU's will send and receive control signals from the FAIC master station which is located at the Western Area Power Administration's Flatiron Dispatch Center. The third RTU will communicate with the Watertown AGC computer located at Watertown, South Dakota.
W86-03326

HYDRAULIC MODEL STUDIES OF MODIFICATION TO KLANG GATES DAM, MALAYSIA,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
K. Gibson, and R. A. Dodge.
Available from Engineering and Research Center, Denver, CO. Report No GR-82-12, March 1983. 23 p, 19 fig, 3 tab.

Descriptors: *Hydraulic equipment, *Model studies, *Hydraulic gates, *Radial gates, *Spillway gates, *Hydraulic models, Models, *Hydraulic machinery, Dams, Spillways, Dam design.

A hydraulic model was used to study a proposed modification to Klang Gates Dam, Malaysia. To raise the reservoir elevation 3.05 m, four radial gates were to be added to the double-curvature spillway. Spillway pressures were measured for a flush sillplate and a raised sillplate to accommodate the gates to the curvatures of the spillway. Discharge calibration curves were determined for various gate openings. Hydraulic performance of the proposed spillway modification proved satisfactory. At the design reservoir elevation of 97.8 m and with the gates fully opened, the release was 376.6 cu m/sec. A higher discharges, damage to the gabions and control house by scour, flood, or wave action appeared possible. It was recommended that calibration curves for gate openings smaller than 152 mm be determined in the field by gaging the stream. Four-gate operation is recommended for as low a discharge as is compatible with accuracy requirements and/or confidence in the calibrations developed from the downstream gaging.
W86-03329

CASS - A MICROCOMPUTER CONTROL SYSTEM FOR GRAND COULEE AGC SIGNALS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. R. Schurz, and T. R. Valdez.
Available from Engineering and Research Center, Denver, CO. Report No GR-81-6, August 1981. 64 p, 8 fig, 3 app, 3 ref.

Descriptors: *Computers, *Control systems, *Automation, *Electric power production, *Electric powerplants, *Data transmission, Powerplants, Computer programs, Electronic equipment, Data processing, Grand Coulee Dam, Washington.

A processor dubbed the Coulee Automatic Generation Control (AGC) Signal Stuffer (CASS) was developed and installed at Grand Coulee Powerplant in November 1980. This processor allows the Bonneville Power Administration to receive the actual plant total power generation with minimal delay, thus allowing EPA to implement AGC control of Grand Coulee. As an added benefit, the CASS processor derives and sends to the Grand Coulee programmable master supervisory control a value for substitute generation which relieves the operator of the duty of manually entering changes in substitute generation. The theory, operation, and program flow charts for the new microcomputer control system are presented. The AGC system should prove more predictable and stable as a result of this installation.
W86-03330

LABORATORY TESTS OF A HYDRAULIC PRESSURE SURGE RELIEVER,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
B. W. Mefford.
Available from Engineering and Research Center, Denver, CO. Report No GR-83-4, September 1983. 25 p, 8 fig, 1 app, 4 ref.

Descriptors: *Hydraulic machinery, *Hydraulic valves, *Hydraulic gates, *Model studies, *Models, *Mathematical models, *Simulation analysis, *Surges, Hydraulic equipment, Water pressure, Laboratory tests.

The positive pressure surge reliever capability of the Grove Flexflo Model 887 Surge Reliever Valve was evaluated in laboratory tests. The 4-inch relief valve, supplied by the Grove Valve and Regulator Company, was designed to reduce positive pressure surges in water pipelines by placing it on a pipeline upstream of a quick closing gate valve. During the tests, the gate valve was slammed shut to produce a sharp pressure wave traveling upstream. Performance of the surge reliever valve was determined by measuring the reduction in the pressure wave as it traveled past the valve. Results showed that the Flexflo surge reliever valve is capable of significantly reducing pressure amplitudes of common hydraulic transients. The valve is capable of reacting to overpressure in 8 to 10 milliseconds. Although the valve testing period was of a short duration, the valve proved reliable in all laboratory tests. Complex systems incorporating a relief valve or valves can be mathematically modeled to provide detailed system/valve sizing data.
W86-03340

VARIABLE SPEED A-C MOTOR CONTROLLER FOR CANAL GATE HOISTS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
D. Ehler.
Available from Engineering and Research Center, Denver, CO. Report No GR-83-1, March 1983. 24 p, 4 fig, 5 app.

Descriptors: *Hydraulic equipment, *Hydraulic gates, *Radial gates, *Electrical equipment, *Motors, Hydraulic machinery, Aqueducts, Canals.

A variable speed-motor controller for application to control large radial gate operation was tested in the laboratory. Results showed that the 3-hp variable-speed motor controller is sufficient to provide variable speed operation on the large gage hoists to be installed on the Granite Reef Aqueduct. Noise interference produced by the controller is low enough to be used in the field without causing interference to microprocessor, electronic, and communication circuits. The motor controller must be matched to the motor with respect to horsepower rating and revolutions per minute. The Parajust controller which is temperature rated conservatively will provide cyclic duty at elevated temperatures. D-C voltage motors with controllers provide better low speed control and are more efficient and economical for large horsepower ratings. A-C voltage motors with controllers offer lower cost, especially for induction motors, and require no brushes or slip rings.
W86-03341

8D. Soil Mechanics

HYDROLOGY, GEMORPHOLOGY, AND DAM-BREAK MODELING OF THE JULY 15, 1982, LAWN LAKE DAM AND CASCADE LAKE DAM FAILURES, LARIMER COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
R. D. Jarrett, and J. E. Costa.
Available from OFSS, USGS Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-612, 1984. 109 p, 72 fig, 13 tab, 29 ref.

Descriptors: Dams, *Dam failure, *Floods, *Geomorphology, Dam-break model, Flood routing, Alluvial fan, Earthdams, Flood damage, Hydraulic models, Computer models, *Colorado, Lawn Lake Dam, Cascade Lake Dam, *Piping(dam failure).

On July 15, 1982, Lawn Lake Dam, a 26-foot-high earthfill irrigation dam built in 1903 in Rocky Mountain National Park, Colorado, failed, due to piping, releasing 674 acre-feet of water with a peak discharge of 18,000 cubic feet per second down the Roaring River. Three people were killed, and damages were estimated at $31 million. Cascade Lake Dam, downstream from Lawn Lake Dam, subsequently failed as a result of the flood, increasing the peak flow at this point from 7,210 cubic feet per second to 16,000 cubic feet per second. The flood wave took 3.28 hours to travel 12.5 miles to Lake Estes, where all the floodwater was stored. The channel of the Roaring River was scoured as much as 50 feet and widened 300 feet. An alluvial fan of 42.3 acres, containing 10 million cubic feet of material, was deposited at the mouth of the Roaring River, damming the Fall River and forming a 17-acre lake. Various methods were used to indirectly compute peak discharge, attenuation of flow, and flood traveltime. A version of the National Weather Service dam-break flood model was used to evaluate its performance on high-gradient streams, to provide supplemental hydrologic information, and to evaluate various scenarios of dam-break development. (USGS)
W86-03017

FROST ACTION IN SOIL FOUNDATIONS AND CONTROL OF SURFACE STRUCTURE HEAVING,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2C.
W86-03317

QUANTIFICATION OF PINHOLE TEST EQUIPMENT HYDRAULIC CHARACTERISTICS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. G. Acciardi.
Available from Engineering and Research Center, Denver, CO. Report No. REC-ERC-82-15, September 1982. 73 p, 15 fig, 8 tab, 4 app, 8 ref.

Descriptors: *Soil engineering, *Clays, *Soil properties, *Soil erosion, *Soil classification, *Soil analysis, *Soil tests, *Soil mechanics, Engineering, Soils, Erosion, Turbidity.

A modified pinhole test procedure for identifying dispersive clays was developed by the Bureau of Reclamation. These clays are highly susceptible to erosion and are unsuitable materials for earthwork construction. Changes to the original test procedure developed by Dr. James L. Sherard included increased emphasis on the use of system flow rates in the classification of dispersive soil grade, reduced emphasis on the qualitative test evaluation criteria such as final eroded pinhole size and discharge effluent turidity in the final dispersive grade classification, and designing the equipment to assure atmospheric pressure at the pinhole discharge and verification of the actual hydraulic head on the system. Routine laboratory testing and analysis of Sherard's original data was performed to substantiate proposed changes. An extremely high degree of correlation was found between

solid originally classified as dispersive by Sherard on the basis of effluent turbidity and subsequently reclassified as dispersive on the basis of system flow rates. The quantitative method of evaluating pinhole test results on the basis of flow rates showed considerable improvement over the original qualitative methods because subjective criteria and operator bias are eliminated.
W86-03323

CLOSED-SYSTEM FREEZING OF SOILS IN LININGS AND EARTH EMBANKMENT DAMS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones.
Report No REC-ERC-81-1, March 1981. 52 p, 36 fig, 3 app, 23 ref.

Descriptors: Closed systems, *Freezing, *Linings, *Embankments, Compacted soils, Canal linings, Frost, Frost protection, Soil water, *Soil engineering.

A brief review of studies of closed-system freezing (no source of water except that in voids) of compacted soils performed by other investigators, and the laboratory and field data collected from Water and Power Resources Service experiences are presented. For compacted soil canal linings, laboratory and field test results show that under certain soil and temperature conditions, freezing decreases soil density near the surface, but increases density at depth. In two linings, the average density increased slightly during a 20-year period. Frost penetration measurements made during the 1978-79 winter on a 1.5-m-thick reservoir lining, on three earth dams under construction, and on the Teton Dam remnant are shown along with associated soil conditions, air freezing indexes, and insulating effects of snow and, for one dam, a loose soil cover. There is a discussion of (1) frost penetration in different types of soil with and without gravel particles, (2) the effect of freezing on soil near the surface of partially completed earth dams during winter shutdown periods, (3) the need for investigating frost conditions in preparation for resumption of embankment placement in the spring, (4) a suggestion of possible detrimental freezing action at the interface between a rock abutment and an earth embankment, and (5) the possibility of crack formation caused by soil shrinkage during freezing action.
W86-03328

8E. Rock Mechanics and Geology

GRAVITY SURVEY AND DEPTH TO BEDROCK IN CARSON VALLEY, NEVADA-CALIFORNIA,
Geological Survey, Carson City, NV. Water Resources Div.
D. K. Maurer.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4202, 1985. 20 p, 2 fig, 17 ref.

Descriptors: *Alluvial deposits, *Bedrock, *Gravity studies, Geophysics, *Carson Valley, Depth to Bedrock, *Nevada, *California, Carson Range, Pine Nut Mountains.

Gravity data were obtained from 460 stations in Carson Valley, Nevada and California. The data have been interpreted to obtain a map of approximate depth to bedrock for use in a ground-water model of the valley. This map delineates the shape of the alluvium-filled basin and shows that the maximum depth to bedrock exceeds 5,000 feet, on the west side of the valley. A north-south trending offset in the bedrock surface shows that the Carson-Valley/Pine-Nut-Mountain block has not been tilted to the west as a simple unit, but is comprised of several smaller blocks. (USGS)
W86-03087

8F. Concrete

EVALUATION OF CONCRETE CORES, BLACK CANYON DAM, IDAHO,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
P. O. Castaneda.
Available from Engineering and Research Center, Denver, CO. Report No. GR-83-5, June 1983. 71 p, 2 fig, 1 tab, 2 app.

Descriptors: *Strength, *Core drilling, *Concrete technology, *Concrete dams, *Concrete construction, *Dam stability, *Concrete testing, *Petrography, Dam construction, Dams, Dam foundations, Dam design, Idaho.

In 1977, 6- and 10-inch diameter cores were extracted from Black Canyon Dam (Idaho) which was built by the Bureau of Reclamation in 1924. Results showed that the concrete in the dam is of good quality, with an average compressive strength of 4,500 pounds/sq inch and an average density of 155.4 pounds/cu ft. Petrographic studies showed that the concrete is of satisfactory physical and chemical quality. No evidence of alkali-aggregate reaction, sulfate or chloride attach, or freeze-thaw deterioration was observed in the interior concrete. Direct shear test results, analyzed by linear regression, were comparable to results obtained on other Bureau projects, with the cohesion on sliding friction tests averaging 215.5 pounds/sq inch, and the average angle of friction was 39 degrees. Sliding friction results indicated similar behavior in both unbonded and bonded joints. These results provide necessary data for design modifications required to withstand the redefined maximum inflow design flood and maximum credible earthquake.
W86-03324

THEODORE ROOSEVELT DAM CONCRETE CORE INVESTIGATIONS: 1981,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
T. A. Gaeto.
Available from Engineering and Research Center, Denver, CO. Report No GR-81-12, October 1981. 29 p, 10 fig, 2 tab, 1 app, 3 ref.

Descriptors: *Concrete dams, *Concrete technology, *Dam stability, *Concrete testing, *Concrete construction, *Dam foundations, *Core drilling, *Strength, Dams, Dam construction, Dam design, Reservoirs, Storage capacity, Theodore Roosevelt Dam, Arizona.

Tests made on concrete cores taken in 1979 and 1980 from Theodore Roosevelt Dam, Salt River Project, Arizona showed that the concrete in this dam constructed between 1903 and 1911 is in satisfactory condition. The average ratio of tensile to compressive strength in the concrete core specimens was about 4.4%, a normal value for mass concrete. The tensile bond strength at the rock-mortar interface was less than 50% of the tensile strength of the concrete itself. Cores received with disbonded segments were not concentrated in a specific area of the dam which may indicate that there is not significant stress in a particular area. Petrographic examinations confirmed that the concrete is in satisfactory physical condition, but there is some evidence of very minor deleterious chemical alteration. These tests were done to aid in ascertaining the feasibility of raising the structure to increase flood storage capacities of the reservoir.
W86-03332

EVALUATION OF CONCRETE CORES, ARROWROCK DAM, IDAHO,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. M. Harboe.
Available from Engineering and Research Center, Denver, CO. Report No GR-82-6, March 1982. 31 p, 13 fig, 4 tab.

Descriptors: *Dam construction, *Concrete dams, *Concrete technology, *Core drilling, *Dam stability, *Strength, *Concrete construction, *Concrete testing, Concretes, Dam foundations, Cements, Dams, Dam design, Idaho.

Construction of Arrowrock Dam was completed in 1915. This structure is unique in that it is one of three dams constructed with what was called sand-cement. In 1978, concrete cores were drilled from six locations in the dam. The evaluation of these cores will be used in a feasibility study for the possible modification of the structure. Compressive strength tests indicate a low compressive strength but no significant reduction from the control strengths established during construction. The difference in strength and modulus of elasticity of the concrete when tested in a wet condition, compared to cores tested in a dry condition, was greater than usually observed between wet and dry concrete. No explanation for this behavior was determined. Minor evidence of silica gel was observed but not to the extent that the structure would be affected by an alkali aggregate reaction. (Author)
W86-03342

8I. Fisheries Engineering

WATER QUALITY CRITERIA FOR PRIMARY NURSERY AREAS IN NORTH CAROLINA,
North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
For primary bibliographic entry see Field 5C.
W86-03134

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1983 THROUGH SEPTEMBER 1984,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 10C.
W86-03166

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

PUBLICATIONS OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION, FOR PUERTO RICO AND THE U.S. VIRGIN ISLANDS,
Geological Survey, San Juan, PR. Water Resources Div.
F. Quinones, and M. Lopez.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-229, 1985. 21 p, 167 ref.

Descriptors: *Bibliographies, Publications, *Water Resources Investigations, U.S. Geological Survey, *Puerto Rico, *U.S. Virgin Islands, Vieques, Culebra, St. Thomas, St. John, St. Croix.

A bibliography of water-resources investigations conducted by the U.S. Geological Survey, Water Resources Division in Puerto Rico and the U.S. Virgin Islands was compiled. The bibliography includes an alphabetical listing by author as well as listings by general and specific areas in Puerto Rico and the U.S. Virgin Islands. The publications are also classified by type of report: Open File, Open-File Data Report, KWater-Supply Paper, Water-Resources Investigations, and Professional Paper. (USGS)
W86-03047

INVESTIGATIONS AND RESEARCH IN NEVADA BY THE WATER RESOURCES DIVISION, U.S. GEOLOGICAL SURVEY, 1982-83,
Geological Survey, Carson City, NV. Water Resources Div.
T. Katzer, O. Mossburner, and W. D. Nichols.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 83-768, 1984. 40 p, 1 fig, 26 ref.

Descriptors: *Geothermal resources, *Groundwater, *Waste disposal, *Floods, *Sedimentation, Acid mine drainage, Hydrology, *Nevada, Statewide research investigations.

The Water Resources Division, U.S. Geological Survey, is charged with (1) maintaining a hydrologic network in Nevada that provides information on the status of the State's water resources and (2) engaging in technical water-resources investigations that have a high degree of transferability. To meet these broad objectives, 26 projects were active during fiscal year 1982, in cooperation with 36 Federal, State, and local agencies. Total funds were $3,319,455, of which State and local cooperative funding amounted to $741,500 and Federal funding (comprised of Geological Survey Federal and cooperative program plus funds from six other Federal agencies) amounted to $2,577,955 for the fiscal year. Projects other than continuing programs for collection of hydrologic data included the following topics of study: geothermal resources, areal ground-water resources and ground-water modeling, waste disposal, paleohydrology, acid mine drainage, the unsaturated zone, stream and reservoir sedimentation, river-quality modeling, flood hazards, and remote sensing in hydrology. In total, 26 reports and symposium abstracts were published or in press during fiscal year 1982. (USGS)
W86-03114

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1983 THROUGH SEPTEMBER 1984.
Geological Survey, Helena, MT. Water Resources Div.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-435, May 1984. 44 p, 3 fig, 2 tab, 132 ref.

Descriptors: Data collection, *Water resources projects, Water quality, Surface water, Groundwater, *Montana.

U.S. Geological Survey investigations of the water resources of Montana are described. Hydrologic information and knowledge of the water resources are gained and disseminated principally by programs of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. The Montana district of the U.S. Geological Survey conducts its hydrologic work through a headquarters office in Helena, a subdistrict office in Billings, and field offices in Helena, Fort Peck, and Kalispell. The district employs 67 people to work on 25 funded projects that are organized under the general categories of data-collection programs, problem-oriented studies, a real appraisals, coal-related studies, research projects, and hydrologic studies and research performed under contracts to research organizations. (USGS)
W86-03166

10D. Specialized Information Center Services

OVERVIEW OF CAPABILITIES AVAILABLE THROUGH THE TNRIS GEOGRAPHIC INFORMATION SYSTEM.
Texas Natural Resources Information System, Austin.
TNRIS-017, September 1981. (Reprinted May 1982). 8 p.

Descriptors: *Natural resources, *Texas, *Information systems, Information exchange, Information retrieval, Geography, Computers, Automation, Computer programs, Mapping, Geologic mapping, Hydrologic maps.

The Texas Natural Resources Information System (TNRIS), which was established to provide maximum availability of natural resources data and related information to state, federal, regional, local, and private entities in Texas, is discussed. One aspect of the overall system, a Geographic Information System (GIS), which provides for computer processing of maps and other spatial data, is being developed as one of many analytical tools for handling TNRIS data. The current and anticipated near future TNRIS capabilities for handling spatial data, and procedures for making use of these capabilities are presented. (Halterman-PTT)
W86-03261

TEXAS NATURAL RESOURCES INFORMATION SYSTEM (TNRIS): A PROGRESS REPORT,
Texas Natural Resources Information System, Austin.
TNRIS-033, March 1983, 62 p, 14 fig, 8 tab, 27 ref, 2 append.

Descriptors: *Texas, *Natural resources, *Information systems, Information retrieval, Geography, Computers, Computer programs, Mapping, Geologic mapping, Hydrologic maps.

The origin, design, implementation, and growth of the Texas Natural Resources Information System (TNRIS) are discussed. A review of the various types of services and capabilities that have been developed over the past several years to support user needs is provided. Activities of the Task Force, its committees, and the TNRIS Systems Central staff described include conducting inventories, establishing a library of natural resource data and information, monitoring other systems, and providing an educational program for System staff and users. Also discussed are capabilities for data analysis, including remote sensing and geographic systems, which have been developed to support decision making by the participating State agencies. Examples are provided of the types of approaches used in processing user requests and discusses various assessments of the System that have been made by the Task Force and others. A number of future TNRIS objectives are noted, including planned emphasis on more efficient handling of user requests, additional capabilities for processing natural resource data, and improved means for maintaining current inventories of newly collected data. (Author)
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COMPUTER BASED MAPPING SYSTEM FOR STORAGE AND RETRIEVAL OF SOIL AND LAND USE DATA: SUPPORT ACTIVITIES REPORT,
Texas Natural Resources Information System, Austin.
TNRIS-018, August 1982. 33 p, 8 fig, 5 ref, 2 append.

Descriptors: *Natural resources, *Texas, *Information systems, Information exchange, Information retrieval, Geography, Computers, Automation, Computer programs, Mapping, Geologic mapping, Hydrologic maps.

An automated system to store soils, surface water and land-use information, developed by the Texas Natural Resources Information System (TNRIS) and the Soil Conservation Service (SCS) in Texas, is described. The automated system provides capabilities to select data from master files of soil and land-use data for production of tabular reports and interpretive maps. Computer software from the Map Information Assembly and Display System (MIADS), developed by the Forest Service, was used in conjunction with TNRIS, and served as the foundation for development of the Computer Based Mapping System (CBMS). Using 15.55-acre grid cells, data for more than thirty-five counties have been included in CBMS. The production of line printer plots, and reports of acreage covered by each type of data stored, is discussed. The use of these interpretive maps by Texas agencies is also discussed. (Halterman-PTT)
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SELECTED WATER RESOURCES ABSTRACTS

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

VOLUME 19, NUMBER 9
SEPTEMBER 1986

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 19, NUMBER 9
SEPTEMBER 1986

W86-03420 -- W86-03900

MARCH 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
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Reston, VA 22092

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Anderson-Nichols and Co., Inc., Palo Alto, CA.
A. S. Donigan, J. C. Imhoff, B. R. Bicknell, and J. L. Kittle.
EPA-600/3-84-065, June 1984. Environmental Research Laboratory, Athens, GA. 177 p, 19 fig, 17 tab, 3 app, 20 ref. 68-01-6207.

Descriptors: *Model studies, *Simulation analysis, *Fortran, *Computer programs, *Computer models, *Hydrologic models, *Water quality, *River basins, Models, Iowa River basin, Iowa, Infiltration, Rainfall-runoff relationships.

The Hydrological Simulation Program-FORTRAN (HSPF) is a set of computer codes that can simulate the hydrologic and associated water quality processes on pervious and impervious land surfaces, in the soil profile, and in streams and well-mixed impoundments. The entire application process of HSPF is documented for the Iowa River Basin Study to demonstrate the decisions, procedures, and results that are involved in a typical application. Process steps include study definition, development of a modeling strategy, operational aspects of HSPF use, input and management of time series data, model parameters and parameter evaluation, calibration and verification, and analysis of alternate conditions. These data are intended to supplement the existing HSPF user's manual and programmer's supplement to provide sufficient guidance for the full and intelligent use of the broad range of capabilities of the HSPF model.
W86-03614

STREAMFLOW SUMMARIES FROM TWELVE TRIBUTARIES OF FARMINGTON CREEK, DAVIS COUNTY EXPERIMENTAL WATERSHED, NORTHERN UTAH,
Forest Service, Ogden, UT. Intermountain Region.
J. M. Pankey, and N. V. DeByle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-117689, Price codes: A08 in paper copy, A01 in microfiche. 157 p, 14 fig, 223 tab, 64 ref.

Descriptors: *Watersheds, *Streamflow, *Water yield, *Precipitation, *Hydrologic data, Wasatch Mountains, Runoff, Catchment areas, Tributaries, Grazing, Land use, Canyons, Farmington Creek, Davis County Experimental Watershed, Utah, Rainfall-runoff relationships.

Streamflow in Farmington Creek, a 6400-acre, west-facing watershed in the Davis County Experimental Watershed, has been monitored since 1933. Of the 12 permanent tributaries, ranging from 50 to 464 acres, ten are in steep terrain, two are in more gentle terrain. Data had been collected to study the effects of stopping domestic livestock grazing, which had denuded the watershed and produced damaging mud-rock floods during intense summer rainstorms in 1923 and 1930. For the 12 catchments, mean annual flows are 10.19-25.95 area inches. Mean daily and monthly flows are also tabulated for all years of record, which range from 5 to 21 years during 1939 to 1972. A watershed description and topographic map accompany the data from each tributary. Monthly and annual precipitation records, measured at the Farmington-Rice Station from 1940 to 1972, are listed. Annual precipitation ranges from 29.44 inches to 51.47 inches. Although most of the annual precipitation falls as gentle rain or snow in autumn, winter, and spring, summer thunderstorms have produced very intense rainfall.
W86-03640

USER'S MANUAL FOR EXPLORE-I: A RIVER BASIN WATER QUALITY MODEL, HYDRAULIC MODULE ONLY,
Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi.
EPA 600/3-82-054, May 1982. Environmental Research Laboratory, Athens, GA. 126 p, 16 fig, 4 tab, 7 ref, append. 68-03-2613.

Descriptors: *Computer models, *Hydraulic models, *River basins, *Estuaries, *Water quality, *Reservoirs, *Mathematical models, *Computer programs, Models, Model studies, Mathematical equations, River systems, Hydrologic models.

EXPLORE-I is a computer program that simulates the dynamic hydraulic and water quality characteristics of a river basin. It can be used to study the effects of various flow conditions, waste discharge, and treatment schemes on the water quality conditions of lakes, reservoirs, rivers, and estuaries. EXPLORE-I consists of four computer program modules: hydraulic code for river and estuary flow, quality code for river and estuary systems, hydrothermal code for thermally stratified reservoirs, and quality code for thermally stratified reservoirs. The hydraulic and hydrothermal codes must be run first. This user's manual provides input instructions for the hydraulic module of the EXPLORE-I code. The hydraulic code solves two-dimensional problems with a modified set of one-dimensional Saint Venant equations by superimposing on the estuary or river basin a grid of junctions and channels simulating the actual physical system but allowing only one dimensional flow. Basic programming requirements of the code are given.
W86-03646

WATER QUALITY MONITORING: A SYSTEM'S PERSPECTIVE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 7A.
W86-03655

DATA COLLECTION FOR HYDROCHEMICAL BALANCES: THEORETICAL ASPECTS,
Oslo Univ. (Norway). Inst. of Geophysics.
L. Gottschalk, and B. Webb.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 139-151, 4 fig, 36 ref.

Descriptors: *Hydrologic data collections, *Data interpretation, *Theoretical analysis, *Chemical properties, *Error analysis, *Statistical analysis, *Probabilistic process, *Hydrologic budget, Data collections, On-site data collections, Spatial distribution, Temporal distribution, Errors.

Methodologies are reviewed which may be used to evaluate data content, and uncertainties and errors in hydrochemical data collection and show how these problems can be reversed to one of collecting data in such a way that the data content is maximized or uncertainties and errors are minimized. It is difficult to use error statistics as an objective measure of the worth of hydrochemical data, since it is very difficult to relate errors to the cost of collecting the data. A small relative decrease in the error generally demands a substantial increase in collected data, and the relative benefit of these new data is hard to prove. However, the error terms can usefully indicate a minimum threshold level for the amount of collected data, below which it is impossible to draw meaningful conclusions. Estimated errors are a useful tool for comparing different strategies for data collection, and allow the evaluation of the importance of observations in space relative to observations in time. With respect to hydrochemical balances, this methodology allows the terms giving the largest errors to be analyzed, and indicates where corresponding improvements in data collection may be made. In order to successfully apply these methodologies, there is a need for basic information on variation patterns of hydrochemical elements in space and time and their corresponding scales.
W86-03766

HYDROCHEMICAL RELATIONSHIPS BETWEEN RAINWATER, FLOODS, GROUNDWATER AND LITHOLOGY IN THE AVEDAT GROUP ON THE NEGEV HIGHLANDS, ISRAEL,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
E. Rosenthal, R. Nativ, and A. S. Issar.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 407-418, 2 fig, 7 tab, 11 ref.

Descriptors: *Rain, *Floodwater, *Groundwater, *Geohydrology, *Rocks, *Arid-zone hydrology, *Chemical properties, *Hydrologic models, Hydrologic data collections, Israel, Arid zone, Chemical reactions, Salinity, Salts.

The chemical composition of rainwater falling on the arid Negev is identical to that of rainwater collected over the sub-humid and humid central and northern parts of Israel. It is of bicarbonatic-calcic composition, with the only exception being the higher Ca-content encountered over the dusty desert area and a lower salinity level due to the greater distance of the investigated area from the Mediterranean seashore. The chemistry of floodwaters in the Negev is affected by the interaction of rainwater with the exposed rocks, the dissolution of soluble salts accumulated in the surface layers and ion-exchange with surrounding rocks. The floodwaters of the Upper Zin stand out due to their 25% higher SO4 content. In all floodwaters studied, the bicarbonatic assemblage of the causative rain was preserved. Along the flow-course of the Negev groundwaters, the dissolution of soluble salts from the surrounding rocks becomes the dominant hydrochemical process. The content of soluble Cl and SO4 in the Avedat rocks of the Negev is much higher than in the temperate regions of the country where the main factor influencing the chemistry of groundwater is the composition of rainwater. A model of the hydrochemical relations between rainwater, floodwater, groundwater and the input of soluble salts from the rocks of the Avedat Group was devised to summarize the experimental findings.
W86-03789

SURFACE AND GROUNDWATER MIXING AND IDENTIFICATION OF LOCAL RECHARGE-DISCHARGE ZONES FROM SEASONAL FLUCTUATIONS OF OXYGEN-18 IN GROUNDWATER IN FISSURED ROCK,
Uppsala Univ. (Sweden).
For primary bibliographic entry see Field 2F.
W86-03790

PROCEEDINGS OF STORMWATER AND WATER QUALITY MANAGEMENT MODELING USERS GROUP MEETING.
Environmental Research Lab., Athens, GA.

Group 2A—General

For primary bibliographic entry see Field 5B.
W86-03822

DYNAMIC MODEL ADJUSTMENT,

D. Hoang.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 162-178, 1 fig, 1 tab.

Descriptors: *Mathematical models, *Computer models, *Mathematical studies, Runoff, Transport, Storm water, Calibrations, Vancouver Drainage Basin.

This project describes mathematical approaches to match simulated flows with the flows actually observed at a storm sewer monitoring station. A power series equation is developed and partial differential equations are substituted into the power series to yield a dynamic coefficient. The dynamic coefficient is time, flow and site dependent. The error in the dynamic coefficient is adjusted for depth and the sum of the squares of the residuals is minimalized. The Vancouver Drainage Basin is given as an example.
W86-03831

PREPARING A DESIGN STORM,

Gore and Storrie Ltd., Toronto (Ontario).
S. A. McKelvie.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 191-209, 5 fig, 4 tab, 12 ref.

Descriptors: *Design storms, *Mathematical studies, *Storm water, *Synthetic hydrology, Mathematical models, Gumbel analysis, Rainfall, Watershed.

This project presents methods for, and comments on, constructing 'design' storms. The most commonly used synthetic design storms are the 'Chicago' design storms, the SCS Type II distribution, and direct use of the Intensity-Duration-Frequency (IDF) curve. The Gumbel analysis, or the Log-Pearson Type III analysis, is used on local weather station data to prepare the IDF curve. Regardless of which design is used, the duration of the design storm should be longer than the time of travel from headwater to outlet of the largest watershed.
W85-03833

PREDICTIVE MODEL FOR HIGHWAY RUNOFF POLLUTANT CONCENTRATIONS AND LOADINGS,

Washington Univ., Seattle. Dept. of Civil Engineering.
B. W. Mar, and R. R. Horner.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 210-228, 10 fig, 1 tab, 8 ref.

Descriptors: *Mathematical models, *Urban runoff, *Pollution load, *Nonpoint pollution sources, Highway runoff, Lead, Zinc, Suspended solids, Copper, Phosphorus, Kjeldahl procedure, Nitrogen, Chemical oxygen demand.

This research presents a model with experimental verification for quantifying highway runoff pollutant concentrations and loadings. Composite samples from five hundred storms, at nine locations in Washington state, were analyzed for total suspended solids (TSS), lead, zinc, copper, total phosphorus, total Kjeldahl nitrogen and chemical oxygen demand. The model consists of a component for predicting total pollutant loadings over an extended time period, plus a series of charts with which individual event impacts may be assessed probabilistically. These elements have been assembled in a guidebook for evaluating aquatic impacts due to highway operations and maintenance. It is believed that the specific research findings and the proposed impact assessment procedures apply throughout the Pacific Northwest and that the techniques used to monitor storms and analyze the data are more generally applicable.
W86-03834

CHIMNEY HILL OFF-SITE DRAINAGE STUDY,

MMM Design Group, Norfolk, VA.
J. M. Normann, and E. R. Estes.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 229-247, 7 fig, 5 tab, 7 ref.

Descriptors: *Mathematical models, *Urban drainage, *Drainage patterns, *Simulation analysis, Drainage canals, *Storm runoff, Runoff, Virginia Beach.

This project describes the successful application of the SWMM II model to the drainage system for the Chimney Hill subdivision of Virginia Beach, VA. The SWMM Version II model with EXTRAN option has been successfully applied to the simulation of a series of large storage canals, linked by culverts, and discharging into a tidal estuary. The results from the SWMM Version II model seem reasonable. However, due to shortcomings in the model, it would be beneficial to apply the Version III model to the data. A capability which would be very useful in the EXTRAN model would be the ability to simulate in-line weirs, as well as diversion weirs. In this study, weirs were simulated using short conduits, but instability in the model was a problem. Overall, SWMM Version II worked quite well in simulating the canal system, and the results confirmed the results of the hand calculations performed earlier.
W86-03835

2B. Precipitation

SCPP FORECASTING SUPPORT FOR THE PERIOD 1 DECEMBER 1978 THROUGH 30 SEPTEMBER 1984,

Electronic Techniques, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 3B.
W86-03495

PROBABLE MAXIMUM PRECIPITATION ESTIMATES FOR THE DRAINAGE ABOVE DEWEY DAM, JOHNS CREEK, KENTUCKY,

National Weather Service, Silver Spring, MD. Office of Hydrology.
D. D. Fenn.
NOAA Technical Memorandum, NWS HYDRO 41, August 1985, 33 p, 12 fig, 17 tab, 12 ref.

Descriptors: *Probable maximum precipitation, *Orographic precipitation, *Mathematical studies, *Terrain analysis, *Drainage area, Probabilistic process, Probability distribution, Models, Model studies, Mathematical models, Precipitation, Prediction, Hydrologic models, Kentucky.

This report discusses estimates of probable maximum precipitation (PMP) for the drainage of Johns Creek, Kentucky above Dewey Dam. Estimates are given for duration from 1 to 72 hr for the drainage which is partly within a stippled region identified in Hydrometeorological Report (HMR) No 51, thereby necessitating evaluation of terrain effects on precipitation. Part of the procedures used to evaluate terrain effects required selection of proxy observations of precipitation since there were no reporting locations within the drainage. The remainder of the terrain evaluation procedure was the same as the one reported earlier in NOAA Technical Memorandum NWS HYDRO 39. As in the earlier report, the application procedures of HMR No 52 were used along with generalized PMP estimates from HMR No 51 to obtain a drainage average depth of nonorographic PMP. The final, or total, PMP estimates are the products of the drainage average depth of nonorographic PMP and the orographic intensification factor representing the evaluation of terrain effects within the drainage. (Author)
W86-03503

MULTI-PARAMETER REMOTE MEASUREMENT OF RAINFALL,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. Atlas, C. W. Ulbrich, and R. Meneghini.
Available from the National Technical Information Service, Springfield, VA 22161 as N82-33947, Price codes: A07 in paper copy, A01 in microfiche. NASechnical Memorandum 83971, July 1982 128 p, 19 fig, 1 tab, 108 ref.

Descriptors: *Rainfall, *Remote sensing, *Radiometry, *Radar, *Measuring instruments, *Microwaves, Parametric hydrology, Precipitation.

The measurement of rainfall by remote sensors is reviewed. One-parameter radar rainfall measurement is limited because both reflectivity and rain rate depend on at least two parameters of the drop size distribution (representative raindrop size and number concentration). A generalized rain parameter diagram, includes a third distribution parameter (breadth of drop size distribution), to better specify rain rate and remote variables. Simulations show the improvement in accuracy when combinations of two and three remote measurables are used. Remote measurables are reviewed. These include path-integrated techniques of radiometry and of microwave and optical attenuation. When paths are colinear, attenuation deduced from radar and radiometry agree well with direct measurements. Generally, dual wavelength radar methods designed to improve measurements in small range increments were disappointing. However, when estimated attenuation is used as a constraint on the retrieval of rain profiles from the radar, results are improved. Combinations of two or more of the three measurables, radar reflectivity, attenuation, and/or radiometry, produces promising results when sampling and air motion problems are considered. Dual polarization or differential reflectivity produces the best results in gate-by-gate measurements. Using a third parameter in addition to radar reflectivity factor and differential reflectivity is promising. Personal examination of the radar displays can greatly improve accuracy.
W86-03618

ICE FORMING EXPERIMENT,

Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2C.
W86-03641

INVESTIGATIONS OF LARGE SCALE STORM SYSTEMS: FINAL REPORT,

Air Force Geophysics Lab., Hanscom AFB, MA.
A. A. Barnes, I. D. Cohen, and D. W. McLeod.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-119862, Price codes: A03 in paper copy, A01 in microfiche. AFGL-TR-82-0169, Environmental Research Paper No. 779, June 8, 1982. 44 p, 5 tab, 4 ill, 21 ref, 2 append. 2310.

Descriptors: *Atmospheric water, *Meteorological data collection, *Weather data collections, *Precipitation, *Cloud physics, *Storm morphology, *Crystal growth, *Cyclones, Data collections, Aircraft, On-site data collections, Spatial distribution, Weather, Storms, Clouds, Particle size, Snow.

The microphysics of Large Scale Cloud Systems (LSCS) were investigated using in-situ measurements taken from two specially instrumented U.S. Airforce Aircraft, the MC-130E and a Learjet 36. Data was collected on the distribution of liquid and ice water content, particle size distributions, crystal habits and other meteorological parameters. The LSCS flights helped verify and extend the model of Lo and Passarelli (1981) for studying snowflake growth and also contributed to data being collected in the CYCLES (Cyclonic Extratropical Storms) program by the University of Washington. The morphologies of three storms as they crossed the U.S. were studied in detail. Cirrus cloud studies detected the existence of subvisible cirrus, background cirrus (particles in the 1-10 micron size range) and large isolated ice crystals (a form of subvisible cirrus). The airforce can use this information to gauge hydrometer hazards to reentry and weaponry vehicles and predict possible

effects on laser systems. The results of this task may also advance the formation of weather prediction models.
W86-03647

HYDROCHEMICAL BUDGETS OF SOME DUTCH WOODLAND SOILS WITH HIGH INPUTS OF ATMOSPHERIC ACID DEPOSITION: MOBILIZATION OF ALUMINUM,

Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 5B.
W86-03774

APPLIED CLIMATOLOGY.

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geographisches Inst.
Proceedings of the 25th International Geographical Congress Symposium No 18: Applied Geography, August 21, 1984, Zurich, Switzerland. No 14, 1984. Edited by W. Kirchhofer, A. Ohmura, and H. Wanner. 108 p.

Descriptors: *Climatology, *Alpine regions, *Runoff forecasting, *Model studies, Hydrologic budget, Glaciers, Snowmelt, Planning, Hydroelectric power, Precipitation, Evaporation.

Current research in the field of applied climatology, presented during the 25th International Geographical Congress Symposium, is described. Topics of discussion include urban climatology, applied topoclimatology, and the use of model studies and of satellite data in the field of applied climatology. Studies have been carried out in alpine regions on various topics relating to water resources: knowledge of water resources in relation to climate; use of discharge forecasting from glacierized areas to optimize hydroelectrical power management; and the regional water balance in the mountainous Artic and its application for water resources planning. (Halterman-PTT)
W86-03846

VIEW ON OUR KNOWLEDGE OF WATER RESOURCES IN RELATION TO CLIMATE IN THE ALPS,

Eidgenoessische Technische Hochschule, Zurich (Switzerland).
H. Lang.
IN: Applied Climatology, Proceedings of the 25th International Geographic Congress Symposium No 18: Applied Geography, 1984. p 53-58, 5 fig, 23 ref.

Descriptors: *Climatic data, *Alpine regions, *Precipitation, Glaciers, Snow cover, Evaporation.

Studies on the interrelationship between climate and water resources in mountain areas (specifically, the Alps) are reviewed, with emphasis on suggestions for future research. The hydroclimatic components considered are precipitation, evaporation, snowcover, and the glaciers. A major problem is the lack of reliable and complete records of the high altitude regions. Data are presented on longterm variations in annual precipitation and summer temperature, using information collected in Geneva from 1835-1978. Evaporation is the least studied of the processes, but is an important one because evaporation figures provide an essential link between climate and water resources, and in the determination of groundwater recharge and soil moisture deficit. Snowcover and glaciers are important research topics because they reflect both precipitation and heat balance conditions. Suggestions are made for future studies on both long-term and short-term aspects of the climate-glacier relationship. (Halterman-PTT)
W86-03847

2C. Snow, Ice, and Frost

FLOODS OF MARCH 1982, INDIANA, MICHIGAN, AND OHIO,

Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03552

ICE FORMING EXPERIMENT,

Wyoming Univ., Laramie. Dept. of Atmospheric Science.
Available from the National Technical Information Service, Springfield, VA 22161 as N82-33948, Price codes: A04 in paper copy, A01 in microfiche. NASA-CR-170623, July 30, 1982. 205-5 Final Report. National Aeronautics and Space Administration, Huntsville, AL. 70 p, 8 fig, 17 ref, append. NAS-8-33150.

Descriptors: *Ice formation, *Cloud physics, *Cooling, Supercooling, Nucleation, Precipitation.

The sharpness of the boundary which develops as a supercooled water cloud evaporates in the vicinity of ice was studied in several laboratory experiments conducted on a cold stage. A droplet-free zone began to develop around the ice patches immediately after deposition of the droplet layer. The zone grew in size and its boundary remained easily discernible to the eye. The size of the droplet-free zone showed a nearly linear increase with time for ice patches having straight edges; a gradual decrease in the rate of growth in the width of the droplet-free zone for a circular ice patch. The initial rate of growth of the zone, for periods less than 10 sec, appeared to be faster that of subsequent growth.
W86-03641

WORLD GLACIER INVENTORY WORKSHOP: PROCEEDINGS OF THE WORKSHOP AT RIEDERALP, SWITZERLAND,

World Glacier Inventory, Riederalp (Switzerland). September 17-22, 1978. IAHS-AISH Publication No 126. 1980. 351 p. Edited by F. Muller and K. Scherler. 117 fig, 70 tab, 480 ref.

Descriptors: *Glaciers, Sympocium, *Glaciohydrology, *Glacial drift, *Glacial streams, *Glacier surges, Hydrologic data collections, *Glacier balance, Satellite technology, Conferences, *Glaciology, Baseline studies, Data collections, Data processing, Data acquisition, Data interpretation, Climatology, Firn, Glacier mass balance.

This workshop which took place in Valais, Switzerland from September 17 to 22, 1978 was organized by the Temporary Technical Secretariat for the World Glacier Inventory of the International Commission on Snow and Ice. The main topics of the workshop were: techniques of glacier inventory data compilation, including use of satellite imagery; specific inventory difficulties with Greenland and Antarctica, rock glaciers, surging glaciers, with the firn and equilibrium line and with glacier identification and classification; the problem of glacier fluctuations causing an uneven data base; data handling and organization in an inventory data bank and retrieval system; analysis of national, regional and global glacier inventories for practical purposes and in particular for monitoring climatic change. The proceedings contain all but one paper presented at the workshop and most of the numerous discussion contributions. The proceedings give a fairly complete up-to-date account of the state of national and regional glacier inventories, as well as guidance for the continuation of this task and for the further standardization of the data.
W86-03673

EAST-WEST AND NORTH-SOUTH SNOW LINE GRADIENTS IN THE NORTHERN PATAGONIAN ANDES, ARGENTINA,

Departamento de Recursos Naturales y Energia, San Carlos de Bariloche (Argentina).
J. Rabassa, S. Rubulis, and A. Brandani.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 1-10, 1 fig, 3 tab, 21 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Argentina, *Snowline, *Climatology, Firn, *Glacier mass balance, *Hydrologic data collections, Snow surveys, Snow cover, Snow, History, Mountains, Data collections, Meteorologic data collection.

The snow line has been identified on the Argentine side of the northern Patagonian Andes. A definite trend is observed in both the east-west and the north-south snow line gradients. The snow line rises abruptly from the west (Chile) to the east (Patagonia), having progressively higher positions in the landscape since it remains above the summit of the higher peaks of the Sub-Andean ranges and Patagonian volcanoes. Similarly, the snow line descends steadily, although not so markedly, from north to south, favoring the conservation of cirque and valley glaciers at lower latitudes. The east-west gradients are caused by the interference of the humid winds from the Pacific with the Andean Cordillera. The north-south gradient is related to the lowering of mean annual temperatures away from the equator and also to the lower elevation of Andean peaks. For certain latitudes, present snow line gradients are compared with those from the Pleistocene. (Author)
W86-03674

GLACIERS AND GLACIOLITHIC SYSTEMS OF THE CENTRAL ANDES,

Instituto Argentino de Nivologia y Glaciologia, Mendoza.
A. E. Corte.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 11-24, 5 fig, 33 ref.

Descriptors: *Glaciers, *Andes, *Argentina, *Glaciohydrology, *Ice cover, Altitude, *Climatic data, *Glacial drift, *Moraines, Climatology, Glacial sediments, Precipitation.

A study of debris-covered glaciers and rock glaciers has been made within the context of the glacier inventory of the Mendoza River basin, Argentina. A relationship was identified between precipitation amounts and types of glacier activity. Covered ice is observed to be distributed in four altitudinal facies; thermokarst, structural debris, inactive rock glacier, and fossil ice rock glacier. Other types of glaciolithic systems included in the inventory were those of the talus type, ice-cored moraines located away from the uncovered ice and related to surging activity (ice under fast motion), and ice-cored moraines (lateral and frontal) related to slow ice motion. Debris cover varied from a few centimeters to many meters at lower altitudes. The sequence of four facies is explained as the result of four warm and cold phases of the Holocene. The ice formed during the last cold spell of the Little Ice Age (1450-1650) AD is being melted through the present thermokarst.
W86-03675

GLACIER INVENTORY OF BOLIVIA,

Hanover Univ. (Germany, F.R.).
E. Jordan, C. Brockman, A. Fernandez, R. Alvarez, and K. Jacobsen.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 25-32, 3 fig, 11 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Glacier balance, *Bolivia, *Aerial photography, *Glacier mass balance, Tropical regions, Moraines, Hydrologic data collections, Satellite technology, Firn, Ablation.

A glacier inventory for Bolivia has been started. Since the whole territory of Bolivia is north of the southern tropic, glaciation is limited to the mountain peak regions of the Andes. The present glaciation is almost entirely limited to the northern part of the Cordillera Oriental. Glaciated areas, from north to south are the Cordillera de Apolobamba, the Cordillera Real of Illampu, the Tres Cruces, and the Santa Vera Cruz. Existing satellite and aerial maps of the glaciated area of Bolivia are of poor quality. Glacier inventory work is continuing in the southwestern part of the northern Cordillera Real and the Tres Cruces with aerial photography and an aerotriangulation method, respectively. Data about accumulation and ablation characteristics cannot be given for glaciers in the Tres Cruces and other tropic areas due to the temporal inhomo-

geneity of the aerial photos and daily variations in the mass balance of such glaciers.
W86-03676

INVENTORY OF CANADIAN GLACIERS: PROCEDURES, TECHNIQUES, PROGRESS AND APPLICATIONS,

Environmental Protection Service, Ottawa (Ontario).
C. S. L. Ommanney.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 35-44, 2 tab, 14 ref.

Descriptors: *Aerial photography, *Glaciers, *Data acquisition, *Hydrological data collections, Bibliographies, Data storage and retrieval, Computers, Glaciohydrology, Glaciology, Data transmission, Baseline data, *Canada, Hydrologic maps.

The procedures, techniques, progress and applications of the Canadian glacier inventory are reviewed. The Canadian program adhered strictly to the UNESCO system of glacier classification but added to it while keeping within the basic framework. Volumes have been determined for Axel Heiberg Island and Vancouver Island. Complete mapping aerial photography is available but the quality of maps varies considerably. Aerial photographs are examined using standard mirror or scanning stereoscopes. Features of work maps are color-coded. Glacier details from the work maps are used to compile the glacier index map. Data acquisition is handled by computer. Data is stored on magnetic tapes and a computerized bibliography system permits the retrieval of data through key words. A glacier archives exists but there is no acquisition program for it. The major constraint on progress of the Canadian glacier inventory has been the variable nature of the resource allocation. It is unlikely that Canada can complete this project within the time-frame suggested. The Canadian glacier inventory has already progressed too far to switch to the TTS system now being used by countries just starting glacier inventories. The Canadian glacier inventory has been used extensively by researchers, universities, and exploration groups.
W86-03677

HYDROLOGICAL BASINS IN WEST GREENLAND AND THEIR RELATIONSHIP TO A PRELIMINARY SECTORIAL DIVISION OF THE INLAND ICE SHEET,

Groelands Geologiske Undersoegelse, Copenhagen (Denmark).
A. Weidick.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 49-55, 4 fig, 4 ref.

Descriptors: *Glaciers, *Mapping, *Glaciohydrology, Ablation, *Ice cover, *Glacier mass balance, Hydrologic maps, *Water resources development, Firn, Glacier balance, Fjords, *Greenland.

A map of hydrological basins in West Greenland has been prepared by the Geological Survey of Greenland. The map serves to evaluate the freshwater potential of natural basins in west Greenland (especially with regard to future use of hydroelectric power) and the western slope of the Inland Ice. The total amount of water to the West Greenland basins, including all precipitation, ablation of local glaciers and ablation and iceberg production of the western margin of the Inland Ice, is estimated to be 217 cu km/yr water equivalent. The altitude of the firn line, as estimated by aerial photographs, turned out to be very close to the position of the glaciation limit over the Inland Ice. Individual sectors of the Inland Ice have been defined by section division, and by construction of flowlines upstream at right angles to the contour lines. Sectors determined in this manner were not in complete agreement with regard to mass balance estimates of the individual sectors. However, the map furnishes an administrative, technical and scientific classification of natural basins to allow a fast reproduction of data relating to freshwater resources.
W86-03678

WEST GREENLAND OUTLET GLACIERS: AN INVENTORY OF THE MAJOR ICEBERG PRODUCERS,

Coast Guard Academy, New London, CT.
R. C. Kollmeyer.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 57-65, 6 fig, 1 tab, 3 ref.

Descriptors: *Glaciers, *Icebergs, *Floating ice, Glacial drift, Glaciology, Glaciohydrology, Ice cover, *Greenland, Ice, Fjords.

By an international treaty between 22 nations involved in North Atlantic shipping, the United States Coast Guard has been assigned a statutory mission to act as the International Ice Patrol. The International Ice Patrol was formed shortly after the iceberg sinking of the RMS Titanic. Ice Patrol duties include studies of the current conditions affecting the drift and persistence of icebergs in the North Atlantic Ocean and the glacial origin of the ice. In 1968 the US Coast Guard commenced an examination of the major iceberg producing glaciers along the west coast of Greenland. This program, called the West Greenland Glacier Survey, is attempting to visit and revisit every major outlet glacier along the western edge of the ice sheet. Terminus locations have been surveyed along with height measurements on 27 major outlet glaciers. A total of 59 glaciers have been photo-documented. Most of the glaciers exhibit retreat. (Author)
W86-03679

SOME PROBLEMS OF GLACIER INVENTORY IN THE HIMALAYAS,

C. P. Vohra.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 67-74, 1 fig, 1 tab, 4 ref.

Descriptors: *Glaciohydrology, *India, *Glaciers, *Aerial photography, *Satellite technology, Glaciology, Snowline, Moraines, Seismology, Mountains, River basins, Climatology, *Ice cover, *Himalayas, Geophysics.

Problems encountered in the pilot project undertaken by the Geological Survey of India in the Baspa River of the Indian Himalayas are discussed. The river basin has 89 glaciers and a glacierized area of 22% of the whole basin. The identification systems as defined in the UNESCO/IAHS guide and the Temporary Technical Secretariat guide (TTS) for compiling glacier inventories were not readily adaptable to the glaciers of India. Snowline data is usually obtained by ground parties but may be collected in the future by satellite. The topography of the Himalayas makes it difficult to estimate the equilibrium line. Aerial photographs by photogrammetry are not always accurate for determining glacier length. The accumulation area ratio should be easier to calculate with estimations of snowlines from satellite data and from careful study of aerial photographs. Geophysical methods such as seismic reflection and refraction and electrical resistivity are being used to determine mean glacier depth. Permanent snow/ice bodies on the valley walls often account for a considerable area of the basin. It is possible that the thick ice-covered moraines contribute significantly to the water discharges. The glacier inventory contributes to the study of the climate of the Himalayas.
W86-03680

PRESENT AND LATE PLEISTOCENE EQUILIBRIUM LINE ALTITUDES IN THE MT EVEREST REGION - AN APPLICATION OF THE GLACIER INVENTORY,

Eidgenoessische Technische Hochschule, Zurich (Switzerland).
F. Muller.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 75-94, 4 fig, 3 tab, 46 ref.

Descriptors: *Glaciology, *Glaciers, *Himalayas, *Precipitation, *Orography, *Snowline, Ablation, Air temperature, Mountains, Monsoons, Ice cover, Temperature, Glaciation, Cirques, Glaciohydrology.

UNESCO's pilot glacier inventory of the Mt. Everest area was extended to include some 450 glaciers. After evaluation of various methods to establish the ELA (equilibrium line altitude), the pattern of the ELA isolines was analyzed in relation to the orography, precipitation and temperature. The dominant role played by precipitation is recognized, and the unusually low mean AAR (accumulation and ablation relationship) value of 0.41 is explained. Based on the assumption that the elevations of the numerous empty cirques in the area represent the ELA at the time of their formation, a map and subsequently a comparative SSW-NNE profile of present and late Pleistocene ELAs was constructed. The difference between the two curves, only 100 m at the main crest and almost 600 m at the southern end, must be attributed, in part, to differential uplifting of the Mt. Everest area. After making allowance for this effect, the late Pleistocene temperature depression was estimated to be 4-5 degrees on the monsoon-affected Indian side and 2-3 degrees near the main mountain crest. It is concluded that the present pattern of monsoonal moisture supply also existed during late glacial times. Glaciation in the late Pleistocene was - as it is today - small in comparison to that of the other ice-prone parts of the globe. (Author)
W86-03681

GLACIER INVENTORY IN THE DUDH KOSI REGION, EAST NEPAL,

Nagoya Univ. (Japan). Water Research Inst.
K. Higuchi, H. Fushimi, T. Ohata, S. Takenaka, and S. Iwata.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 95-103, 5 fig, 2 tab, 15 ref.

Descriptors: *Glaciers, *Nepal, *Glaciology, *Glacial drift, *Glaciation, Glaciohydrology, Aerial photography, Hydrologic maps, Moraines, Ablation, Accumulation.

A glacier inventory was compiled of the Dudh Kosi region of East Nepal by field studies and aerial photographs in 1974-1976 as part of the Glaciological Expedition of Nepal (GEN). Glaciers in this region were classified as debris-covered or debris-free glaciers. Analysis of the GEN inventory showed that the lowest elevation of the debris-free glaciers in the basin of the Dudh Kosi tend to be higher in the sub-basin of the upper stream. The earlier Mueller (1979) inventory which used maps based on 1955-1963 terrestrial photogrammetry was compared with the GEN inventory. Differences between the lowest glacier elevations of debris-free glaciers in the GEN inventory and in the Mueller inventory indicate that variations in the glacier fronts during the peiod of approximately 1960-1975 had occurred. In the upper part of the study region, most of the debris-free glaciers during this time period were in retreat.
W86-03682

MATERIAL FOR A GLACIER INVENTORY OF THE INDUS DRAINAGE BASIN - THE NANGA PARBAT MASSIF,

W. Kick.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 105-109, 2 fig, 9 ref.

Descriptors: *Glaciers, *India, *Glaciology, *Glaciation, *Hydrologic maps, Glaciohydrology, Mountains, Indus River basin, Data collections, Hydrologic data collections, Snow, Aerial photography, Satellite technology.

The local maps of India are for the most part inadequate for providing data needed for a glacier inventory of the Indus basin. One of the best local maps, that for the Nanga Parbat massif, was used as the basis for a glacier inventory in that area. The TTS identification system worked without difficulty when applied to the Indus drainage basin. Sixty-nine glaciers have been counted in the Nanga Parbat area; most of them are on the northern side mainly because of the relief. The climate is very arid in the lower regions but heavy snowfall in the higher altitudes causes very active glacerization which reaches down to pastures and fields, and even to areas of human settlement. The glaciers of Nanga Parbat cover 302 sq km and have an estimated volume of 25 cu km. Other sources for gathering glacier data (quarter-inch maps, aerial photographs, satellite images, etc.) should be spot checked against the results from the local maps before being generally used.
W86-03683

DISTRIBUTION, FEATURES AND VARIATIONS OF GLACIERS IN CHINA,

Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
Y-F. Shih, T-C. Hsieh, P-H. Cheng , and C-C. Li.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 111-116, 2 fig, 1 tab, 2 ref.

Descriptors: *Glaciers, *Glaciology, *Glaciohydrology, *Hydrologic maps, *Glacial drift, Aerial photography, Precipitation, Snowline, Air temperature, Climatology, Spatial distribution, Glacier mass balance, *China.

Since 1975 a new glacier inventory is being made in China with new aerial and ground stereophotogrammetric maps. In Chilien Shan, Tien Shan, Altai and part of the Chinghai-Tibet Plateau there are 17,123 glaciers covering an area of 22,181 sq km. This represents roughly half of the glaciers in China. The new results show that the previous 1959 survey underestimated the number and the area of glaciers. Analysis of the spatial distribution of the snow line shows clearly the three main sources of precipitation. From the 1950's to 1960's glaciers were retreating but in the 1970's positive mass balances appeared and the snow line descended. Temperature has decreased and precipitation increased since the 1950's and, on the basis of dendroclimatological data, this trend may last until the end of the century with an increase of advancing glaciers. (Author)
W86-03684

RECENT RESEARCH ON GLACIERS ON THE CHINHAI-TIBET PLATEAU,

Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
C-C. Li, and P-H. Cheng.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978 IAHS-AISH Publication No 126. 1980. p 121-127, 2 fig, 2 tab, 2 ref.

Descriptors: *Glaciers, *China, *Glaciology, *Glaciohydrology, *Monsoons, Glacial drift, Ice cover, Climatology, Air temperature.

Results of recent research on glaciers on the Chinghai-Tibet Plateau are briefly reviewed. Statistical and inventory work have been carried out in two main glacier areas, the Nyenchintangla Range and west Kunlun Shan, as well as in other areas. Development of glaciers on the plateau is greatly influenced by monsoons from the Indian Ocean. Glaciers can be classified as maritime or continental, the former being concentrated in west Szechuan, north Yunnan and southeast Tibet. Research on glacier fluctuations shows that the Little Ice Age was also experienced here with maxima occurring during the nineteenth century. This was followed by a strong retreat since the 1930's with recent signs of the initiation of a new period of glacier advance. (Author)
W86-03685

PROBLEMS AND RESULTS OF STUDIES OF MOUNTAIN GLACIERS IN THE SOVIET UNION,

Akademiya Nauk SSSR, Moscow.
V. M. Kotlyakov.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 129-137, 1 fig, 2 tab, 8 ref.

Descriptors: *Glaciers, *USSR, *Glaciology, *Glaciohydrology, *Firn, *Glacier surges, Glacier balance, Precipitation, Glacial drift, Alpine regions, Aerial photography, Satellite technology, Remote sensing, Cirques.

From 1965 to 1974, observations of heat, ice and water balances for the IHD program were carried out on seven selected mountain glacier basins of the USSR. The types of glaciers adopted in the glacier inventory of the USSR include: hanging, spill-over, slope, cirque, cirque-valley, hollow, simple-valley, compound valley, dendritic, expanded-foot, piedmont, conic summit glacier, and flat summit. The USSR glacier inventory serves as the primary source of data for the present study. The Kurowski method proved to be the best indirect method for calculating the firn line or equilibrium line. A glaciological method of calculating precipitation in the alpine zone, based on the concepts of Ahlmann and developed further by Krenke and Khodakov is described. Using this method, calculations were made on a small scale for the total territory of the USSR and in detail for the Pamirs and Caucasus. Results showed that the amount of precipitation, in particular solid precipitation, is far greater in the mountains than on the abutting plains and piedmonts. The inventory of surging glaciers of the USSR presents special dangers due to mudflows. Precise criteria for distinguishing surging glaciers from normal glaciers have not yet been worked out. Some data on glacier surges have been gained by remote sensing, aerial photography, and satellite observations.
W86-03686

STUDIES OF GLACIER FLUCTUATIONS IN THE USSR,

K. G. Makarevich.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 143-148, 3 tab, 13 ref.

Descriptors: *Glaciers, *USSR, *Glaciology, *Glaciohydrology, *Glacier surges, Glacier balance, Glaciation, Glacial drift, Ablation, Glacier mass balance, Firn, Hydrological data collections.

In the USSR, a new program of glacier variation surveys is being conducted which consists of three classes of observation. The annual full scale first-class observations should be carried out on specially chosen glaciers which are most suitable for modeling. The second-class observations (made periodically twice a year or once in several years) are aimed at obtaining the statistical characteristics of the changes occurring and an independent control of glacier fluctuations. The third-class observations should collect actual data for glacier fluctuations in a certain area and explain them by analyzing their interrelations with the help of mathematical models. The first-class observation program is subdivided into glaciological, glaciohydrological and glaciometeorological studies comprising 25 types of observations in all. A program of observation to identify surging glaciers has also been worked out.
W86-03687

SPECIAL PROBLEMS OF GLACIER INVENTORY IN AFGHANISTAN,

J. F. Schroder.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978.IAHS-AISH Publication No 126. 1980. p 149-154, 1 tab, 15 ref.

Descriptors: *Afghanistan, *Glaciers, *Glaciohydrology, *Glaciology, *Hydrologic maps, Glaciation, Hydrologic data collections, Remote sensing, Satellite technology, Mapping.

The physical features of Afghanistan make it difficult to complete a glacier inventory. Maps are difficult to obtain due to the political situation and American and Russian maps are often incompatible. Travel in many areas is either prohibited or very difficult. Many drainage basins have large man-made irrigation ditches that appear as dashed lines on maps. A preliminary mapping showed the general distribution of permanent ice and snow but was inadequate to give more than a general impression. Satellite imagery is being applied with some success to the study of glaciers in Afghanistan. The inventory work is proceeding in three large basins: Turkestan endorheic, Indus, and the Afghan-Iran plateau. A total of 1,207 glaciers have been inventoried so far.
W86-03688

PRESENT GLACIATICN IN TURKEY,

Istanbul Univ. (Turkey).
A. Kurter, and K. Sungur.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 155-160, 3 tab.

Descriptors: *Glaciers, *Glaciation, *Turkey, *Glaciohydrology, Glaciology, Cirques, Snowline, Alpine regions, Aerial photography.

Glacier studies in Turkey have been difficult due to the lack of large scale topographical maps until recent times. Previous data on the lowest glacier elevations and the elevations of snow lines differ from author to author. Air photographs have recently become available. Three main groups of glaciers are found mainly in the eastern, northeastern, and southeastern parts of Turkey. The area in the eastern part of the Black Sea coastal ranges contains several glaciers longer than 1 km, the most famous of which is the Kackar Glacier. The second group in the Taurus ranges includes about two-thirds of the total number of glaciers in Turkey with several longer than 4 km. The most famous of the third group which consists of isolated extinct volcanic cones in the interior is the ice cap on Mount Agri (Ararat) with an area of 10 sq km. The valley glacier on the volcanic cone of Mount Erciyes is also well known.
W86-03689

SOME COMMENTS ON THE SWISS GLACIER INVENTORY,

Eidgenoessische Technische Hochschule, Zurich (Switzerland).
F. Muller, and K. Scherler.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 185-195, 3 fig, 16 ref.

Descriptors: *Glaciers, *Glaciology, *Glaciohydrology, *Switzerland, Snowline, Firn, *Hydrologic maps, Moraines, Ablation, Climatology, Hydrologic data collections, Glaciation.

The Swiss glacier inventory contains 1828 units over 1 ha in size with an average of 35 parameters each. It was recorded in accordance with the UNESCO/IAHS guidelines; however, instead of comparisons of firn line or ELA, the mapping of median glacier elevation is advocated. Experience with the Swiss inventory has clearly shown that snowline, firn line and ELA maps which are comparable over large areas, can only be achieved on the basis of assumptions which must be tested for each region through investigations. This requirement is beyond the scope of an inventory. The largest coherent ice masses occur in the highest chains: the Valais, the Bernese and the southern Grison Alps. Many smaller individual glaciers of various shapes and types are dispersed throughout the remaining parts of the area. The cumulative effect of the weather on a glacier is reflected by the altitude of the equilibrium line. The difference between the 1973 natural budget ELA and the altitude of the early September snow line is very small. The 1972/1973 budget year must be classed as a strongly negative one in terms of the accumulation area ratio (AAR). Snowline altitude for the

six major mountain groups varies by about 420 m. This variation is explained in terms of location and exposition to dominant winds and moisture supply. Further depth measurements using new radio echo-sounding equipment for temperate glaciers is in progress, to improve the volumetric data of the inventory.
W86-03690

MOUNTAIN GLACIERS IN THE MEDITERRANEAN AREA AND IN AFRICA,

Bern Univ. (Switzerland). Geographisches Inst.
B. Messerli.
In: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 197-211, 7 fig, 6 tab, 21 ref.

Descriptors: *Glaciers, *Glaciology, *Glaciohydrology, *Glaciation, *Snowline, Ice cover, Climatology, Mediterranean Sea, Alpine regions, Africa.

Few glaciers or glacierets still exist in the Mediterranean area. The snowline between the Alps and the mountains of North Africa and the Near East must be reconstructed with the help of climatic data. The only glaciers in Africa are on Mt. Kenya (covering an area of 0.8 sq km), on Kilimanjaro (5 sq km), and in the Ruwenzori (5 sq km). The median glacier elevation increases from the Ruwenzori (4680 m) to Mt. Kenya (4790 m) and to Kilimanjaro (5430 m). A retreat of the ice limits since the last century, or during the present one, can be reconstructed for the glaciers of the Mediterranean area and of East Africa. The climatic changes of the Mediterranean area are reflected in the conditions found for glaciers in the transition zone from a seasonal to a diurnal type of climate.
W86-03691

GLACIER SNOW LINE VARIATIONS IN THE SOUTHERN ALPS, NEW ZEALAND,

Ministry of Works and Development, Christchurch (New Zealand).
T. J. Chinn, and I. E. Whitehouse.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 219-228, 6 fig, 3 tab, 13 ref.

Descriptors: *Snowline, *Glaciers, *Glaciology, *Glaciohydrology, Glaciation, Alpine regions, *New Zealand, Precipitation, Spatial distribution.

End-of-summer glacial snowline elevation estimates have been made of several hundred glaciers over some 400 km of the Southern Alps from oblique photographs taken over the past two seasons. Aspect correction factors were applied to put all elevations in terms of south-facing glaciers. Accuracy is estimated at + or - 50 m, but by comparing photographs of successive years very small changes are detectable. The results show that the snowline elevations follow closely the precipitation distribution and exhibit a similar steep west-east gradient, together with a north-south gradient caused by latitude. The glacial snowline remains slightly below the 'glacial limit snowline' despite extensive glacial recession over the past century. Historical data indicate that over the past half-century glacial snowlines have generally undergone an accelerating increase in elevation which continued until the mid 1970's. (Author)
W86-03692

PROBLEM OF A GLACIER INVENTORY OF ANTARCTICA,

British Antarctic Survey, Cambridge (England).
C. Swithinbank.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 229-236, 4 fig, 8 ref.

Descriptors: *Glaciers, *Mapping, *Antarctica, *Glacioloy, Glaciohydrology, Polar regions, Antarctic, Ice cover, Ice thickness, Hydrologic maps, Glaciation, Remote sensing, Satellite technology, Aerial photography, Hydrologic data collections.

Only 19% of Antarctica has been mapped at the minimal scale of 1:250,000 required by the TTS instructions for glacier inventories. Only half the coastline has been mapped at the 1:250,000 scale. The largest scale at which the whole ice sheet has been mapped is 1:2,000,000. Even at this scale, some errors exist that are greater than 100 km. Satellite imagery will be useful for the mapping of Antarctica only if ground control equipment can be installed. The cost of using air photography for reconnaissance mapping of the remaining areas is likely to remain prohibitive for the remainder of the twentieth century. Large amounts of data have been collected on ice depth in Antarctica by radio echo-sounding techniques. The achievement of a 100-km spacing grid is limited only by the aircraft operating range and the availability of only one landing strip. Real advances in understanding the physical characteristics of the continent will only be achieved by successive approximations based on small scale 1:20.000,000 maps of ice surface elevation, ice thickness, bedrock elevation, accumulation rate, surface temperature, flowline spacing, balance velocity, strain rate, surface slope, basal shear stress, and basal temperature.
W86-03693

GLACIER BALANCES IN THE DRY VALLEYS AREA, VICTORIA LAND, ANTARCTICA,

Ministry of Works and Development, Christchurch (New Zealand).
T. J. Chinn.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 237-247, 4 fig, 3 tab, 12 ref.

Descriptors: *Glaciers, *Antarctic, *Glaciology, *Glaciohydrology, Glacier mass balance, Glacier balance, Snowline, Moraines, Ablation, Alpine regions, Sublimation, Glacial drift.

The glaciers of the Dry Valleys, a cold desert, occur in topographically favored positions in coastal and elevated areas where snow accumulation exceeds sublimation and other losses. Mass balance measurements have been made over a 6-yr-period on three glaciers (Jeremy Sykes, Alberich and Heimdall) and measurements of debris, snow accumulation, ablation and other parameters have been made of eight other glaciers. Measured mass changes are extremely small and indicate that all the glaciers are close to equilibrium although studies of marginal morphology and movement suggest that the glaciers are slowly expanding in readjustment to the post Pleistocene climatic amelioration. The glaciers carry very small loads of debris, largely as wind blown dust and sand carried in with drifting snow; consequently, recently constructed moraines are very limited in volume. One exception is the Taylor Glacier which carries large quantities of basal till. Extremely light snowfall occurring throughout the Dry Valleys allows wind to play the dominant role in governing the location of accumulation areas. Redeposited snow accumulating in valley heads and against steep slopes becomes the source of the majority of the alpine glaciers. Mass wasting from the glaciers is predominantly by sublimation, and meltwater is rarely seen above 1500 m altitude.
W86-03694

RECENT SECULAR VARIATIONS OF SNOW AND SEA ICE COVER,

Lamont-Doherty Geological Observatory, Palisades, NY.
G. J. Kukla, and J. Gavin.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 249-258, 7 fig, 2 tab, 10 ref. NSF ATM77-01062.

Descriptors: *Cryology, *Ice cover, *Snow cover, *Sea ice, *Satellite technology, Infrared imagery, Radiometry, Aerial photography, Seasonal variation, Snowpack, Polar regions, Arctic, Antarctic, Ice.

Recent seasonal and interannual variation of snow and ice cover has been observed in both hemispheres from 1967. Data was obtained by U. S. Navy and NOAA charts produced by satellite imagery. Mean extent of the snow and ice cover in the Northern Hemisphere and of pack ice around Antarctica peaked in 1972-1973. Snow was again extensive from late 1976 whereas pack ice in the Southern Hemisphere was close to the lowest levels observed by satellites between 1967 and March 1978. Snow cover area in autumn and sea ice area in spring displayed the largest variance. The changes were due mainly to earlier establishment of snow in autumn and later disappearance rather than to the changes of winter and summer extents. Except for the 1976-1977 seasons, the fluctuations of the surface extent of the cryosphere during the 11-yr-study period in both hemispheres seem to be generally in phase.
W86-03695

PARAMETERIZATION OF GLACIER EQUILIBRIUM LINE ALTITUDE,

Eidgenoessische Technische Hochschule, Zurich (Switzerland).
R. J. Braithwaite, and F. Muller.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 263-271, 4 tab, 23 ref.

Descriptors: *Glaciers, *Glaciology, *Orography, *Glacier mass balance, Glaciohydrology, Ablation, Glaciation, Glacier balance, Firn.

The equilibrium line altitude (ELA) is defined as the line separating the ablation area of a glacier from the accumulation area. Values for ELA are included in most glacier inventories; however, there are few glaciers whose ELA has been directly measured. ELA's are usually highly variable from year to year in comparison with their secular variations. A statistical analysis was made of mass balance and ELA time series for 33 glaciers. The steady state ELA was estimated for each glacier and its approximation in terms of simple and easily measured orometric parameters within the context of a glacier inventory was tested. In most cases, discrepancies of only a few decameters were found. For the purposes of a world glacier inventory, a theory relating equilibrium line altitude to climatic and orographic factors is required.
W86-03696

CAN THE LINEAR BALANCE MODEL BE EXTENDED TO THE WHOLE ALPS,

Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
L. Reynaud.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 273-284, 8 fig, 2 tab, 9 ref.

Descriptors: *Glaciers, *Glaciology, *Glacier mass balance, *Hydrologic models, *Model studies, Temporal distribution, Alpine regions, Glaciohydrology, Statistical analysis, Glacier balance, Models, Mathematical models, Comparison studies, Climatology.

Mass balance series in the Alps were compared for 10 glaciers using the linear balance model of Lliboutry to show similarity in the variations. The glaciers studied included 2 French, 4 Swiss, 3 Austrian, and 1 Italian glacier. The data collected on the 10 glaciers gave four sets: 2 glaciers (Aletsch and Sarennes from 1949-1977; 5 glaciers (Aletsch, Sarennes, Limmern, Hintereisferner and Kesselwandferner from 1953-1975); 8 glaciers (the previous plus St. Sorlin, Silvretta and Gries from 1961-1975); and 1 glacier (Careser Glacier plus the preceding with the Stubacher Sonnblickkees from 1967-1975). The variations each year between the glaciers was attributed to the different computations of balance used (hydrological, linear model, and direct measurement). Results indicated that for 1974 a great climatic difference existed between the French Alps and the rest of the Alps. To monitor these climatic variations more field work using the linear model is proposed. The centered balance variations were very similar for the differ-

ent series of comparison for all the other years studied.
W86-03697

ROCK GLACIERS: GLACIAL AND NON-GLACIAL ORIGINS,
Ottawa Univ. (Ontario). Dept. of Geography.
P. G. Johnson.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 285-293, 7 fig, 8 ref.

Descriptors: *Glaciers, *Rock glaciers, *Glaciology, *Talus, Avalanches, Glaciation, Glaciohydrology, Glacial drift.

The development of rock glaciers of glacial origin is dependent on the accumulation of sufficient surface detritus to protect the ice from melting over a long period of time. The term rock glacier has been widely applied to all major rock mass movement forms in alpine conditions without a true understanding of the flow mechanisms involved. Studies in the southwest Yukon Territory of Canada have shown that a number of mechanisms are involved in the formation of rock glaciers with a major difference between those of glacial and non-glacial origin. Glacial origin rock glaciers reflect the glacial history of an area while non-glacial rock glaciers are not directly related to glacier activity and their activity periods differ from the glacial-origin rock glaciers. Various origins of non-glacial rock glaciers have been proposed including snow avalanche origin, talus with inherited ice, and those with no ice content. For inclusion in the glacier inventory some distinction as to the type of rock glacier is essential in order to distinguish between glacier controls and periglacial (talus) controls.
W86-03698

CLIMATIC BACKGROUND TO SOME GLACIER FLUCTUATIONS,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
U. Radok.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 295-304, 8 fig, 18 ref.

Descriptors: *Climatology, *Glaciers, *Glacier mass balance, *Glacial drift, *Hydrologic models, Glaciology, Glaciohydrology, Glacier balance, Glaciation, Model studies, Models, Air temperature.

Glaciers reflect changes in climate through fluctuations in their net mass balance profiles. Early attempts at reconciling glacier fluctuations and net balance changes relied on Nye's kinematic wave model. The general recession of glaciers since the Little Ice Age has been examined with a dynamic glacier model proposed by Budd and Jenssen. The experimental reconstructions of net balance profiles by Kruss, Smith, and Allison which could account for the observed changes in several well documented glaciers in different climate regions are given. The results collectively point to a rise in mean temperature of less than 1 degree since the Little Ice Age.
W86-03699

EFFECT OF TOPOGRAPHIC ORIENTATION ON THE VARIATIONS OF GLACIER LENGTH,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
P. Kasser.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 305-311, 3 fig, 6 tab, 4 ref.

Descriptors: *Glaciers, *Topography, *Glaciology, *Statistical analysis, Alpine regions, Climatology, Geomorphology, Glaciation, Frequency distribution.

The relation between the length changes of glaciers and their orientation was investigated for the observation network of 115 glaciers in the Swiss Alps for seven years within the period 1946/1947-1976/1977. The number of glaciers diverging positively (+) and negatively (-) from the median value in their changes of length were counted and the ratio M(+/-) was tabulated for eight sectors of 90 degrees each, each sector being designated by its central direction. The glaciers in the central direction are counted with weight 1 while those in the two adjacent directions are added with weight 0.5. The maximum of M(+/-) is always in the northwest to northeast sectors, the minimum in the sectors southeast to southwest. This asymmetrical distribution is not due to climatic but to morphological factors, as is reflected in the inverse distribution of the sizes of glaciers in the network over the sectors. (Author)
W86-03700

USE OF THE DATA OF GLACIER INVENTORIES FOR COMPILATION OF THE WORLD ATLAS OF SNOW AND ICE RESOURCES,
Akademiya Nauk SSSR, Moscow.
N. N. Dreyer, and V. M. Kotlyakov.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 313-319, 2 tab, 5 ref.

Descriptors: *Glaciers, *Glaciology, *Hydrologic maps, *Glaciation, Glaciohydrology, Ice cover, Snow cover, Sea ice, Hydrologic data collections, Mapping.

The 'World Atlas of Snow and Ice Resources' covers all types of glacio-nival formations: snow cover, sea and river ice, ground ice and icings, ice sheets and mountain glaciers. The atlas is subdivided into 17 subject sections, of which the sections on glacier morphology and regime are the largest. The nature of coverage, contents, ways of depiction, and scales make it possible to unite all the maps of glacier morphology and regime into three groups. Large scale maps of separate glaciers show boundaries, firn line and snow cover, surface topography, transported and deposited till and hydrographic network. Mid-scale maps of morphological types of glaciers are prepared for mountain knots of glaciation. Small scale maps depict the properties of glacier systems in general. Glacier inventories serve as the main source for compiling the different scale maps. The inventory data used for the compilation of maps include: glacier name, the river flowing from the glacier, morphological type, general orientation, glacier length and area, glacier altitude, height of firn line, ablation area, and ice volume.
W86-03701

USE OF LANDSAT DIGITAL INFORMATION FOR ASSESSING GLACIER INVENTORY PARAMETERS,
Nebraska Univ. at Omaha. Remote Sensing Applications Lab.
D. C. Rundquist, S. G. Collins, R. B. Barnes, D. E. Bussom, and S. A. Samson.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 321-331, 3 fig, 1 tab, 16 ref.

Descriptors: *Satellite technology, *Glaciers, *Glaciology, *Ice cover, *Remote sensing, Aerial photography, Ablation, Computer programs, Glaciation, Moraines, Firn, Snow cover.

Traditional glacier inventory methods are both time consuming and costly, whether using direct field mapping or through interpretation of aerial photographs. The present study evaluates the potential for Landsat (MSS) digital information in analyzing the various components and characteristics of valley glaciers within a global framework as an alternative. Eight ice masses in four mountain areas of the world, Hindu Kush, St. Elias Range, Himalayas and Axel Heiberg Island, were examined in some detail with both single-channel thresholding and multispectral analysis of Landsat data. Experience with Landsat digital procedures indicates that the major surface features on larger valley glaciers can be properly identified and mapped. The accumulation and ablation zones can be differentiated well. The same pixel-radiance thresholds are applicable, with only minor modifications, to glaciers in close proximity to one another, otherwise substantial modifications are necessary. (Author)
W86-03702

SATELLITE IMAGE ATLAS OF GLACIERS,
Geological Survey, Reston, VA. Water Resources Div.
J. G. Ferrigno, and R. S. Williams.
IN: World Glacier Inventory Workshop: Proceedings of the Workshop at Riederalp, Switzerland, September 1978. IAHS-AISH Publication No 126. 1980. p 333-341, 4 fig, 20 ref.

Descriptors: *Satellite technology, *Hydrologic maps, *Glaciers, *Glaciology, Remote sensing, Mapping, Hydrologic data collections, Geography, Glaciohydrology, Antarctica, Greenland, Iceland, Maps.

The U.S. Geological Survey has initiated a project to prepare a satellite image atlas of glaciers with the cooperation of a number of U.S. and international organizations. The atlas will include the geographical distribution of glaciers as well as topics of glaciology and related environmental phenomena using Landsat, NOAA and other satellite data. The primary objectives of the atlas are to serve as an inventory of available images of extant glaciers, to show their scientific value, and to serve as the basis of Landsat image maps of glacierized areas. Examples of Landsat images from Antarctica, Greenland, Iceland, and Svalbard are given along with a brief discussion of some of the initial research with Landsat images in each area.
W86-03703

APPLIED CLIMATOLOGY.
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geographisches Inst.
For primary bibliographic entry see Field 2B.
W86-03846

VIEW ON OUR KNOWLEDGE OF WATER RESOURCES IN RELATION TO CLIMATE IN THE ALPS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2B.
W86-03847

DISCHARGE FORECASTING FROM GLACIERIZED AREAS TO OPTIMIZE HYDROELECTRIC POWER MANAGEMENT,
Grande Dixence Societe Anonyme, Sion (Switzerland).
For primary bibliographic entry see Field 8C.
W86-03848

REGIONAL WATER BALANCE IN THE MOUNTAINOUS ARCTIC AND ITS APPLICATION FOR WATER-RESOURCE PLANNING,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2D.
W86-03849

2D. Evaporation and Transpiration

REGIONAL WATER BALANCE IN THE MOUNTAINOUS ARCTIC AND ITS APPLICATION FOR WATER-RESOURCE PLANNING,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
A. Ohmura.
IN: Applied Climatology, Proceedings of the 25th International Geographical Congress Symposium No 18: Applied Geography, 1984. p 67-77, 3 fig, 7 tab, 30 ref.

Descriptors: *Hydrologic budget, *Alpine regions, *Evaporation, Glaciers, Snowmelt, Planning, Climatology.

The natural cause for the fresh water shortage at arctic settlements is attributed to small precipitation and relatively large evaporation on the ground. Most of the annual evaporation takes place during the short snow-free period in summer, when the fresh water demand is high. During this period the evaporation exceeds precipitation at most arctic coastal settlements. It was found that in the western part of Axel Heiberg Island, N.W.T., the water balance on arctic tundra varies considerably with altitude, the precipitation exceeding the evaporation above 500 a.s.l. The specific runoff at altitudes between 500 and 800 m was found to be approximately 20 mm or 20,000 cu m discharge from 1 sq km drainage basin, which is sufficient to support a population of fifty at the current water consumption rate in the Canadian Arctic. As a second alternative the possibilty of tapping glacier melt water was investigated. The average specific runoff at altitudes between 500 and 800 m was found to be approximately 20 mm or 20,000 cu m discharge from 1 sq km drainage basin, which is sufficient to support a population of fifty at the current water consumption rate in the Canadian Arctic. As a second alternative the possibility of tapping glacier melt water was investigated. The average specific ablation in summer in the Queen Elizabeth Islands lies between 20 and 30 cm or 300,00 cu m discharge from a glacier of 1 cu km surface area, which meets the annual demand for a population of eight hundred. (Author)
W86-03849

2E. Streamflow and Runoff

EVALUATING THE USE OF DEPTH-FREQUENCY EQUATIONS FOR ENFORCING LOCAL FLOODPLAIN REGULATIONS,

Illinois State Water Survey Div., Champaign.
J. P. Lardner.
IN: Proceedings of a Conference on Management Techniques for Water and Related Resources, April 1984. p 131-142. 1 fig, 2 tab, 5 ref. Illinois University at Urbana-Champaign, Water Resources Center, October 1984, Special Report 14.

Descriptors: *Flood plain management, *Flood plains, *Flood frequency, Regional floods, Statistical analysis, Drainage area, Flood profiles, Catchment areas, Enforcement.

In Illinois the procedure used to estimate 100-year flood boundaries and prepare maps of flood-prone areas is the Depth and Frequency (D&F) Method. The purpose of this paper is to examine the variability of the D&F Method results when compared with detailed flood elevation data and to suggest ways to improve the accuracy of the D&F Method. Although this report shows the potential for serious error in flood depth calculation using the D&F Method, it remains the easiest and quickest tool to help planners, inspectors, and designers estimate flood depths where none exist. When used with discretion and good engineering judgement, the D&F Method has beneficial uses in providing a starting point toward arriving at a flood depth for a selected frequency at a given site. The most practical use occurs when errors in depth estimate will have minor consequence to those who use the results. In this analysis, differences between (a) depths predicted by the D&F Method versus those measured from profiles, and (b) the corresponding actual depth to predicted depth ratios were used to evaluate the D&F Method. Although the mean error of the D&F Method is acceptable (less than 1 foot, or 10% error) in parts of the state, the variability is high and unacceptable depths may result. Drainage area and slope show the most impact on flood depth at any given location. Use of rural and urban locations as a variable did not prove to be significant in predicting flood depths by the D&F Method. (Fazio-Omniplan)
W86-03450

HYDROLOGY OF AREA 1, EASTERN COAL PROVINCE, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
W. J. Herb, D. E. Brown, L. C. Shaw, and A. E. Becher.
USGS Water-Resources Investigation Report 83-223, 1983. 89 p, 74 fig, 27 tab, 34 ref.

Descriptors: *Hydrologic data, *Pennsylvania, Surface water, Groundwater, Water quality, Permits, *Acid-mine water, Biological communities, Metals, Flood peaks, Flow-duration curves, Water pollution effects, Eastern Coal Province, Susquehanna River basin, Public Law 95-87, Office of Surface Mining, Permit application, Energy, Bituminous coal, Benthic invertebrates, Bottom materials, Diversity index, Juniata River basin.

Hydrologic data are presented for Area 1 of the Eastern Coal Province, 7,400 square miles of the West Branch Susquehanna and upper Juniata River basins in west-central Pennsylvania. One hundred thirteen streams were sampled four times during the 1979 and 1980 water years for specific conductance, pH, acidity alkalinity, dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and bottom material samples were analyzed for metals. Fifty-five streams had pH, acidity, alkalinity, total-iron, total-manganese, and dissolved-sulfate levels indicative of acid-mine drainage. Streams in the top coal-producing counties generally had the lowest median pH, and highest median specific-conductance, dissolved-solids, total-iron, total-manganese, dissolved-sulfate, bed-material iron, and bed-material coal values in the area. These water-quality constituents were positively correlated with coal production except for pH which showed a negative correlation. Low-flow, mean-flow, peak-flow, and flow-duration statistics can be computed for gaged streams and estimated for ungaged streams. Median well yields in the area range from 5 to 50 gallons per minute, and ground water quality is suitable for most uses. (USGS)
W86-03547

STATISTICAL SUMMARIES OF STREAMFLOW DATA IN OREGON; VOLUME 1 EASTERN OREGON,

Geological Survey, Portland, OR. Water Resources Div.
J. Friday, and S. J. Miller.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Open-File Report 84-454, 1984. 150 p, 1 fig (map), 5 ref.

Descriptors: *Streamflow, *Statistical analyses, *Flow duration, *Flood recurrence interval, *Oregon, Annual flow statistics, Monthly flow statistics, Low flow, High flow.

Statistical summaries of streamflow data at 335 streamgaging sites are presented in this two volume report to aid in appraising the hydrology of river basins in Oregon. Records for 31 gaging stations were compiled into separate periods owing to changes in regulation during the period of data collection. The periods before and after regulation are presented for comparison. A brief station description is given describing the physical and operational features for each gaging station. Following the station description are tables of monthly and annual flow statistics, flood frequency data, low-flow and high-flow frequency data, and flow-duration information. (USGS)
W86-03550

STREAMFLOW AUGMENTATION AT FOSTERS BROOK, LONG ISLAND, NEW YORK - A HYDRAULIC FEASIBILITY STUDY,

Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4A.
W86-03551

FLOODS OF MARCH 1982, INDIANA, MICHIGAN, AND OHIO,

Geological Survey, Indianapolis, IN. Water Resources Div.
D. R. Glatfelter, G. K. Butch, and J. A. Stewart.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4201, 1984. 40 p, 30 fig, 1 tab, 7 ref.

Descriptors: Flood frequency, Flood hydrographs, Flood peak, *Floods, Indiana, Michigan, Ohio, *Rainfall, Regional floods, *Snowmelt, *Streams, *Surface runoff, Fort Wayne, Wabash River, St Joseph River, River Raisin, Maumee River, Kankakee River.

Rapid melting of a snowpack containing 2 to 6 inches of water equivalent coinciding with moderate rainfall caused flooding in March 1982 across northern Indiana, southern Michigan, and northwestern Ohio. Millions of dollars in property damage and the loss of four lives resulted from the flooding. Peak discharges at several gaging stations in each of the following river basins have recurrence intervals of 50 to greater than 100 years: Wabash, St. Joseph, River Raisin, Maumee, and Kankakee. Flooding in the Wabash River basin was confined to major tributaries draining from the north. The St. Joseph River experienced flooding having a recurrence interval of about 50 years. Peak discharges having recurrence intervals of 50 to greater than 100 years were recorded on the River Raisin. Flooding on most large streams in the Maumee River basin was the worst since 1913. The Kankakee River and its major tributary, Yellow River, recorded peak discharges having recurrence intervals greater than 100 years. Hydrologic data have been tabulated for 83 gaging stations and partial-record sites. Maps are presented to emphasize the severity and untimely sequence of meteorological conditions that provided the potential and triggered the floods. Hydrographs are shown for 32 gaging stations. (USGS)
W86-03552

HYDROLOGY AND LAND USE IN VAN BUREN COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
T. R. Cummings, F. R. Twenter, and D. J. Holtschlag.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4112, 1984. 124 p, 33 fig, 41 tab, 25 ref.

Descriptors: *Water quality, *Water utilization, *Land use, *Agriculture, Groundwater, Surface water, Geology, Irrigation, *Michigan, Van Buren County.

Van Buren County, in southwest Michigan, is drained by the Paw Paw and South Branch Black Rivers. The maximum discharge of the Paw Paw River is 2,500 cubic feet per second; the minimum is 202. Corresponding discharges of the South Branch Black River are 1,680 and 20 cubic feet per second. Dissolved-solids concentrations of strams and lakes range from 28 to 749 milligrams per liter. Total nitrogen concentrations as high as 15 milligrams per liter occurred at two stream sites. Glacial deposits, 100 to 600 feet thick, are sources of groundwater supplies. Irrigation wells are capable of yielding 1,000 gallons per minute. Model simulations are used to predict the effects of increased irrigation withdrawals. Dissolved-solids concentrations of ground water range from 112 to 878 milligrams per liter. Nitrate in water from 22 percent of the wells in the southern part of the county exceeded 10 milligrams per liter. Areal variations in the chemical characteristics of ground and surface water are related to land use and chemical inputs to the hydrologic system. Nitrogen input is 72.7 percent from fertilizer, 21.3 percent from precipitation, 4.5 percent from animal wastes, and 1.5 percent from septic tanks. (USGS)
W86-03554

RESULTS OF A SOLUTE TRANSPORT EXPERIMENT AT UVAS CREEK, SEPTEMBER 1972,

Geological Survey, Menlo Park, CA. Water Resources Div.
R. J. Avanzino, G. W. Zellweger, V. C. Kennedy,

S. M. Zand, and K. E. Bencala.
USGS Open-File Report 84-236, 1984. 82 p, 40 fig, 9 tab, 5 ref.

Descriptors: *Solute transport, Experimental data, Chloride, Strontium, Sodium, *Adsorption, Streams, Low flow, *Environmental tracers, Santa Clara County, *California.

A 3-hour constant-rate injection of chloride, strontium, and sodium was made into Uvas Creek, Santa Clara County, California, to determine solute transport and sorption properties of a small stream. Seven observation stations were selected within a 635-m reach of the stream where water samples were collected before, during and after the injection. Size-sorted stream sediments placed in the stream prior to the injection were sampled to determine sediment sorption properties. Dissolved solute concentration data are presented in both original and normalized forms to illustrate the different transport properties of the three solutes. Sorbed concentrations are tabulated as a function of both time and grain size. Calculations of streamflow and sorptive distribution coefficient are given. (USGS)
W86-03556

TIME OF TRAVEL AND DISPERSION OF SOLUTES IN A 36.4-MILE REACH OF THE NORTH PLATTE RIVER DOWNSTREAM FROM CASPER, WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
G. W. Armentrout , and L. R. Larson.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 82-4103, 1984. 17 p, 6 fig, 2 tab, 7 ref.

Descriptors: *Streamflow velocity, *Dispersion, *Dye releases, *Fluorescence, Salute transport, *Time of travel, North Platte River, *Wyoming, Casper.

Time-of-travel and dispersion measurements made during a dye study November 7-8, 1978, are presented for a reach of the North Platte River from Casper, Wyo., to a bridge 2 miles downstream from below the Dave Johnston Power Plant. Rhodamine WT dye was injected into the river at Casper, and the resultant dye cloud was traced by sampling as it moved downstream. Samples were taken in three equal-flow sections of the river's lateral transect at three sites, then analyzed in a fluorometer. The flow in the river was 940 cubic feet per second. The data consist of measured stream mileages and time, distance, and concentration graphs of the dye cloud. The peak concentration traveled through the reach in 24 hours, averaging 1.5 miles per hour; the leading edge took about 22 hours, averaging 1.7 miles per hour; and the trailing edge took 35 hours, averaging 1.0 mile per hour. Data from this study were compared with methods for estimating time of travel for a range of stream discharges. (different from 940 cubic feet per second.) (USGS)
W86-03559

WATER RESOURCES DATA, COLORADO, WATER YEAR 1981; VOLUME 3: DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN.

Geological Survey, Lakewood, CO. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124446, Price codes: A19 in paper copy, A01 in microfiche. Water-Data Report CO-81-3, 1982. 436 p, 6 fig, 4 tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, Sampling sites, Water levels, Water analysis.

Water-resources data for Colorado for the 1981 water year consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies. (USGS)
W86-03609

STORMWATER RUNOFF TREATMENT BY IMPOUNDMENT: BARRHAVEN PILOT STUDY,

For primary bibliographic entry see Field 5D.
W86-03632

USER'S MANUAL FOR EXPLORE-I: A RIVER BASIN WATER QUALITY MODEL, HYDRAULIC MODULE ONLY,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 2A.
W86-03646

STUDY OF THE HYDROCHEMICAL REGIME AND ITS LONG-TERM VARIATIONS IN THE CASE OF SOME RIVERS IN U.S.S.R.,

Hydrochemical Inst., Rostov-na-Donu (USSR).
For primary bibliographic entry see Field 2K.
W86-03778

SEPARATION OF RUNOFF COMPONENTS BY NO3-N LOADING AND ESTIMATION OF RUNOFF LOADING BY EACH COMPONENT,

National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5B.
W86-03788

PREPARING A DESIGN STORM,

Gore and Storrie Ltd., Toronto (Ontario).
For primary bibliographic entry see Field 2A.
W86-03833

CHIMNEY HILL OFF-SITE DRAINAGE STUDY,

MMM Design Group, Norfolk, VA.
For primary bibliographic entry see Field 2A.
W86-03835

2F. Groundwater

MODELING CHEMICAL REACTIONS AND TRANSPORT IN GROUNDWATER SYSTEMS: A REVIEW,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W86-03428

GROUND-WATER CONDITIONS OF THE TRIASSIC AQUIFER IN DEAF SMITH AND SWISHER COUNTIES,

Texas Dept. of Water Resources, Austin.
G. I. Duffin.
LP-195, December 1984. 121 p, 14 fig, 5 tab, 25 ref.

Descriptors: *Groundwater, *Texas, *Aquifers, Well data, *Water quality, Radioactive wastes, Groundwater pollution, Stratigraphy, Structural geology, Groundwater movement, Groundwater recharge, Aquifer characteristics, Hydraulic profiles, Water level fluctuations, Water use, Test wells, Well logs, Chemical analysis, Unconfined aquifers, Confined aquifers.

In April 1984 the Texas Department of Water Resources initiated a study of the ground-water conditions of the Triassic aquifer in Deaf Smith and Swisher Counties. The need for the study was prompted by the Department of Energy's announcement that consideration was being given to locating high-level nuclear waste repository sites in these counties and by the concern over what impacts operation of such sites might have on the ground-water resources. Data gathered indicated that a limited number of water wells are completed in the Triassic aquifer. A comprehensive pumping test was conducted in Deaf Smith County using two wells completed in the Triassic aquifer. Results showed a well yield of 788 gallons per minute and an average transmissivity of 22,000 gallons per day per foot. These values should not be accepted as applying to the Triassic aquifer everywhere in the study area. Ground water in the Triassic aquifer occurs under both water-table and artesian conditions and water level measurements suggest that the potentiometric surface of the aqufier generally dips to the east and southeast. The chemical quality of ground water from Triassic aquifer wells that are used for municipal, irrigation, and domestic and livestock purposes ranges from fresh to slightly saline. No information was available on ground-water pumpage from industrial, irrigation, and domestic and livestock wells. However, during 1983 approximately 1,555 acre-ft of ground-water was pumped from the Triassic aquifer by the cities of Happy, Hereford and Tulia for municipal purposes. (Fazio-Omniplan)
W86-03439

INVESTIGATION OF THE FEASIBILITY OF SECONDARY RECOVERY OF GROUND WATER FROM THE OGALLALA AQUIFER: A REPORT TO THE SIXTY-EIGHTH LEGISLATURE,

Texas Dept. of Water Resources, Austin.
For primary bibliographic entry see Field 3B.
W86-03442

GROUNDWATER CONTAMINATION AND EMERGENCY RESPONSE GUIDE,

Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W86-03457

MATHEMATICAL ANALYSIS OF GROUNDWATER RESOURCES,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Butterworths Publishers, Boston. 1983. 271 p.

Descriptors: *Groundwater movement, *Mathematical studies, *Model studies, *Finite difference methods, Darcys law, Laplace equation, Aquifers, Boundary conditions, Saline water intrusion, Anisotropy, Confined aquifers, Computer programs, Unsteady flow, Transmissivity, Pumping tests, Steady flow, Groundwater pollution, Water pollution, Uniform flow, Nonuniform flow, Fate of pollutants, Water pollution sources, Hydrology, Schwarz-Christoffel transformation, Hydrographs, Recharge, Groundwater recharge, *Wells.

A textbook on the use of mathematics to describe and solve problems in groundwater concentrates on finite-difference methods. Introductory material includes definitions, basic concepts, and derivation of partial differential equations of movement (e.g., Darcy's law) and several boundary conditions (e.g., seawater intrusion). Finite differences and computers are used to obtain approximate solutions of problems. Hele-Shaw experiments are used for problems with a free surface. The inverse problem, the problem of determining aquifer parameters for use in solving boundary-value problems, is discussed. Groundwater pollution topics include diffusion and dispersion, pollution sources in uniform flow, series expansions of the well function for leaky aquifers, and calculations in nonuniform flow. Complex variable theory is used to obtain exact solutions for two-dimensional, steady-flow problems. The Schwarz-Christoffel transformation maps the interior of regions bounded by straight lines into either an upper or lower half plane. Use of the Laplace transform is demonstrated in one-

dimensional examples, a groundwater recharge problem, well storage effect, and well recovery problems. (Cassar-PTT)
W86-03478

STUDIES ON GROUNDWATER TRANSPORT IN FRACTURED CRYSTALLINE ROCK UNDER CONTROLLED CONDITIONS USING NONRADIOACTIVE TRACERS,

Sveriges Geologiska Undersoekning, Uppsala.
E. Gustafsson, and C. E. Klockars.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-701952. Price codes: A04 in paper copy, A01 in microfiche. April 1981. 58 p, 19 fig, 14 tab, 26 ref.

Descriptors: *Tracers, *Groundwater movement, *Anions, *Crystalline rocks, *Fracture permeability, Ions, Environmental tracers, Boreholes, Geologic fractures, Permeability coefficient, Chromium, Nitrates, Iodine, Bromine, Rhodamine.

The hydraulic properties of rock mass and fractures, adsorptive properties of some selected tracers during transport along fractures, dispersivity and dilution of tracers during transport in fractures, and kinematic porosity of fractured bedrock were studied along existing fractures between two boreholes. Hydraulic tests and tracer experiments reveal that the studied fracture zone has a hydraulic conductivity of .002-.003 m/s, and its constituent main transport zones have a hydraulic conductivity of .003-.005 and .001-.002 m/s, respectively. Kinematic porosity is .0008-.0009, while the roughness factor is approximately 0.2. Estimations of fracture width give varying values depending upon the calculation method used. Water quantity calculations give approximately 20 times greater width than transport velocity calculations. Rhodamine WT shows a weak retardation and sorption compared with NO3(-) and I(-), while I(-), NO3(-), and Cr-EDTA appear to be comparable as nonreactive tracers. Br(-) exhibits lower recovery than NO3(-) and I(-). The natural occurrence of some ions may cause difficulties in interpreting results where the same ions are used as tracers. The tracer tests with radial flow show that the studied fracture zone consists of at least two transport pathways with different hydraulic chracteristics. The dispersivity of the two transport pathways is 0.9-1.2 m. The dilution of the tracer in the case of instantaneous injection is mainly dependent upon the flow geometry and less on dispersion and dilution in the pump well. (Geiger-PTT)
W86-03497

STOCHASTIC-CONVECTIVE ENSEMBLE METHOD FOR REPRESENTING DISPERSIVE TRANSPORT IN GROUNDWATER,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-03498

HYDROCHEMICAL AND ISOTOPIC CONTENT OF BASALT GROUNDWATERS BENEATH THE HANFORD SITE, WASHINGTON,

Rockwell International, Richland, WA. Energy Systems Group.
For primary bibliographic entry see Field 2K.
W86-03517

GROUND WATER IN CARBONATE ROCKS AND REGOLITH IN THE FAIRVIEW AREA, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
C. R. Burchett, A. Zurawski, A. K. Sparkes, and E. F. Hollyday.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4134, 1983. 38 p, 18 fig, 5 tab, 17 ref.

Descriptors: *Geohydrology, *Well data, *Groundwater, Groundwater availability, Carbonate rocks, *Tennessee, *Williamson County, Western Highland Rim, Mississippian carbonates.

Fourteen test wells drilled in the Fairview area, Tennessee, produce from 3 to 100 gallons per minute and have an average yield of 32 gallons per minute, measured while blowing water from the wells with compressed air. In comparison, the average yield of supply wells reported by drillers is 13 gallons per minute. Specific capacities for three of the test wells ranged from 0.3 to 0.6 gallons per minute per foot of drawdown after 8 hours of pumping at 20 to 47 gallons per minute. Two test wells had specific capacities of 1.1 and 0.4 gallons per foot of drawdown after 72 hours of pumping at 55 and 43 gallons per minute. The mineral content of ground water increases greatly below a gypsum horizon approximately 100 feet below the top of the Fort Payne Formation. Ground water above the gypsum horizon, however, meets the standards for finished drinking water. (USGS)
W86-03548

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1984,

Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds.
Price codes: A04 in paper copy, A01 in microfiche. USGS Open-File Report 84-711, 1984. 58 p, 4 fig, 15 tab, 18 ref.

Descriptors: *Groundwater level, *Aquifers, Well hydrographs, *Arkansas, *Alluvial aquifer, Sparta Sand.

This report contains about 680 ground-water level measurements made in observation wells in Arkansas in the spring of 1984. In addition, the report contains well hydrographs relating to the alluvial aquifer and the Sparta Sand and Memphis Sand aquifers, the most important aquifers with respect to ground-water availability and use in Arkansas. (USGS)
W86-03553

HYDROLOGY AND LAND USE IN VAN BUREN COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03554

HYDROGEOLOGIC DATA FROM A TEST WELL AT KATHRYN ABBEY HANNA PARK, CITY OF JACKSONVILLE, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
D. P. Brown, R. A. Johnson, and J. S. Baker.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-143, 1984. 41 p, 19 fig, 6 tab, 3 ref.

Descriptors: *Observation well, *Groundwater, *Subsurface investigations, Saline-water intrusion, Confined aquifers, Hydrogeology, Well logging, *Florida, Duval County, City of Jacksonville, *Floridan aquifer.

A 2,026-foot test well was drilled at Hanna Park, City of Jacksonville, Florida, to obtain hydrogeologic data. Drill cuttings and water samples were collected, and water-level measurements and lithologic and geophysical logs were made. The well is constructed with 6-inch diameter casing from land surface to a depth of 1,892 feet and cement grouted in place. The remainder is open hole. The uppermost 411 feet of material penetrated by the well consists of sand, clayey sand, phosphatic sandy clay, coquina, sandy limestone, and dolostone. In the remainder of the hole, the material consists of limestone and dolostone, which comprise the Floridan aquifer in the area. (USGS)
W86-03555

GEOLOGIC AND HYDROLOGIC DATA FROM A TEST-DRILLING PROGRAM IN THE HIGH PLAINS AREAS OF SOUTH DAKOTA, 1979-1980,

Geological Survey, Rapid City, SD. Water Resources Div.
C. L. Loskot, H. L. Case , and D. C. Hern.
Available from OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-148, 1984. 31 p, 2 fig, 1 tab, 2 ref.

Descriptors: *Drillers logs, *Drilling samples, Test holes, Aquifers, Electrical well logging, *South Dakota, *High Plains, *Ogallala Formation, *Arikaree Formation, White River Group, Rosebud Reservation, Pine Ridge Reservation.

The High Plains aquifer system in south-central South Dakota comprises dune sands, the Ogallala Formation, the Arikaree Formation, and the White River Group. As part of the High Plains Regional Aquifer-Systems Analysis, a total of 29 test holes were drilled from 1979 to 1980 to aid in defining the geometry of the aquifer system. The information obtained from these drilling programs is presented. (USGS)
W86-03558

CHALLENGES IN AFRICAN HYDROLOGY AND WATER RESOURCES: PROCEEDINGS OF THE HARARE SYMPOSIUM,

Ministry of Water Development, Salisbury (Zimbabwe).
July 1984. IAHS Publication No. 144, 1984. Edited by D. E. Walling, S. S. D. Foster, and P. Wurzel. 587 p.

Descriptors: *Water resources development, *Groundwater, *Erosion control, *Erosion, *Sedimentation, Sediment yield, Soil conservation, Water supply, Exploration, Geohydrology, Aquifers, Africa, Isotope studies, Recharge, Model studies, Data collections, Conservation, Sediment transport, Soil erosion, Agriculture, Soil loss.

Drought, rural development, and soil erosion are some of the problems faced in Zimbabwe and other African nations. This symposium explores problems and solutions in the areas of groundwater development and soil erosion. Papers concerning groundwater include basic data on groundwater resources in the basement shield, sedimentary basins, and volcanic terrains; use of isotopes and models; and data aquisition and archiving of information. Although groundwater resources are adequate in many areas, many have not been developed. Artificial recharge and conjunctive use have been explored. Soil erosion and sediment yield measurements are given for Africa as a whole and for specific locations. Measurement and prediction techniques for soil erosion are described. The assessment and control of soil erosion problems in agricultural lands and at mining sites are discussed. Studies on reservoir sedimentation show how to predict and extend the useful life of a reservoir by proper design, reservoir management, and flushing.
W86-03562

AFRICAN GROUNDWATER DEVELOPMENT-THE CHALLENGES FOR HYDROGEOLOGICAL SCIENCE,

British Geological Survey, Wallingford (England).
S. S. D. Foster.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 3-12, 3 fig, 5 ref.

Descriptors: *Groundwater potential, *Water resources development, Water management, *Water supply, *Exploration, *Geohydrology, Wells, Aquifers, Groundwater hydrology, Hydrology, Africa, Boreholes, Drilling, Economic aspects, Water demand, Regoliths, Groundwater mining, Recharge, Groundwater recharge.

Groundwater has many advantages for water supply development in Africa. The principal hydrogeological problems associated with groundwater development are (1) inhomogeneity of many minor aquifers, resulting in difficulty in well siting, (2) estimation of resources for large-scale development, and (3) the presence of unacceptable inorganic substances in some aquifers. Economic constraints are a major factor retarding groundwater development in Africa. Each of the three principal African geohydrological areas (basement shield,

sedimentary basins, and volcanic terrains) are characterized by different groundwater potential and by distinct exploration, evaluation, development, and management problems. In the basement shield two basic aquifers are developed: the weathered mantle (regolith) and the fractured basement rocks (bedrock). The regolith is less expensive to develop for small water supplies. More data is needed for developing large supplies in the basement rocks. The sedimentary basins contain enormous volumes of water in storage. However, exploration is needed to allow effective borehole siting. Since some of this resource is fossil water, the extent of groundwater mining must be determined. Volcanic terrains have extremely variable aquifer occurrence, potential, and chemical quality. Exploration costs are expected to be higher than in the other hydrogeological regions. Practical issues to be considered in groundwater development are engineering aspects, protection from pollution, and artificial recharge. A national archives for borehole drilling records can serve as a reference for exploration and ultimately reduce costs.
W86-03563

GROUNDWATER RESOURCES IN TROPICAL AFRICAN REGOLITHS,

Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 15-23, 2 fig, 2 tab, 20 ref.

Descriptors: *Groundwater potential, *Water resources development, *Water management, *Exploration, *Geohydrology, *Wells, *Aquifers, Groundwater hydrology, Hydrology, Nigeria, Boreholes, Drilling, Regoliths, Tropical regions.

A direct method for quantitative groundwater evaluation in the tropical African regoliths is suggested. It requires reliable information on the following hydrogeological parameters: the spatial pattern or mode of occurrence of the zone of saturation, the mean thickness of the zone of saturation, the porosity and specific yield of the saturated material, and the size or areal extent of the area under investigation. The method is illustrated in applications to three areas in Nigeria. Calculations show that in these areas (Middle Osun Valley, Upper Oba Basin, and Ilorin southeast) 50-60% of the total groundwater is available for use, providing a perennial, high yield supply. Advantages of the direct method over indirect methods are as follows: (1) it uses data on essential hydrogeological parameters of the regoliths and offers opportunity of explaining the nature of groundwater storage in a given regolith, (2) groundwater resources in deep basins of decomposition can be readily included in the quantity of total and drainable groundwater storage, (3) the data required by the method can be statistically analyzed to provide further information, (4) the method can be applied at any time of the year and is not restricted to drainage basins, (5) information derived from the method can contribute to high success rates for wells, and (6) it helps to prevent overabstraction.
W86-03564

CHARACTER OF FRACTURED ROCK AQUIFERS IN EASTERN BOTSWANA,

British Geological Survey, Wallingford (England).
D. K. Buckley, and P. Zeil.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984 IAHS Publication No. 144, 1984. p 25-36, 8 fig, 5 ref.

Descriptors: *Groundwater potential, *Water resources development, *Exploration, *Water supply, *Geohydrology, *Wells, *Aquifers, Groundwater hydrology, Hydrology, Botswana, Boreholes, Drilling, Geologic fractures, Channel aquifers.

Hydrogeological studies for village water supply from basement rocks in eastern Botswana show that groundwater occurrence is restricted to linear structural features associated with faulting and intrusion. The fractured aquifer which develops in this situation is characteristically channel-shaped of large length and narrow width and is best regarded as a vertical feature rather than a horizontal one. The most promising location for borehole sites has proved to be at the major intersections of the separate channels. Standard exploration techniques can be used to identify these channel aquifers and a combination of magnetometer and resistivity methods proved useful to locate successful sites. Particular challenges faced by the hydrogeologist working with these aquifers lie in locating suitable structures, estimating possible recharge and analyzing the aquifer response to pumping. (Author)
W86-03565

ESTIMATING GROUNDWATER RECHARGE BASED ON INFILTRATION CHARACTERISTICS OF LAYERED SOIL,

National Sugar Research Station, Kisumu (Kenya).
J. Singh, W. W. Wapakala, and P. K. Chebosi.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 37-45, 5 fig, 3 tab, 12 ref.

Descriptors: *Groundwater recharge, *Recharge, *Infiltration, *Rainfall, Kenya, Excess rainfall, Evaporation, Soil water, Soil horizons.

The infiltration characteristics of three soil horizons at the National Sugar Research Station, Kenya, were measured by use of concentric 1.5-m and 2.4-m squares constructed of galvanized iron sheets, placed at depths of 30 cm. The constants of the Horton, Philip and Kostiakov equations were determined by the method of least squares. The rainfall and pan evaporation data were analyzed to determine periods of excess rainfall, and the relation between rainfall intensity and duration. Soil moisture data indicated the depth of water needed to fill the void spaces and initiate groundwater recharge. The groundwater recharge was estimated by application of Horton's equation for periods when rainstorms exceeding 10 mm fell on two or more consecutive days during April-June; in 1983 it was estimated to be about 55 mm. (Author)
W86-03566

SOME CRITICAL ISSUES WITH MONITORING CRYSTALLINE ROCK AQUIFERS FOR GROUNDWATER MANAGEMENT IN RURAL AREAS,

Prakla-Seismos Geomechanik, Accra (Ghana).
R. R. Bannerman, and N. B. Ayibotele.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 47-56, 3 fig, 4 ref.

Descriptors: *Groundwater management, *Network design, *Water management, *Exploration, *Geohydrology, *Wells, *Aquifers, *Monitoring, Groundwater hydrology, Hydrology, Ghana, Boreholes, Drilling, Rural areas, Pumping.

A groundwater monitoring network was established in Ghana, using a sample of production boreholes instead of the usual observation wells, drilled at extra cost. Fifty-three boreholes were selected to form the network, about 2% of the number of production boreholes. Aquifers in this region have low transmissivities and low storativities. Being heterogeneous, the aquifers have variable hydraulic characteristics over short distances and little interbasin exchange. It was shown that the groundwater regime in this crystalline rock region was largely under the influence of the rainfall regime. Although about 2500 wells were installed, most fitted with hand pumps, they had no apparent adverse effect on groundwater levels. This was a result of the small withdrawals.
W86-03567

CHARACTERISTICS OF THE WEATHERED BASEMENT AQUIFER IN MALAWI IN RELATION TO RURAL WATER SUPPLIES,

British Geological Survey, Wallingford (England).
P. J. Chilton, and A. K. Smith-Carington.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 57-72, 5 fig, 4 tab, 9 ref.

Descriptors: *Groundwater, *Water quality, *Exploration, *Geohydrology, *Wells, *Aquifers, *Water supply, Groundwater hydrology, Hydrology, Malawi, Boreholes, Drilling, Recharge, Groundwater recharge, Rural areas.

Prolonged weathering of crystalline Basement Complex rocks in Central Africa has produced a layer of unconsolidated material which forms an extensive but relatively thin aquifer of low permeability. This is an important source of rural water supplies in Malawi. Potential yields are low, but the 0.25-0.5 liter per second required for hand pumps can be widely obtained where the saturated thickness is more than 10 m. Although the aquifer is fairly extensive, on a local scale, differences in bedrock mineralogy and structure produce significant variations in its physical and chemical characteristics. The distribution of permeability within the aquifer and its relationship to the fluctuating water table are important in determining the drought reliability of the aquifer. Occurrences of poor quality groundwater affect the acceptability of the water supplies and the costs of rural water supply projects. There are difficulties in estimating recharge to the weathered basement aquifer, but even at complete water supply coverage for the rural population the abstraction is only a small proportion of the annual recharge. (Author)
W86-03568

ELECTRIC LOGS FOR GROUNDWATER EXPLORATION IN THE NIGER DELTA.

Ilorin Univ. (Nigeria). Dept. of Geology.
A. U. Oteri.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 87-94, 5 fig, 1 tab, 13 ref.

Descriptors: *Groundwater potential, *Exploration, *Electrical studies, *Water supply, *Water quality, *Geohydrology, *Wells, *Aquifers, *Boreholes, Niger Delta, Brackish water, Saline water, Confined aquifers, Deep aquifers, Shallow aquifers, Geophysics, Oil wells.

The riverine ara of the Niger Delta, Nigeria's major oil producing area, is a broad belt of saline/brackish mangrove swamps riddled by meandering tidal creeks. Provision of potable water in this area has been a major problem, despite the heavy annual rainfall of over 3000 mm. The development of groundwater resources is the only alternative to the present inadequate system, which relies on collected rainwater. Fresh water in the area occurs in shallow unconfined aquifers in beach ridges and tidal point bars along creeks and/or in deep confined aquifers. Most boreholes drilled to date have encountered brackish water due to inadequate hydrogeological feasibility studies. A study of electric logs from oil wells is shown to be a feasible exploration tool for deep aquifers. This is supplemented by geoelectrical surveys for shallow aquifers in the areas not logged by oil companies. (Author)
W86-03570

WATER RESOURCES ASSESSMENT STUDY IN KIAMBU DISTRICT, KENYA,

Dienst Grondwaterverkenning TNO, Delft (Netherlands).
J. P. Heederik, N. Gathuru, F. I. Majanga, and P. G. Van Dongen.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 95-110, 10 fig, 5 tab, 5 ref.

Descriptors: *Groundwater, *Geohydrology, *Groundwater potential, Model studies, Kenya, Hydrologic budget, Boreholes.

Groundwater resources were investigated in a 300-sq mile area west of Nairobi, Kenya. The present public water supply consists of 8 boreholes and a piped gravity system. In addition, there are pri-

vately owned boreholes. The district is an almost closed basin with internal drainage. Volcanic formations form nearly the whole area. The volcanic rocks do not transmit water. The weathered fault and fractured zones are the main water transmitters. Sedimentary horizons between impervious layers provide cross connections. Four groundwater zones exist: eastern boundary (many perennial springs feeding small streams); highlands (high transmissivity, along faults, groundwater at depths of 50-100 m); western grazing area (very low transmissivity, groundwater at depths of 150-200 m); and Rift Valley floor (groundwater at depths exceeding 320 m). Groundwater recharge (100 mm for the eastern part and 60 mm for the western part) was estimated from a surface water balance based on simplified assumptions for the actual evapotranspiration. A steady-state numerical-difference flownet analysis was used to calculate the groundwater balance.
W86-03571

ISOTOPE STUDIES AS A FINAL STAGE IN GROUNDWATER INVESTIGATIONS ON THE AFRICAN SHIELD,

Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
W. Geirnaert, M. Groen, J. Van Der Sommen, and A. Leusink.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 141-153, 8 fig, 1 tab, 3 ref.

Descriptors: *Groundwater, *Geohydrology, *Isotope studies, *Recharge, *Exploration, Groundwater recharge, Upper Volta, Radioisotopes, Carbon radioisotopes, Deuterium, Tritium, Oxygen isotopes, Natural recharge, Groundwater dating, Dating.

Isotopes were used to study geohydrology in Upper Volta, where limited observation wells are available. In general, little evaporation occurs prior to infiltration. Recharge takes place only during heavy showers. In areas with a thick weathered zone no recent recharge was observed. Carbon-14 determination in these wells gave a water age of 2000-3000 years. However, such determinations are not as dependable where calcium carbonate solution and silicate weathering are common. Application of the isotope methods to specific cases showed that at Bousse, groundwater extraction is essentially a mining operation. At Djibo, located near a lake, direct recharge occurs close to the lake and diminishes further from the lake.
W86-03574

ISOTOPES IN GROUNDWATER HYDROLOGY,

BKH Consulting Engineers, The Hague (Netherlands).
J. L. Terwey.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 155-160, 2 fig, 1 tab, 5 ref.

Descriptors: *Groundwater, *Hydrology, *Geohydrology, *Isotope studies, Groundwater dating, Dating, Oxygen isotopes, Carbon radioisotopes, Aquifers, Deuterium, Tritium, Recharge, Groundwater recharge.

Stable and radioactive isotopes were used to study groundwater hydrology in the Sudan. A groundwater sample from a well near the White Nile and from the river itself had a similar isotopic composition, indicating recent recharge. Another sample taken at a considerable distance from the Blue Nile had very low isotopic values, indicating a groundwater age of 15,000 years.
W86-03575

ENVIRONMENTAL ISOTOPE HYDROLOGY IN SOUTHERN AFRICA,

University of the Witwatersrand, Johannesburg (South Africa).
B. T. Verhagen.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 161-174, 6 fig, 22 ref.

Descriptors: *Groundwater, *Geohydrology, *Isotope studies, *Groundwater recharge, *Recharge, *Mine water, Infiltration, Fate of pollutants, Water pollution sources, Africa, Carbon radioisotoeps, Oxygen isotopes, Serowe, Botswana, Dewatering, Kalahari.

Increasing use of isotope hydrological studies in southern Africa is a result of growing expertise. At Serowe, the largest traditional village in Botswana, isotope studies revealed that recharge was more general and more recent than previously assumed. Tritium analyses at a few boreholes showed that the water in certain areas was under immediate threat of bacterial and chemical pollution. Iron mines at Sishen were flooded during exceptionally heavy rains, necessitating increased dewatering activity. A major dyke divides the mine into northern and southern sections. Isotope studies showed that water from the north mine was several thousand years old; that in the south mine was derived from the recent floods. Seepage water from a diamond mine, being used for a domestic supply, suddenly showed pH levels of 9-10. Although sodium hexametaphosphate descaling agent was first blamed forthe pH rise, isotope studies showed that the high pH was actually the result of contact with freshly fractured kimberlite. Isotopes were also used to investigate the hydrology of the Kalahari, particularly the association of groundwater with surface water and the implications of local recharge.
W86-03576

GROUNDWATER MANAGEMENT BY MEANS OF A QUASI-THREE-DIMENSIONAL FINITE ELEMENT FLOW MODEL,

G. Pizzi, and L. Sartori.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 175-184, 9 fig, 1 tab, 4 ref.

Descriptors: *Groundwater management, *Groundwater availability, *Geohydrology, Water management, *Model studies, IGROSS model, Computer programs, Mathematical models, Libya, Finite element method.

IGROSS (International Groundwater Systems Simulation) is an industrial system of digital programs specially designed for multi-aquifer groundwater systems simulation, and is based on the quasi-three-dimensional finite element approach. The system of computer programs is modular, and the different programs are linked by means of auxiliary data files. The model of the western Libya regional groundwater system is presented as a relevant application of IGROSS. The aquifer system concerned extends over 800,000 sq km and is composed of four aquifers hydraulically interconnected both along aquifer branchings and through interbedded aquitards. The model has been calibrated in a steady and an unsteady state; subsequently 10 simulations have been run until the year 2030. (Author)
W86-03577

ROLE OF MODELING IN THE DEVELOPMENT OF AFRICAN GROUNDWATER RESOURCES,

W. I. M. Elderhorst.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 185-191, 5 fig, 8 ref.

Descriptors: *Groundwater, *Geohydrology, *Model studies, *Water resources development, Exploration, Africa, Mathematical models.

Numerical modeling can find widespread application in Africa. For most projects in rural areas, it is sufficient to use a two-dimensional, single aquifer model without considering unsaturated zone interaction and groundwater density difference. First attempts to model a given area should use no more than 50 elements in the network. Square and rectangular elements are easiest to handle, but triangular and polygonal elements often are more suitable for a network of wells. Groundwater modeling should be an integral part of the entire water resources development project.
W86-03578

WATER RESOURCES DATA, COLORADO, WATER YEAR 1981; VOLUME 3: DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN.

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03609

CONSEQUENCE ASSESSMENT OF HYDROLOGICAL COMMUNICATIONS THROUGH BOREHOLE PLUGS,

INTERA Technologies, Inc., Houston, TX.
For primary bibliographic entry see Field 5G.
W86-03629

ROLE OF NATURAL ORGANICS ON WATER INTERACTION WITH SOIL AND ROCK,

Kiel Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2K.
W86-03754

HYDROGEOCHEMICAL EVOLUTION AND VARIABILITY OF GROUNDWATER IN EXPERIMENTAL BASINS OF S. W. WESTERN AUSTRALIA,

J. V. Turner.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 41-54, 6 fig, 1 tab, 14 ref.

Descriptors: Spatial distribution, Temporal distribution, *Geohydrology, *Aeration zone, *Groundwater basins, *Groundwater recharge, *Hydrologic cycle, *Geochemistry, Groundwater, Water quality, Infiltration, Silicates, Australia, Weathering, Cation exchange, Water chemistry.

Spatial and temporal variations in the hydrogeochemical characteristics of groundwater are of interest both in terms of the evolution of water quality and because they are indicative of a range of processes that occur in the hydrologic cycle. These interacting processes include the hydrogeochemical evolution during infiltration of rainfall through the unsaturated zone, solute concentration by evapotranspiration and eventual recharge to groundwater. In the saturated zone hydrogeochemical variability may be attenuated or persist, depending on the flow characteristics and geochemical processes that occur in the saturated medium. A case study involving three experimental basins in the southwest of Western Australia is used in an attempt to identify the principal hydrogeochemical and hydrologic processes which interact to produce spatial variability in groundwater ionic composition on a basin scale. It is found that temporal variability in hydrogeochemistry of unpumped bores is minor over a period of ten years. The principal hydrogeochemical processes leading to spatial variability in groundwater were found to be cation exchange and chemical weathering of primary silicates in the unsaturated zone. It was also necessary to consider both the gaseous atmosphere and mineralogy of the unsaturated zone, the water flux through the unsaturated zone and the rate of recharge to groundwater. Interpretations were assisted by a similar and relatively uniform mineralogy in the basins studied. (Author)
W86-03757

COMPARATIVE STUDY OF SEQUENTIAL REDOX PROCESSES IN THREE BRITISH AQUIFERS,

British Geological Survey, Wallingford (England).
W. M. Edmunds, D. L. Miles, and J. M. Cook.
IN: Hydrochemical Balances of Freshwater Sys-

tems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 55-70, 6 fig, 2 tab, 28 ref.

Descriptors: *Oxidation-reduction potential, *Oxygen depletion, *Oxygen transfer, *Groundwater, *Aquifers, *Aerobic conditions, *Anaerobic conditions, *Rocks, Oxygen, Nitrates, Denitrification, Methane, Hydrogen, Oxidation, Limestone, Sandstones, Sulfides, Sulfates.

The transition from aerobic to anaerobic conditions in water and rock has been followed in three major British aquifers - the Chalk, Lincolnshire Limestone and Sherwood Sandstone. Oxygen is maintained at levels of 6-10 mg/l in the aerobic aquifer sections but is removed abruptly at redox boundaries (redox potential +250 to +100 mV); in the sandstones, oxygen persists for many thousands of years. Nitrate is also stable in the presence of oxygen, but rapid denitrification occurs at the redox boundary. In the reducing section a zone (+100 to 0 mV) appears to be controlled by Fe(2+). Sulfide, together with Fe(2+), probably affects the redox potential below 0 mV although it is never a major component and SO4(2-) dissolution is quantitatively more important. Methane and hydrogen influence the redox potential below -200 mV. The sequences observed are in line with theoretical predictions and measured redox potential, even as a mixed potential, can be useful in monitoring redox changes in aquifers. (Author)
W86-03758

GROUNDWATER QUALITY EVOLUTION IN THE UPPER AQUIFER OF THE COASTAL DUNE AREA OF THE WESTERN NETHERLANDS,

Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
P. J. Stuyfzand.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 87-98, 5 fig, 1 tab, 9 ref.

Descriptors: *Radioactive tracers, *Aquifers, *Groundwater dating, *Cation exchange, *Piezometers, *Minerals, *Halogens, Water quality, Sulfates, Nitrates, Metals, Heavy metals, Geohydrology, Aeration zone, Phosphates, Geochemistry.

The quality evolution of fresh groundwater younger than 30 yr is presented as observed in a piezometer nest equipped with miniscreens. Age was determined using H3, O18, and Cl. The aquifer is composed of sands on top of reducing, finer-grained deposits. Cl, SO4, NO3, F, Na, K, Mg and possibly Cu and Zn are almost exclusively derived from (high) atmospherical inputs. Adsorption of SO2, NOx and HF contributes also to this input. Atmospherically deposited Pb and V are almost completely retained in the unsaturated zone, Zn and Cd to a lower degree. Cu and F are partially immobilized within 2 m below the water table. Dissolution of shell fragments is important. Redox reactions involve O2, NO3, SO4, HCO3, Fe, Mn, PO4, NH4, U and possibly Zn and V. Biogenic opal is dissolved slowly in the fine-grained deposits. Cation exchange processes involve Na and Ca mainly, throughout the profile. Strong seasonal Cl-fluctuations are discernable to a depth of 3 m below the water table. Fluctuations in Na, K and Mg, which in bulk precipitation are strongly correlated with Cl, are dampened considerably due to cation exchange for Ca. (Author)
W86-03761

HYDROCHEMICAL PROCESSES IN GROUNDWATER DISCHARGE AREAS,

Uppsala Univ. (Sweden).
E. Eriksson.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 99-106, 5 fig, 4 ref.

Descriptors: *Geochemistry, *Geohydrology, *Surface-groundwater relations, *Evapotranspiration, *Carbon dioxide, *Groundwater, *Chemical properties, *Oxygen, Flow pattern, Groundwater movement, Chemical reactions, Calcite, Calcium, Calcium carbonate, Root zone, Minerals, Organic matter, Nutrients, Hardpan soils.

A groundwater discharge area is a site where groundwater enters the root zone from below. These sites are usually found along natural drainage channels. The flow pattern, and consequently, the mineralization of the discharging groundwater is, for the most part, a function of the geometry of the geometry of the drainage area. Processes due to changing partial pressures of oxygen gas in groundwater are the release of ferrous Fe into soils and the formation of Fe hardpans. Processes due to changing partial pressures of CO2 in groundwater are precipitation of CaCO3 and a decrease in the saturation with respect to calcite. A major factor influencing the chemical composition of discharged groundwater is evapotranspiration which increases the concentration of dissolved components, generally favors the accumulation of soil organic matter, and leads to the precipitation of calcite and formation of hardpans under sem-arid conditions. Under humid conditions, the accumulation of soil organic matter in groundwater discharge areas may lead to peat formation and soil rich in plant nutrients. In arid areas, evapotranspiration of discharged groundwater may lead to a sequence of salts precipitated along the flow pattern.
W86-03762

RESPIRATORY GAS CONTENT (O2 AND CO2) AND IONIC COMPOSITION OF RIVER WATER IN THE PLAIN OF ALSACE (EASTERN FRANCE),

Centre National de la Recherche Scientifique, Strasbourg (France). Lab. de Physiologie Respiratoire.
J-C. Massabuau, and B. Fritz.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 107-115, 4 fig, 2 tab, 9 ref.

Descriptors: *Aquifers, *Carbon dioxide, *Oxygen, *Dissolved oxygen, *Seasonal variation, *Diurnal distribution, *Ions, *Alluvial plains, Water table, Sodium chloride, Trout, Aeration, Groundwater, Alluvial rivers, Springs.

An important water table in the alluvial plain of the River Rhine interacts with all the surface waters. Measurements were taken of the annual and daily variations of respiratory gas content and ionic composition in rivers fed by this water table. Results showed that the hydrochemical balance which is steady at the springs varies as a function of distance from the emergences, with season of the year, the confluence with other water courses and with disturbance of the water table. The respiratory gas content is affected by the poorly aerated groundwater supply, and the equilibration with air, the climatic conditions and the effect of biota whose relative importance increases as a function of distance from the springs. The ionic composition, typical of water coming from a sandy, argillaceous aquifer under calcareous soil is influenced by NaCl waste from salt mines, which appears to have reacted in the aquifer by an exchange of Na(+) against Ca(++), followed by calcite deposition. Trout were also noted in the poorly aerated waters that were low in dissolved oxygen but were otherwise of good quality. The presence of the trout was attributed to an abundance of food in the form of freshwater shrimp.
W86-03763

CHANGES IN GROUND-WATER CHEMICAL COMPOSITION IN DRAINED PEAT BOGS IN CONNECTION WITH ENVIRONMENTAL PROTECTION MEASURES,

Akademiya Navuk BSSR, Minsk.
V. Pashkevitch.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 117-124, 1 fig, 7 ref.

Descriptors: *Chemical properties, *Groundwater, *Peat bogs, *Environmental protection, *Bogs, *Swamps, *Geohydrology, *Drainage, Groundwater mining, Oxidation-reduction potential, Iron, Organic matter, Oxidation, Trace elements, Chemical reactions, Geochemistry.

The main factors and processes governing groundwater chemical composition in swampy land are exemplified by a study of Byelorussian Polessie areas. Some trends in the change of the chemical composition of groundwaters under the influence of reclamation are described. It is shown that the oxidation-reduction conditions in groundwaters are changed during the post-reclamation period, which results in an alteration of migration conditions for elements with variable valency (Fe, Mn, S, etc.). The phenomenon of a rapid increase in Fe concentration in groundwaters during the first few years after reclamation is described. Soluble organic substances, Mn, P and some other microelements are intensively removed from the limits of the drained zone. This results in an impairment of surface-water quality. In the future, the reclamation by drainage will arrest peatforming processes and active generation of soluble organic substances in the areas concerned. Reclamation will promote oxidation conditions in groundwaters and decrease the concentration of a number of microelements. (Author)
W86-03764

HYDROCHEMISTRY OF SPRINGS FROM DOLOMITE REEFS IN THE SOUTHERN ALPS OF NORTHERN ITALY,

Vrije Univ., Amsterdam (Netherlands).
For primary bibliographic entry see Field 2K.
W86-03765

TEMPORAL CHANGES IN GROUND WATER QUALITY IN THE PHREATIC ZONE UTTAR PRADESH (INDIA) AND THEIR IMPACT ON SAMPLING SCHEDULE,

Central Chemical Lab., Lucknow (India).
B. K. Handa.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 167-177, 6 fig, 3 tab, 5 ref.

Descriptors: *Chemical properties, *Water analysis, Water quality, *Hydrologic data collections, *Statistical analysis, *Water sampling, *Temporal distribution, Dug wells, *Groundwater, Water sampling, Sampling, Data collections, On-site data collections, Statistical methods, Data interpretation, Variability.

Examination of the chemical data obtained by repeated analysis of dug well water samples from the phreatic zone in the Ganga alluvium of the Ballia district has shown that preparation of water quality maps based on single water sample analysis, collected year after year in any specific month is likely to lead to biased results. In order to devise a more reasonable sampling schedule, statistical methods were used on data obtained from the dug well water of Shahpur Bahmanauli. Random and more frequent sampling was recommended to assess the groundwater quality and determine the magnitude of changes in the concentrations of various water quality parameters. To achieve reliable data, a minimum of 2-4 samples/yr distributed randomly in time is suggested. Where resources present a severe constraint, reliable data may still be obtained by reducing the number of sampling points.
W86-03768

EVALUATION OF THE INTENSITY OF SOME RECENT EXOGENIC GEOLOGICAL PROCESSES IN THE U.S.S.R. BY THE HYDROGEOCHEMICAL BALANCES METHOD,

Akademiya Nauk SSSR, Moscow. Geologicheskii Inst.
For primary bibliographic entry see Field 2K.
W86-03777

HYDROCHEMICAL BUDGETING IN STUDIES OF GROUND-WATER RENEWABILITY IN AREAS OF GLACIAL FORMATION SYSTEMS,

Polish Academy of Sciences, Warsaw. Geological Sciences Inst.
J. Mitrega, and J. Pachla.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 331-341, 4 fig, 1 tab, 8 ref.

Descriptors: *Geohydrology, *Groundwater recharge, *Evapotranspiration, *Hydrologic models, *Infiltration, *Groundwater potential, *Water chemistry, *Surface-groundwater relations, *Tritium, Geochemistry, Models, Groundwater movement, Geophysics, Geomorphology.

Studies of the renewability of the potential groundwater supply of the Quaternary system show that the structure of the system may be viewed as a multicompartment model with rapid infiltration as a source of groundwater recharge and evapotranspiration as a considerable source of groundwater discharge. Hydrogeochemical studies are incorporated to support or reject models based on groundwater dynamics. The mechanism of groundwater recharge and the climatological/geomorphological effect determine the water balance of the basin as reflected in the composition of basic ions. The regional importance of Lake Hancza was downgraded, and its position within the surface/groundwater system suggests that some lakes may serve as natural gauging stations for regional analyses for recharge evaluation and corresponding environmentally smoothed tritium concentrations. Tritium identification of hydrogeological structures and base-flow balance suggests that the shallow groundwater system contributes almost exclusively to water circulation in the basins.
W86-03783

ACCUMULATION AND TRANSPORT OF WATER AND SOLUTES IN THE SATURATED AND UNSATURATED ZONES,

Institute for Soil Fertility, Groningen (Netherlands).
P. A. C. Raats.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 343-357, 7 fig, 1 tab, 1 append, 27 ref.

Descriptors: *Runoff, *Water quality, *Mathematical models, *Saturated zone, *Unsaturated zone, *Solute transport, *Water supply, *Surface-groundwater relations, Soil water, Mathematical studies, Temporal distribution, Subsoil drainage, Flow pattern.

Some aspects of the linear, time-invariant theory, causal systems (LS) of solute and water transport are reviewed and some of the simpler implications of nonlinearity and time-variance are described. The physical-mathematical model is based on equations which may be used to determine the pattern of streamlines and the velocity field for any geometry and boundary conditions. In general, for convective transport of solutes by steady flow of water in the saturated zone, the travel time density distribution can be evaluated on the basis of the flow pattern. In locations with homogeneous subsoils and deep water tables in the unsaturated zone, a surplus of precipitation and/or irrigation above evaporative demand will induce a vertical, purely gravitational flow of water. Examples of the model's application to studies of various aspects of water quantity and quality involving different transfer functions are given. The implifications of nonlinearity and the propagation of waves and fronts are discussed.
W86-03784

SALINE GROUNDWATER DISCHARGES FROM CRYSTALLINE ROCKS NEAR THUNDER BAY, ONTARIO, CANADA,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. K. Frape, P. Fritz, and A. J. Blackmer.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 369-379, 7 fig, 2 tab, 9 ref.

Descriptors: *Groundwater, *Salinity, *Geochemistry, *Geohydrology, *Saline water, *Salts, *Geophysics, Calcium, Chlorine, Sodium, Piezometers, Seismology.

Bedrock groundwater discharges have been identified in Northern Ontario in an area encompassing Lake Nipigon, Sibley Peninsula, and St. Ignace Island. Detailed studies including piezometric and seismographic tests and a geophysical survey and soil profile logging were carried out at a Lake Nipigon site where saline seeps discharge Na-Ca-Cl water containing at least 9000 mg/liter total dissolved solids from granitic rocks. The discharge points are overlain by glacio-lacustrine sediments. The discharges are <10 liters/day and mixing with local freshwater occurs within the unconsolidated sediments. The dispersion of the saline water in the deposits leads to the formation of moose licks which are characterized by the presence of soupy Na-rich clay sediments. Chemical and isotope analyses suggest a bedrock origin for the salt.
W86-03786

SURFACE AND GROUNDWATER MIXING AND IDENTIFICATION OF LOCAL RECHARGE-DISCHARGE ZONES FROM SEASONAL FLUCTUATIONS OF OXYGEN-18 IN GROUNDWATER IN FISSURED ROCK,

Uppsala Univ. (Sweden).
R. K. Saxena.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 419-428, 9 fig, 1 tab, 4 ref.

Descriptors: *Groundwater recharge, *Seasonal variation, *Oxygen isotopes, *Surface-groundwater relations, *Geologic fractures, *Fissure water, *Isotopic tracers, *Mixing, Groundwater movement, Surface water, Groundwater, Rocks, Radioactive tracers, Tracers, Boreholes.

Seasonal variations of Oxygen 18 (O18) in groundwater in relation to O18 variations in precipitation have been studied in a fissured hardrock area over a period of 2 yr. O18 content of groundwater has been determined at chosen depths in several boreholes penetrating to 100 m depth in the bedrock. It has been observed that the O18 content of the groundwater exhibited seasonal oscillations, i.e. low delta values just after the snowmelt and high delta values in November-December every year. The fluctuations in O18 were maximum at shallow depths but decreased with increasing depth, without any phase-lag. It seems that surface water inputs percolate quickly through the fissures and mix with the groundwater. From the isotopic depth profiles of the boreholes, it has been possible to identify local recharge and discharge zones. Electrical conductivity measurements of the groundwater also corroborate the results obtained by O18-tracing. Temperature profiles of the boreholes indicate that longitudinal convective mixing within the boreholes is negligible. The method for routine sampling of groundwater employing a water sampler has been verified by electrical and pressure pumping from isolated borehole-sections using packers. It is concluded that O18 is a useful environmental tracer of water for studying surface and groundwater interactions in fissured rocks. (Author)
W86-03790

2G. Water In Soils

AERATION/CIRCULATION FOR CONTROL OF ALGAL PRODUCTION,

Tetra Tech, Inc., Bellevue, WA.
R. A. Pastorok, T. C. Ginn, and M. W. Lorenzen.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 57-97, 3 fig, 3 tab, 149 ref.

Descriptors: *Aeration, *Water circulation, *Lake restoration, *Algal control, *Water quality management, Oxidation, Destratification, Fish management, Nutrients, Eutrophication, Trophic level, Macroinvertebrates, Fisheries, Nuisance algae, Algae.

Artificial circulation or aeration is often used to manage problems caused by eutrophication in lakes. Air release devices must not be placed too far above the lake bottom or too close to the water surface. If the aeration device is undersized, it may provide insufficient oxygen. Both artificial circulation and hypolimnetic aeration can provide adequate aeration, although circulation does so more rapidly. Artificial circulation generally reduces the temperature of the surface water and lowers evaporation rates. The abundance of blue-green algae decreases as vertical profiles are disrupted. The increases of mixed depth and suspended silt will probably induce light limitation of peak algal biomass. Aeration/circulation may produce changes in benthic organisms without corresponding shifts in planktonic biomass and production. Aeration/circulation prevents winter and summer fish kills by alleviating anoxic conditions. It creates habitats for cold water fishes and enhances their food supply. Aside from raising the suspended silt levels, artificial circulation has no known adverse impacts on water quality. Macrophyte populations may increase if aeration improves water transparency. Aeration/circulation may raise N gas concentrations to levels capable of inducing gas bubble disease in fish. A surface pump and a bottom aerator should be used in very deep lakes. Long-term responses of lake systems to treatment should be examined. (Geiger-PTT)
W86-03487

ESTIMATING GROUNDWATER RECHARGE BASED ON INFILTRATION CHARACTERISTICS OF LAYERED SOIL,

National Sugar Research Station, Kisumu (Kenya).
For primary bibliographic entry see Field 2F.
W86-03566

COMPARISON OF SOIL MOISTURE CHARACTERISTICS PREDICTED BY THE ARYA-PARIS MODEL WITH LABORATORY-MEASURED DATA,

Lockheed Engineering and Management Services Co., Inc., Houston, TX.
L. M. Arya, J. C. Richter, and S. A. Davidson.
Available from the National Technical Information Service, Springfield, VA 22161 as N82-32792, Price codes: A17 in paper copy, A01 in microfiche. SM-L2-04247, JSC-17820, March 1982. 393 p, 2 fig, 4 tab, 2 ref, 2 append.

Descriptors: *Model studies, *Soil water, Soil horizons, *Computer models, *Computer programs, *Fortran, *Pore pressure, *Soil compaction, Models, Prediction, Comparison studies, Soil types, New Jersey, Particle size, Soil density, Soil porosity.

Soil moisture characteristics predicted by the Arya-Paris model were compared with the laboratory-measured data for 181 New Jersey soil horizons. The Arya-Paris model predicts moisture characteristics of a soil from its particle-size distribution and bulk density in the natural state of packing. The prediction is essentially a translation of the particle-size distribution curve into a moisture characteristic curve. For a number of soil horizons, the predicted and the measured moisture charactertistic curves are nearly coincident. For a large number of other soil horizons, the predicted and measured moisture characteristic curves are strikingly similar in shape. Since the model predicts both the soil water pressure and the soil water content, a computed data pair has uncertainties in both quantities. The measured data, however, consists of water content values for preset soil water pressures and thereby exhibits uncertainty in one dimension only. An example of the computational procedure of the Arya-Paris model and a Fortran program for processing large data sets are also included.
W86-03636

CARBON DIOXIDE IN THE SOIL ATMOSPHERE: SIMULATION MODEL PARAMETER ESTIMATION FROM FIELD MEASUREMENTS,

Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
W. Bouten, F. M. de Vre, J. M. Verstraten, and J. J. H. Duysings.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 23-30, 2 fig, 3 tab, 22 ref.

Descriptors: *Model studies, *Carbon dioxide, *Mathematical models, *Temporal distribution, *Numerical analysis, *Respiration, *Soil environment, *Soil gases, Models, Cycling nutrients, Mathematical studies, Microorganisms, Soil water, Soil temperature, Computer models, Biochemistry, Root zone.

A one-dimensional numerical simulation model in FORTRAN was made to study the vertical distribution and temporal variation of partial CO2-pressure in the soil atmosphere. These pressures are a result of carbon dioxide production by microorganisms and plant roots on one hand and diffusion into the air on the other. The daily input data are soil water contents and CO2 production rates. The model was developed as a part of a research program on nutrient cycling in a forested glacial till (boulder clay) eco-system. Attention is focussed on the decalcification and acidification of boulder clay. In the present research, the model is used in its reversed form to determine CO2 production rates throughout the water unsaturated soil from fortnightly field measurements of soil partial CO2-pressures. The topsoil flux serves as a control. Tentative results of 6 months of measurement (June-December 1983) show distinct fluctuations during the growing season. However, to quantify the sensitivity of microbial and plant root production on soil temperature, moisture conditions and additional food supply, more measurements of CO2-pressures, soil respiration and microbial production are first needed. (Author)
W86-03755

2H. Lakes

CHEMICAL AND PHYSICAL PROPERTIES OF CONNECTICUT LAKES,

Connecticut Agricultural Experiment Station, New Haven.
C. R. Frink, and W. A. Norvell.
Bulletin 817, April 1984. 9 p, 8 fig, 3 tab, 42 ref, 4 append.

Descriptors: *Connecticut, *Lakes, *Eutrophic lakes, *Phosphorus, *Chlorophyll-a, *Algae, Lake classification, Lake morphology, Physical properties, Water properties, Water analysis, Density, Nutrients, Aquatic plants, Aquatic productivity, Limnology.

A total of 70 Connecticut lakes were studied during 1973-80, probing their sediments, sampling weeds and algae, and analyzing their waters for plant nutrients and other chemicals. This report summarizes these analyses and interprets the results in terms of nutrient status and the consequent growth of weeds and algae. Comparable chemical analyses of 35 lakes are available for 1937-39, making it possible to examine changes that may have accompanied changes in the environment. Total phosphorus (P), total nitrogen (N), chlorophyll-a and secchi depth criteria were used to assign lakes to six tropic categories. Lakes similar in nutrients, chlorophyll-a and transparency were clustered according to six characteristics: spring P, spring N, summer P, summer N, summer chlorophyll-a, and summer Secchi depth. The data show that phosphorus is the element controlling the growth of algae and that nitrogen is seldom limiting. Transparency is determined by algal growth and can be predicted by measurements of chlorophyll-a and color. A comparison with prior data shows an increase in total P and chlorophyll while transparency has decreased. Prediction of phosphorus concentrations using a model developed earlier for 35 lakes was similar to observed concentrations. Most of the lakes are fairly dilute bicarbonate waters, which has not changed much from the 1937-39 findings. These data should help develop strategies to control nutrient enrichment, and thus make the lakes more pleasant for all to use. (Atkins-Omniplan)
W86-03438

CURRENTS IN SAN PABLO BAY,

California Univ., Berkeley.
For primary bibliographic entry see Field 2L.
W86-03449

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 2: FIRST YEAR POSTSTOCKING RESULTS,

Florida Univ., Gainesville. School of Forest Resources and Conservation.
K. C. Ewel, and T. D. Fontaine.
Volume VII: A Model for Evaluation of the Response of the Lake Conway, Florida, Ecosystem to Introduction of the White Amur, Technical Report A-78-2, November 1981. Report 2 of a Series. Army Engineer Waterways Experiment Station, Vicksburg, MS. 157 p, 59 fig, 34 tab. 178 ref, 1 append. DACW39-76-C-0019.

Descriptors: *Nutrients, *Phosphorus, *Simulation analysis, *Hydrologic models, *Cycling nutrients, Phytoplankton, Models, Ecosystems, Food chains, Biomass, Eutrophication, Lakes, Succession, Computer models, Eutrophic lakes, Submersed plants.

Simulation of a model summarizing relationships between major biotic and abiotic components in Lake Conway, Florida, showed that the establishment of significant growths of submersed plants had enabled nutrients in sediments, previously removed from nutrient cycling, to be reintroduced into the water column where stimulation of phytoplankton production can occur. Nutrient loading from outside sources had declined over the last few years, and the simulations showed slowly declining submersed plant biomass and productivity as nutrients were washed out. The addition of white amur accelerated the decline of submersed plant biomass. As a result, the transfer of P into the water column also decreased, which in turn accelerated the reduction in phytoplankton biomass and productivity. Consumers that depended most heavily on the pelagic-grazing food chain decreased while consumers that depended most heavily on the benthic-detrital food chain showed little change. Ecosystem gross production and respiration declined at a fairly constant rate over a ten-yr period but net ecosystem production remained essentially the same as in baseline simulations. As a result, the percent of gross production that became net production increased and the ecosystem was set back to an earlier stage of succession. (Geiger-PTT)
W86-03454

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS, REPORT 1: BASELINE STUDIES, VOLUME V, THE HERPETOFAUNA OF LAKE CONWAY, FLORIDA,

University of South Florida, Tampa. Dept. of Biology.
J. S. Godley, R. W. McDiarmid, and G. T. Bancroft.
Volume V: The Hepetofauna of Lake Conway, Florida, Technical Report A-78-2, June 1981. Report 1 of a Series. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. 111 p, 42 fig, 5 tab, 10 ref, 1 append. DACW39-76-C-0047.

Descriptors: *Lakes, *Baseline studies, *Reptiles, *Amphibians, *Aquatic weed control, Biocontrol, White amur, Lake Conway, Florida, Aquatic habitats, Weed control, Snakes, Frogs, Alligators, Turtles, Salamanders.

This report summarizes the baseline conditions for the amphibian and reptile populations of Lake Conway, Florida, for the 15-month study period, June 1977-September 1978. These results will be used later to determine whether any changes in the herpetofauna result from the introduction of the white amur (Stenopharyngodon idella) into the lake system to control aquatic vegetation. This baseline report includes detailed descriptions of the herpetofaunal study sites and methods and community analyses of the temporal and spatial distributions and densities of the species by pool. A total of 5836 individuals representing 11 amphibian species and 16 reptilian species were observed or captured on Lake Conway during the baseline study period. Approximately 93% of the total species pool was obtained within the first 3000 specimens, and between 70% and 80% of the predicted herpetofauna inhabiting each pool has been recorded. Of the 27 species presently recorded from the Lake Conway complex, 11 occur in all pools and together account for 94.4% of the total sample. The mean relative densities of 11 species were found to vary significantly between pools. Development of the shoreline for housing during the baseline study period was shown to have a negative impact on some amphibian and reptile populations. (Author)
W86-03458

BOUNDARY CONDITIONS OF SEDIMENT SURFACES VIEWED FROM DO BEHAVIOR,

T. Yoshida, and T. Mimaki.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 112-129, 15 fig, 1 tab.

Descriptors: *Lakes, *Sediment-water interfaces, *Dissolved oxygen, *Stratification, Oxygen, Thermal stratification, Oxygen demand, Anaerobic conditions, Lake Nakanoumi, Japan.

The dissolved oxygen behavior in the sediment-water interface was investigated with column tests. Water samples from Lake Nakanoumi, Japan, and one of its inflowing rivers were used in the experiments. The sediment surface was always anoxic. Dissolved oxygen stratification was influenced by two factors: thermal stratification and oxygen demand of the sediment. The latter influence was noted within 10 cm of the sediment-water interface. Since no thermal stratification occurs in winter, the dissolved oxygen profile was constant throughout most of the water column until nearing the sediment, where dissolved oxygen levels rapidly decreased. In summer the dissolved oxygen stratification was exponential. (Cassar-PTT)
W86-03467

COMPARISON OF METHODS FOR ESTIMATING NUTRIENT RELEASE FROM LAKE SEDIMENTS,

For primary bibliographic entry see Field 5B.
W86-03477

PRELIMINARY GUIDE TO THE ONSITE IDENTIFICATION AND DELINEATION OF THE WETLANDS OF THE SOUTH ATLANTIC UNITED STATES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. T. Huffman, G. E. Tucker, J. W. Wooten, C. V. Klimas, and M. W. Freel.
Technical Report Y-78-7, May 1982. Final Report. 59 p, 6 fig, 4 ref, 1 append.

Descriptors: *Lakes, *Wetlands, *Aquatic plants, Marshes, Bogs, Fens, Salt marshes, Stream beds, Vegetation, Flooding, Saline water, Salt marshes.

Wetlands of the South Atlantic United States are mainly located on the coastal plain. Freshwater marshes are found in the plateaus. The types of wetlands and the prevalent vegetation are as follows: haline aquatic bed, algae and seagrass; freshwater aquatic bed, free-floating, floating-leaved, and submersed herbs; emergent haline coastal flats, halophytic and succulent forbs; emergent haline marshes, dense stands of graminoids with a few shrubs and forbs; freshwater flats, rooted, emersed herbs and sparsely scattered shrubs and trees;

freshwater marshes, dense stands of graminoids intermixed with occasional forbs; scrub-shrub wetlands and forested wetlands, medium to dense stands of shrubs and/or trees; stream beds, temporary stands of old witchgrass; and unconsolidated shores, temporary stands of goosefoot, barnyardgrass, summer cypress, and cocklebur. (Cassar-PTT)
W86-03480

PRELIMINARY GUIDE TO THE ONSITE IDENTIFICATION AND DELINEATION OF THE WETLANDS OF THE INTERIOR UNITED STATES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Technical Report Y-78-6, May 1982. Final Report. 49 p, 1 fig, 1 tab, 18 ref, 1 append.

Descriptors: *Lakes, *Wetlands, *Aquatic plants, Marshes, Bogs, Fens, Stream beds, Vegetation, Flooding, Mosses, Lichens, Saline water, Salt marshes.

Wetlands communities of the interior United States are classified into six widely varying ecoregions: warm continental, hot continental, subtropical, prairie, steppe, and desert. Most of the original, natural vegetation has been succeeded by agricultural crops. Wetlands have been characterized to help identify and delineate the wetlands. The freshwater aquatic bed wetlands community occurs in ponds, lakes, reservoirs, etc., and contains rooted, submerged plants; floating, nonrooted plants; and rooted plants with floating parts. The saline aquatic bed wetlands, uncommon in this area, are usually sparsely vegetated. Algae and rooted vascular plants occur in dense, scattered stands. Moss-lichen wetlands (often called bogs) occur in the northern midwest on acid, peaty soils. Sphagnum moss is the prevalent species. Emergent wetlands are dominated by erect, rooted, herbaceous hydrophytes, excluding moss and lichens. Perennials are dominant. Common emergent wetlands communities are saline inland flats (scattered halophytic herbs), saline marshes (saltgrass, spikesedge, bulrush, etc.), freshwater flats (rooted, emersed herbs and sparsely scattered shrubs and trees), and freshwater marshes (dense stands of graminoids intermixed with an occasional forb). Scrub-shrub wetlands and forested wetlands have woody vegetation less than 20 ft high. Vegetation is often stunted because of severe environmental conditions. Vegetated stream beds, commonly containing old witchgrass, are colonized during low flow and lose the vegetation during high flow. Unconsolidated shores are briefly vegetated by goosefoot, barnyard grass, summer cypress, and cocklebur, which are killed by rising water.
W86-03482

EXTRACELLULAR METABOLITE INVOLVEMENT IN PLANKTON COMMUNITY STRUCTURE,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
K. I. Keating.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 146-197, 158 ref.

Descriptors: *Diatoms, *Antibiotics, *Phytotoxicity, *Algal control, Vitamins, Predation, Algae, Cyanophyta, Algicides, Nuisance algae, Eutrophication, Silica, Aquatic populations, Biocontrol, Toxins, Toxicity, Phytoplankton, Biochemistry.

In the future, algal management is likely to employ chemical, engineering, and biological approaches to control lake eutrophication. The effects of extracellular metabolites are more far reaching in aquatic systems than in terrestrial systems. Studies of extracellular metabolites in aquatic plants and animals are reviewed. It is speculated that extracellular products contribute to the capacity of blue-green algae to limit predation by rejection, by inhibition feeding, or reproductive activities. Distinguishing between extracellular and membrane-bound metabolic products can help to determine the level, mode, and extent of antibiotic effects. Several studies demonstrate the antibacterial activity of algae and the toxicity of algae to vertebrates, including humans. Excretion, lysis, and decomposition play a part in releasing vitamins reqired by algae for reproduction. The addition of silica to lake waters to encourage diatom growth rather than blue-green algae growth is explored along with the possibility of timing of copper sulfate additions to prevent the release of diatom extracellular inhibitors from blue-green algae blooms. (Geiger-PTT)
W86-03491

CYANOPHAGES: ARE THEY POTENTIAL BIOLOGICAL CONTROL AGENTS OF NUISANCE BLUE-GREEN ALGAE,

California Univ., Riverside. Dept. of Plant Pathology.
P. R. Desjardins.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 198-229, 5 fig, 68 ref.

Descriptors: *Algal control, *Cyanophyta, *Viruses, *Biocontrol, *Nuisance algae, Algae, Eutrophication, Phytotoxicity, Growth kinetics, Environmental effects, Adsorption, Separation techniques.

Methods that have been successfully used to isolate and purify a few of the well characterized cyanophages are described. The isolation of cyanophages from natural water samples requires enrichment or concentration followed by clarification and purification. The adsorption kinetics and growth curves of various cyanophages are essentially the same as those of bacteriophages. Growth of an algal host in the presence of the cyanophage results in the increased production of resistant strains. The effects of environmental factors and extracellular excretions on virus adsorption are not well known. Several field attempts to control blue-green algae with cyanophages have met with mixed results. In some cases, a broad spectrum of cyanophages must be available for controlling different types of algal species. An integrated approach to biological control might be tried to control nuisance algae under field conditions. (Geiger-PTT)
W86-03492

UTILIZATION OF BACTERIA IN MANAGING CYANOBACTERIAL POPULATIONS: A REVIEW AND UPDATE,

Medical Coll. of Ohio at Toledo. Dept. of Microbiology.
J. C. Burnham.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 230-258, 8 fig, 3 tab, 46 ref.

Descriptors: *Cyanobacteria, *Aquatic bacteria, *Water quality management, Biocontrol, Microbiological studies, Lakes, Bacteria, Aquatic populations, Predation, Eutrophication, Reviews, Toxins, Ecological effects.

The bacterium Myxococcus xanthus offers excellent potential as a microbial control agent for cyanobacteria. This lytic system is capable of functioning in the total absence of heterotrophic nutrients other than aqueous cyanobacteria and can carry out cyanobacterial lysis at high agitation rates. The myxobacter AL-1 strain possesses both proteolytic and cell wall lytic activity. Scanning electron micrographs show a parallel orientation of myxococcal cells on the surface of a spherule. It is postulated that myxococcal swarming is both the process responsible for the parallel orientation of bacteria at the spherule surface and the primary mechanism by which the myxococci concentrate the cyanobacteria in the spherule core. With the increasing costs of lake management the favorable cost/benefit ratio provided by biological control makes the development of microbiological control systems seem more attractive. A funding agency might utilize the multidisciplinary approach to review projects for lake or water management to decide which areas should receive research priority. The funding mechanism should include sufficient commitment to provide testing in controlled natural ecosystems. (Geiger-PTT)
W86-03493

EVALUATION OF COMMUNITY INFORMATION INDICES FOR MISSISSIPPI RIVER FISHERIES,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 7C.
W86-03499

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN; V: GRANT AND PLATTE, COON AND BAD AXE, AND LACROSSE RIVER BASINS,

Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 6G.
W86-03501

DISSOLVED ORGANIC MATTER AND LAKE METABOLISM: BIOGEOCHEMISTRY AND CONTROLS OF NUTRIENT FLUX DYNAMICS IN LAKES,

Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
R. G. Wetzel.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-021861. Price codes: A03 in paper copy, A01 in microfiche. DOE/EV/01599 -- 219 Pt 1, August 1982. Technical Progress Report. 48 p. EY-76-S-02-1599.

Descriptors: *Lakes, *Nutrients, *Organic matter, Water circulation, Lake stages, Limnology, Cycling nutrients, Biogeochemistry.

Progress on a long-term research program is reported. Allochthonous sources, cycling and influent output of particulate and dissolved organic matter and inorganic nutrients are outlined. Wetland-littoral metabolism, focussing on physiological ecology, population dynamics, decomposition controls, and the influences on organic-inorganic loading to lakes, is discussed. The importance of thermal stratification and mixing in the nutrient dynamics as well as phytoplankton succession and competition is emphasized. Temporary meromixis in the spring occurs in the lake about every three years. The entire sequence of nutrient regeneration, phytoplankton succession productivity, algal mortality patterns, and effectiveness of inorganic-organic nutrient interactions from wetland-littoral sources are altered in those years. While the differences themselves are of major interest, mechanism differences of productivity control are emerging from these types of natural variations. These important regulatory mechanisms would not have been observed if the studies had been conducted over a period of less than three years. (Halterman-PTT)
W86-03504

AQUACULTURE IN DREDGED MATERIAL CONTAINMENT AREAS: PROCEEDINGS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
September 1982, Galveston TX, Miscellaneous Paper D-83-2, October 1983. 216 p.

Descriptors: *Ponds, *Aquaculture, *Dredging, *Aquatic habitats, *Fish farming, *Fish ponds, Design criteria, Toxicity, Fate of pollutants, Water quality, Habitats, Economic aspects.

A workshop examined issues affecting the technical, legal, economic, and practical use of dredged material containment areas (DMCAs) for aquaculture. The participants agreed that aquaculture as a secondary use of DMCAs would be profitable and desirable. Techniques for site development and pond management presently used are satisfactory in DMCAs; however, some differences exist in

land acquisition and permit procedures. Capital investment requirements could be significantly less due to simplified land acquisition, reduced land costs, and shared costs of dike construction and maintenance. Discussions in this workshop covered species suitable for aquaculture, water quality, health and disease control, pond design, effect of pollutants in the sediments, and property rights.
W86-03704

SITE DESCRIPTION OF DREDGED MATERIAL CONTAINMENT AREAS: AN OVERVIEW OF PHYSICAL, CHEMICAL, BIOLOGICAL FEATURES,

Army Engineer District, Galveston, TX.
R. Medina.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX, Miscellaneous Paper D-83-2, October 1983. p 7-19, 20 fig.

Descriptors: *Ponds, *Aquaculture, *Aquatic habitats, *Dredging, *Fish farming, *Fish ponds, Sediments, Levees, Spillways, Aquatic life.

Dredged material containment areas (DMCA) differ physically, biologically, and chemically. Structural variability includes size, configuration, foundation conditions, water retention properties, and the presence of interior cells. Levees differ in height, width, continuity, and adaptability to aquaculture. Locations may be remote or have ready access to roads and commercial power sources. Water control structures vary in location, state of repair, and usefulness to the prospective culturist. Infrequently used DMCA may be heavily overgrown, while active DMCA, containing sand, silt, or clay, often have irregular bottom topography and potentially unstable interior soils. Most DMCA are biologically productive during inactive periods, but potential contaminants within or scheduled for disposal in DMCA should be assessed. The length of time an area is active and the frequency of disposal, important impacts in DMCA aquaculture activities, should be incorporated into all planning. Cooperation from the local Corps District is anticipated. (Author)
W86-03705

REVIEW OF SPECIES SUITABLE FOR CONTAINMENT SITE CULTURE (FRESH WATER),

Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
R. R. Stickney.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX, Miscellaneous Paper D-83-2, October 1983. p 79-90, 2 fig.

Descriptors: *Ponds, *Fish ponds, *Aquaculture, *Fish farming, *Aquatic habitats, Lakes, Habitats, Fish ponds, Catfish, Channel catfish, Invertebrates, Tilapia, Blue tilapia, Red drum, Drum, Crawfish, Shrimp, Striped bass, Bass, Largemouth bass, Sunfish, Minnows.

Fishes and invertebrates suitable for aquaculture in low salinity or fresh water dredging containment sites should be stenohaline or euryhaline types, fast growing, tolerant to extremes in water quality, have a history of successful aquaculture, and have high economic value. Fish species of the southern United States which appear to meet these criteria are the channel catfish (Ictalurus punctatus), blue tilapia (Tilapia aurea), and red drum (Sciaenops ocellatus). Suitable invertebrates are the crawfish (Orchonetes spp. and Procambarus spp.) and freshwater shrimp (Macrobrachium rosenbergii). Sport fish include striped bass (Morone saxatilis), largemouth bass (Micropterus salmoides), and sunfishes (Lepomis spp.). Bait species are minnows and goldfish.
W86-03706

POND MANAGEMENT: POLYCULTURE VS. MONOCULTURE,

Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
R. K. Strawn.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 115-119, 13 ref.

Descriptors: *Ponds, *Aquaculture, *Dredging, *Fish farming, *Aquatic habitats, *Fish ponds, Lakes, Habitats, Shrimp, Blue shrimp, Green shrimp, Striped mullet, Mullet, Drum, Black drum, Redfish, Blue tilapia, Tilapia, Polyculture.

Polyculture, extensively used in Israel and the Far East, makes better use of resources than monoculture, thus increasing yield and returns. Some species combinations shown to be productive on the Gulf Coast are blue shrimp (Penaeus stylirostris) and green shrimp (P. vannamei), striped mullet (Mugil cephalus) and various shrimp (Penaeus spp.), and striped mullet (M. cephalus) cultured with black drum (Pogonias cromis). Redfish (Sciaenops ocellatus) and blue tilapia (Tilapia aurea) need to be evaluated both together and in polyculture with other species in dredged material disposal areas. (Author)
W86-03707

POND DESIGN AND MANAGEMENT FOR COASTAL AQUACULTURE,

Alabama Dept. of Conservation and Natural Resources, Gulf Shores. Claude Peteet Mariculture Center.
R. V. Minton.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 135-142, 12 ref.

Descriptors: *Ponds, *Fish ponds, *Aquaculture, *Aquatic habitats, *Fish farming, *Dredging, Lakes, Aquatic life, Habitats, Bentonite, Predation, Fertilizers, Soil properties, Water quality, Temperature, Salinity, Oxygen, Dissolved oxygen, Zooplankton, Fish stocking.

Pond design and layout will ultimately determine the degree to which a pond can be managed. Preliminary survey of a prospective site should include soil analysis for water retention capabilities. Promising sites with permeable soils can sometimes be sealed to reduce water loss by mechanical means or through the addition of materials which form an impermeable blanket. The size of a pond is determined by many variables, including the topography of the land, available capital, construction expense, market demand of the product being cultured, and available labor. The pond bottom should slope toward the drain location with a minimum ratio of 1:1000. Harvest areas, or catch basins, are recommended for production ponds and should comprise approximately 10% of the pond area or be large enough to maintain the pond production during the harvest operation. Intake water should be filtered to prevent entry of predator or competitor species. Pond use, filling and drainage, and chemicals and fertilizers added to the pond should be kept as part of the permanent record for each pond. Minimum water quality parameters such as temperature, salinity, and oxygen should be monitored. Systematic pond preparation of each pond should be made prior to stocking of either larval or fingerling fish. Rotenone at a concentration of 4 mg per liter should be added to any water remaining in the harvest area to eliminate wild fish or fish from the previous culture period. Present information on fertilization in brackish water ponds is quite limited. Chicken manure has thus far given the best returns from fingerling production ponds at the Claude Peteet Mariculture Center. (Author)
W86-03710

SELECTION CRITERIA AND PROCEDURES FOR ESTABLISHING MARICULTURE FACILITIES IN EXISTING CONTAINMENT SITES,

Dow Chemical U.S.A., Freeport, TX. Texas Div.
For primary bibliographic entry see Field 5C.
W86-03712

DESIGN CRITERIA FOR AQUACULTURE PONDS ON DREDGED MATERIAL,

Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 8I.
W86-03713

PHYTOPLANKTON-ENVIRONMENTAL INTERACTIONS IN RESERVOIRS: VOLUME 1.

Papers Presented at Workshop. April 10-12, 1979, Monterey, CA, Technical Report E-81-13, September 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 379 p. Marc W. Lorenzen, Editor. DACW39-78-C-0088.

Descriptors: *Lakes, *Reservoirs, *Phytoplankton, *Algae, *Nutrients, Environmental effects, Model studies, Temperature, Water temperature, Kinetics, Light quality, Reservoir operation, Bioassays.

The state of the art in reservoir phytoplankton evaluations was the subject of a collection of papers presented at a workshop sponsored by the U.S. Army Engineer Waterways Experiment Station. Topics included phytoplankton-nutrient kinetics mechanisms in mathematical simulation models, effects of reservoir characteristics and environmental factors on modeling, use of detailed mechanistic models of phytoplankton dynamics, nitrogen fixation and phytoplankton interactions, DCMU-enhanced chlorophyll fluorescence as an indication of phytoplankton physiological status, taste and odor problems in reservoirs related to phytoplankton, bioassay approaches for assessing phytoplankton growth, relationship of dominant phytoplankton to water temperature and season, and relationship of dominant phytoplankton to nutrients.
W86-03716

PHYTOPLANKTON-NUTRIENT KINETICS MECHANISMS IN MATHEMATICAL SIMULATION MODELS, WITH SPECIAL ATTENTION TO RESERVOIRS AND IMPOUNDMENTS,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
V. J. Bierman.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA, Technical Report E-81-13, September 1981. p 11-32, 57 ref.

Descriptors: *Lakes, *Reservoirs, *Phytoplankton, *Nutrients, *Model studies, Mathematical models, Kinetics, Nitrogen, Phosphorus, Silicon, Monod equation, Eutrophication, Cell quota models, Growth rate, Algae, Internal pool models.

Formulations used to describe phytoplankton-nutrient kinetics in deterministic simulation models are reviewed. The rationale and assumptions of each formulation are discussed along with the data required to implement each formulation. Special attention is given to the nutrient recycle characteristics and to nutrient interactions in cases where there is more than one potential limiting nutrient. Fixed stoichiometry models (example, Monod equation) are simple to use because they are empirical equations which exclude processes occurring at the cellular level. Cell quota models (variable stoichiometry) assume that the stoichiometric composition of phytoplankton cells varies as a function of the balance between nutrient uptake rate and cell growth rate. They realistically describe the experimentally observed mode of cell growth without including complex biochemistry. Internal pool models (variable stoichiometry) can correctly describe the limiting behavior of nutrient uptake rates as a function of changes in internal nutrient levels. In choosing a model nutrient recycle kinetics must be considered. Each model type assumes a different mechanism. In models which include more than one potential limiting nutrient, a mechanism must be devised for calculating phytoplankton growth rates when the levels for both nutrients are nonoptimum. Two hypothesis are in use: the multiplicative hypothesis and the threshold hypothesis.
W86-03717

MODELING COMBINED EFFECTS OF ENVIRONMENTAL FACTORS ON PHYTOPLANKTON,

Rensselaer Polytechnic Inst., Troy, NY.
R. A. Park, and C. D. Collins.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 148-195, 18 fig. 93 ref.

Descriptors: *Lakes, *Phytoplankton, *Model studies, *Reservoirs, *Nutrients, Mathematical models, Algae, Advection, Turbulent flow, Sedimentation, Temperature, Water circulation, Water temperature, Light, Predation, Mortality, Photosynthesis, Zooplankton, Cyanophyta, Respiration, Excretion, Water pollution effects.

This paper describes the characteristics of reservoirs that necessitate specific modeling approaches, reviews the combinations of process equations used in phytoplankton models, and gives examples of ways in which these equations are combined. Some reservoir characteristics and their effects on modeling are as follows: advection--loss of phytoplankton and flushing of nutrients; sinking of phytoplankton--variation with shape, specific gravity, size, surface chemistry of the algae, and viscosity and turbulence of surrounding water; temperature--variation of concentration of photosynthetic enzymes; nutrients--storage and delayed response to loadings; light--limited in some areas by turbidity, high density of phytoplankton, and turbulence; predatory mortality--difference in grazing patterns; nonpredatory mortality--effects unclear; respiration and excretion; and toxic chemicals. Eight models are explained and demonstrated. The Chen model and DiToro models are relatively simple. The Kremer and Nixon model is slightly more complex. More complex models are by Straskraba, Lehman-Botkin-Likens, Nyholm, Scavia, and Youngberg's CLEANER. Of these eight models, some present environmental responses as exponential, some use saturation kinetics, and some use nonlinear equations to account for optimal responses. Most combine some or all of the responses in a multiplicative fashion.
W86-03718

USE AND INTERPRETATION OF DETAILED, MECHANISTIC MODELS OF PHYTOPLANKTON DYNAMICS,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 196-222, 9 fig, 1 tab, 21 ref.

Descriptors: *Lakes, *Model studies, *Nutrients, *Phytoplankton, *Reservoirs, Mathematical models, Lake Ontario, Kinetics, Algae, Zooplankton, Grazing, Phosphorus, Nitrogen, Silicon, Oxygen, Carbonates, Stratification, Thermal stratification.

A model for phytoplankton dynamics was applied to lake-scale phytoplankton production and phosphorus cycling in Lake Ontario. The model includes phytoplankton, zooplankton, nutrient cycles, oxygen balance, and the carbonate equilibrium system. Each model compartment is represented by a differential equation composed of biological, chemical, and physical processes. Several conclusions were reached. In spring and fall phytoplankton dynamics are controlled by light. In late spring and summer phytoplankton production is limited primarily by silicon and phosphorus. During stratification, available phosphorus is supplied from several sources: 3% from external sources, 10% from the hypolimnion, and 87% from biological recycling. Zooplankton tend to reduce algal populations in midsummer but excrete nutrients usable by the phytoplankton.
W86-03719

NITROGEN FIXATION AND PHYTOPLANKTON INTERACTIONS IN SOUTHWESTERN RESERVOIRS,

Envirosphere Co., Bellevue, WA.
G. Lawley.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 232-245, 3 fig, 4 tab, 6 ref.

Descriptors: *Lakes, *Nutrients, *Nitrogen fixation, *Phytoplankton, *Reservoirs, Lake Arlington, Lake Ray Hubbard, Texas, Eutrophication, Phosphorus, Nitrates, Sediments, Cyanophyta, Anabaena, Algae, Aufwuchs.

Nitrogen fixation potential was studied in two north Texas lakes. In Lake Arlington, used for powerplant cooling, nitrogen fixation in the water column varied from February through October, reaching a peak in early June. The passage of water through the powerplant cooling system apparently did not affect the ability to reduce nitrogen. Sediment fixation varied considerably but no temporal trends were evident. Nitrate levels varied inversely with nitrogen fixation, indicating that as nitrogen became scarce, the blue-green algae increased their nitrogen fixation rate. Total phosphorus levels varied in proportion with blue-green algal volumes. At some times in the year nitrogen fixation rates were high among epiphytic populations. Algal mats on the rocky shoreline reduced nitrogen at the yearly rate of 1 gram nitrogen per sq meter of rock surface. Likewise, the aufwuchs community and floating algal mats contributed considerable reduced nitrogen to the reservoir. In a nitrogen budget for Lake Arlington nitrogen fixation contributed 11%; rainfall, 11%; dry fallout 9%: watershed runoff, 42%; and point source discharges, 27%. In Lake Ray Hubbard high rates of nitrogen fixation were measured during a blue-green algal bloom.
W86-03720

DCMU-ENHANCED CHLOROPHYLL FLUORESCENCE AS AN INDICATION OF THE PHYSIOLOGICAL STATUS OF RESERVOIR PHYTOPLANKTON: AN INITIAL EVALUATION,

Oklahoma Univ., Kingston. Biological Station.
B. L. Kimmel, and M. M. White.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 246-262, 4 fig, 1 tab, 28 ref.

Descriptors: *Lakes, *Phytoplankton, *Photosynthesis, *Fluorescence, *Chlorophyll, *Productivity, *Reservoirs, 3-(3,4-Dichlorophenyl)-1,1-dimethylurea, Inhibition, Lake Texoma, Broken Bow Lake, Texas.

Measurement of in vivo chlorophyll fluorescence response to DCMU (an inhibitor of photosynthesis) is applicable to field investigations of naturally occurring phytoplankton communities. Fluorescence response index (FRI) ranges of 0.11 to 0.68 were observed in southern Oklahoma reservoirs and ponds. The FRI profiles corresponded well to water column characteristics and to results of experiments that produced independent estimates of phytoplankton photosynthetic potential. Comparison of FRI data to photosynthetic carbon uptake in situ and in displacement experiments clearly shows DCMU-enhanced fluorescence response to reflect phytoplankton physiological state or photosynthetic potential rather than in situ primary productivity.
W86-03721

RELATIONSHIP OF COMMON DOMINANT PHYTOPLANKTON TO WATER TEMPERATURE AND SEASON,

Environmental Monitoring and Support Lab., Las Vegas, NV. Monitoring Operations Div.
W. D. Taylor, D. R. Hetzel, J. J. Janik, S. C. Hern, and L. R. Williams.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 315-327, 6 fig, 3 tab, 3 ref.

Descriptors: *Lakes, *Reservoirs, *Phytoplankton, *Algae, *Temperature, *Seasonal variation, Temperature, Species composition, Myxophyceae, Diatoms, Melosira, Population dynamics.

The twenty most common phytoplankton genera were observed in 815 lakes and reservoirs throughout the U.S. to determine their relationship to water temperature and season. Melosira was by far the most common genus. The other genera, in order of decreasing number of dominant occurrences were Chroomonas, Cryptomonas, Oscillatoria, Stephanodiscus, Aphanizomenon, Fragilaria, Cyclotella, Dactylococcopsis, Lyngbya, Asterionella, Nitzschia, Microcystis, Synedra, Scenedesmus, Dinobryon, Anabaena, Merismopedia, Raphidiopsis, and Ankistrodesmus. Fifteen of the genera were either blue-green algae or diatoms. Diatoms dominated equally throughout the three seasons (spring, summer, fall). The blue-green algae were most important in summer and fall. Blue-green algae dominated in waters of higher temperature during each season. For diatoms, the temperature for domination occurrence was only slightly lower than the temperature observed for nonoocurrence, with the exception of Asterionella. It dominated in much colder waters, particularly in summer and fall. For the green algae, a difference of 6 degrees prevailed between the dominant occurrence and nonoccurrence values. Scenedesmus was dominant at higher temperatures; Ankistrodesmus, at lower temperatures. Temperature, per se, appeared to limit few of the genera studied, although particular temperature ranges seemed to allow more successful competition.
W86-03724

RELATIONSHIP OF COMMON PHYTOPLANKTON GENERA TO NUTRIENTS IN EASTERN AND SOUTHEASTERN LAKES,

Environmental Monitoring and Support Lab., Las Vegas, NV. Monitoring Operations Div.
V. W. Lambou, W. D. Taylor, L. R. Williams, and S. C. Hern.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 328-363, 5 tab, 10 ref, 1 append.

Descriptors: *Lakes, *Nutrients, *Phytoplankton, *Algae, Nitrogen, Phosphorus, Species composition, Melosira, Scenedesmus, Nitrates, Nitrites, Ammonia, Water quality.

The relationship between the occurrence of the common phytoplankton genera and nutrient levels was studied in 250 lakes in the eastern and southeastern states. Melosira (appearing in 87%-92% of samples) was the most common of the 57 genera designated as common (appearing in at least 10% of the 692 samples). Other genera of importance (appearing in greater than 50% of samples), in descending order of occurrence were Scenedesmus, Synedra, Cyclotella, Oscillatoria, Euglena, Cryptomonas, Navicula, Nitzschia, Anabaena, and Microcystis. The following appeared in 40-50% of the samples: Pediastrum, Merismopedia, Tetraedron, Coelastrum, Dactylococcopsis, and Lyngbya. The frequency of occurrence was not related to community dominance. Most genera occurred over a wide range of nutrient conditions. A nutrient-rich group (less than 200 micrograms per liter total P) was identified: four chlorococcaleans, one green flagellate, and two filamentous blue-green genera. The nutrient-poor group (less than 70 micrograms per liter total P) included Asterionella, Dinobryon, Tabellaria, Peridinium, and Ceratium. The ranking schemes can be used to evaluate or predict water quality. For example, Scenedesmus dominance is associated with extremely high mean values for total P, ortho P, and Kjeldahl nitrogen. Dominance of blue-green algae were associated with low N/P ratios. The appendix is a computer-generated compilation of the data.
W86-03725

EFFECT OF LIGHT ATTENUATION ON THE RELATIONSHIP OF PHYTOPLANKTON BIOMASS TO PHOSPHORUS LEVELS,

Environmental Monitoring Systems Lab., Las Vegas, NV.
S. C. Hern, L. R. Williams, V. W. Lambou, and W. D. Taylor.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 365-377, 3 fig, 3 tab, 14 ref.

Descriptors: *Lakes, *Reservoirs, *Phytoplankton, *Light quality, *Phosphorus, Solar radiation, Chlorophyll, Opacity, Secchi disks, Algae.

The effects of light attenuation on chlorophyll production were investigated in 800 lakes throughout the U.S. during 1972-1975. The response ratio (chlorophylla/total phosphorus) was used to establish three groups: very low response (0.00 to less than 0.50), low response (0.50 to less than 1.0), and high response (greater than or equal to 1.0). At a response ratio of 1.0 or greater, all of the total phosphorus is theoretically associated with cellular chlorophyll a, meaning that algae are using all available phosphorus and incorporating it into cellular material. All but 1 of the 104 lakes in the low or high response groups had residual Secchi values less than 0.46 m. However, 42% of the 632 lakes with very low response had residual Secchi values of less than 0.46 m. This led to the conclusion that light, or a combination of light and other factors, was responsible for the inefficient utilization of total phosphorus in the low response group.
W86-03726

ROLE OF BOTTOM SEDIMENTS IN MODIFYING SOLUBLE PHOSPHATE LOADS TO A DENDRITIC, HYPERTROPHIC RESERVOIR,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 2J.
W86-03787

HYPOLIMNETIC OXYGEN DEFICIT IN A EUTROPHIC LAKE AND THE ROLE OF SEDIMENT OXYGEN DEMAND,

National Inst. for Environmental Studies, Tsukuba (Japan).
For primary bibliographic entry see Field 5C.
W86-03869

2J. Erosion and Sedimentation

SIMULATION OF ESTUARINE SILT TRANSPORT ACCORDING TO STORM WATER RUNOFF,

Y. Baba.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Toyko, Japan. July 1984. p 185-201, 14 fig, 1 tab, 4 ref.

Descriptors: *Sediment transport, *Estuaries, *Model studies, Salinity, Tides, Neap tides, Spring tides, Ayase River, Japan, Storm runoff, Erosion, Suspended solids, Runoff.

Estuarine silt transport was simulated for the case of storm water runoff added to tidal flow motion. The Ayase River, Japan, was used to field observations. The following conclusions were drawn. (1) Suspended solids transport along the river reach was successfully simulated using a one-dimensional and one-layer model. Erosion velocity was based on experiments. (2) The simulation was satisfactory under the condition of a constant fall velocity of suspended solids value for both spring and neap tides. (3) For a non-negligible storm runoff rate longitudinal changes of the suspended solids fall velocity with the salinity level proved useful in obtaining a satisfactory simulation. (4) Relevant values of suspended solids fall velocity were not determined. (5) The model was not applicable to the situation in which a definite salt wedge was present. (Casser-PTT)
W86-03465

SEDIMENT YIELDS OF AFRICAN RIVERS,

Exeter Univ. (England).
D. E. Walling.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 265-283, 6 fig, 3 tab, 59 ref.

Descriptors: *Erosion, Literature review, *Sediment transport, *Suspended sediment, *Sediment yield, *Rivers, Africa, Bed load, Sedimentation, Organic matter, Sediment-carrying capacity.

Current knowledge on sediment transport by African rivers is reviewed. Uncertainties arise because of short data records, infrequent sampling, and great variability from one year to the next. Suspended sediment loads in African rivers draining basins on the order of 10,000 sq km are 1 to 4000 tons per sq km per year. The lowest mean annual sediment yield is 0.93 t per sq km, reported for the Chiari River in the Chad basin (193,000 sq km). The highest value is 19,520 t per sq km per year for the 1310 sq km Perkerra basin in Kenya, which has lost its vegetation cover through overgrazing. About 530 million t of sediment and 201 million t of dissolved load are transported to the ocean each year from Africa. A map shows the pattern of suspended sediment yield in Africa--lowest yields being in the northern desert; highest yields, along the northwest coast. Other sections of relatively high yields are the mountain and upland areas of East Africa and southern Africa. Factors controlling these spatial patterns include rainfall-runoff, geological factors, vegetative cover, and land use. In most rivers the suspended sediment load accounts for about 90% of the total load, bed load for about 10%. Studies on local erosion rates and downstream sediment yields are conflicting.
W86-03584

RATES OF EROSION AND SEDIMENT YIELD IN THE AFRICAN ENVIRONMENT,

University of East Anglia, Norwich (England).
M. Stocking.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 285-293, 5 tab, 23 ref.

Descriptors: *Erosion, *Sediment yield, *Sediment transport, Africa, Denudation, Soil erosion, Tanzania, Land use, Grazing, Erosion control, Soil conservation, Conservation, Agriculture.

An overview of many sources, including field research, erosion plot data and studies of continental scale denudation and drainage basin sedimentation, shows that erosion rates in Africa are unexceptional overall, although there are significant localized areas with erosion greater than 100 t per ha per year. Vegetation cover is acknowledged to be principal determinant of specific erosion rates, and its lack controls the incidence of very high erosion. A case study in the Shinyanga region of Tanzania using low-level aerial survey and simple field techniques demonstrates the localized nature of erosion and sediment yield in Africa. Measured rates of erosion are almost wholly explained by the variable condition of rangeland, and the different types of farming and crops on flat-cultivated and ridged fields. It is argued that the only long-term way of controlling erosion rates in the African environment is through vegetative protection and fertility-enhancing farming systems, rather than mechanical protection. (Author)
W86-03585

APPRAISAL OF SEDIMENT TRANSPORT MEASUREMENT IN GHANAIAN RIVERS,

Water Resources Research Inst., Accra (Ghana).
For primary bibliographic entry see Field 7A.
W86-03586

SUSPENDED SEDIMENT TRANSPORT MEASUREMENT IN LESOTHO,

Department of Hydrology and Meteorology, Maseru (Lesotho).
S. Makhoalibe.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 313-321, 5 fig, 2 tab, 6 ref.

Descriptors: *Erosion, *Sediment transport, *Suspended sediments, Lesotho, Senqu River, Caledon River, South Africa, Rivers, Orange River.

This paper discusse the suspended sediment data collected in Lesotho during the period 1976-1982. The drainage areas of the measuring sites vary between 200 and 20,000 sq km. The results demonstrate that annual suspended sediment yields range from less than 10 t per sq km in the igneous region to more than 2000 t per sq km in the sedimentary region. Sediment production rates in the basaltic region are mainly controlled by the extent of the cultivated area. Calculations for the cultivated areas in two drainage areas in this region gave the same estimate of sediment yield of 1 t per sq km per year from an area of 10 sq km. A comparison of Lesotho data with those from the Orange River and its tributaries in the Republic of South Africa reveals that the Caledon basin exhibits the highest sediment yields followed by the Vaal and the Senqu (Upper Orange) basins. (Author)
W86-03587

GULLY EROSION IN THE AGULU-NANKA REGION OF ANAMBRA STATE, NIGERIA,

Anambra State Univ. of Technology, Awka (Nigeria). Dept. of Earth Sciences.
B. C. E. Egboka, and E. I. Okpoko.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 335-347, 6 fig, 11 ref.

Descriptors: *Erosion, *Erosion control, *Groundwater, *Gully erosion, *Geohydrology, *Aquifers, Tropical regions, Geochemistry, Hydrology, Environmental effects, Nigeria.

In the Agulu-Nanka area gully erosion covers an area of about 1100 sq km. The gullying started around 1850, and the rate of gully growth is estimated at about 20-50 m per year. The British Colonial Office and the local inhabitants attempted to control the gullying by constructing dams and planting small trees, but the measures failed. The area lies in the humid tropical rain forest belt of Nigeria. The landscape is a cuesta within the Awka-Orlu uplands formed by the Nanka formation (early Eocene) and the Imo Shale formation (Palaeocene). Both the geological, hydrogeological, geotechnical and hydrogeochemical characteristics of the area and human activity have contributed to gully development and growth. Major aquifers and aquitards form multiaquifer systems, and heavy rainfall causes a rise in the water table. The increase in hydraulic head produces rapid flow rates that enhance the gullying process. Expansion and contraction of the clays and shales in the rainy and dry seasons, respectively, lead to slumping and landslides. Slightly acidic waters produced by redox reactions decompose cementing materials, thereby disaggregating the sand grains and facilitating gullying. An integrated approach is suggested for controlling erosion and gullying. It includes detailed mapping of the affected areas and other areas of potential gullying, and evaluating the adverse effects of rainfall, groundwater flows and seepage, water geochemistry, and anthropogenic activites such as agriculture. (Author)
W86-03589

MEASUREMENT OF SOIL LOSS FROM EXPERIMENTAL BASINS IN MALAWI,

Hydraulics Research Station, Wallingford (England).
M. B. Amphlett.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 351-362, 5 fig, 1 tab, 12 ref.

Descriptors: *Erosion control, *Soil erosion, *Soil conservation, *Land use, *Nutrients, Malawi, Sampling, Vegetation, Rainfall, Runoff, Conservation, Agricultural hydrology.

Field measurements (rainfall, runoff, soil moisture, crop cover, and soil and nutrient losses) were made in four basins under different land use and management practices: complete physical conservation and a land use plan, intensive uncontrolled arable farming without any physical conservation or land use plan, complete physical conservation with no land use plan, and eucalyptus plantation. Results

clearly demonstrate the effects of the different land use practices. Soil losses (in t per ha) during the rainy season were as follows: fully managed basin, 0.15 and 0.2; eucalyptus plantation, 0.13; traditionally farmed basin, 16.0; and the partially managed basin, 2.5. Losses of soil and nutrients from the four basins were consistent with runoff totals. Equipment and techniques developed for this project are described: a pump sampler with programmable chip and a crop cover meter.
W86-03590

SOME METHODS FOR EVALUATING SOIL EROSION RISK,

A. Giordano.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 385-395, 2 fig, 28 ref.

Descriptors: *Erosion, *Soil erosion, *Land use, *Maps, Morocco, Vegetation, Soil types, Satellite technology.

Soil erosion was studied at the site level, drainage basin level and regional level using two methods. A portable rainfall simulator was tested in southern Italy on silty soil with low organic content. At a 47 min rainfall with an intensity of 71 mm per hour, a soil loss of 7.9 t per ha was produced. This compared with 10.5 t per ha calculated from the USLE equation. An empirical model including the factors of rainfall erosivity, soil erodibility, slope, slope length, vegetation cover, and cultural practices, was applied to the Oued Setah basin, Morocco. The resulting grid square maps (scale 1:20,000-1:100,000) showed that erosion risk was highest in the mountain summit areas and on the glacis with poor drainage networks, sandy soil texture and a high fire risk. The same method is useful on the regional level. Here satellite imagery can be useful in producing maps at sales of 1:100,000-1:500,000.
W86-03593

PREDICTING THE SEDIMENT CAPACITY OF A CHANNEL,

G. M. Smart.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 397-401, 3 ref.

Descriptors: *Sediment transport, *Hydraulic properties, *Channels, *Slopes, *Water resources development, Alluvial channels, Mathematical studies, Tanzania.

Alluvial sediment causes major problems in the development of African surface water resources. Almost all formulae for predicting sediment transport capacity are only applicable to low values of channel slope. Experiments and computer analyses have been used to derive a new equation suitable for alluvial sediments with mean grain diameter >0.4 mm on slopes up to 20%. The new equation closely predicts the sediment transport measured at Stiegler's Gorge in Tanzania. (Author)
W86-03594

SEDIMENT YIELD ESTIMATION AND THE DESIGN OF SEDIMENT CONTROL STRUCTURES IN RURAL AFRICA,

Steffen, Robertson and Kirsten, Inc., Johannesburg (South Africa).
For primary bibliographic entry see Field 4D.
W86-03595

SHEET EROSION FROM ARABLE LANDS IN ZIMBABWE: PREDICTION AND CONTROL,

Institute of Agricultural Engineering, Harare (Zimbabwe).
H. A. Elwell.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 429-438, 5 fig, 1 tab, 14 ref.

Descriptors: *Erosion, *Soil loss, *Model studies, Zimbabwe, Sheet erosion, Rill erosion, Gully erosion, Cropland, SLEMSA model, *Erosion control.

Rill and gully erosion on arable lands in Zimbabwe have been effectively controlled by mechanical conservation measures (contour ridges, storm drains, and waterways). However, rates of soil loss by sheet erosion of between 50 and 80 t per ha per year have been estimated. Forward projections indicate that this rate of soil loss will destroy the productive potential of large tracts of cropland within the next 30-50 years. The locally developed soil loss estimator SLEMSA and a soil life-span model are described, and their role in devising acceptable conservation strategies is discussed. (Author)
W86-03596

APPROACH TO TESTING THE USLE FACTOR VALUES IN KENYA,

Agricultural Research Service, Morris, MN.
C. A. Onstad, A. M. Kilewe, and L. G. Ulsaker.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 439-450, 1 fig, 6 tab, 23 ref.

Descriptors: *Erosion, *Soil loss, *Universal Soil Loss Equation, Maize, Kenya, Erosivity, Agricultural engineering, Soil erosion, Storms, Runoff.

The applicability of the Universal Soil Loss Equation to the Kenya region was studied in a set of 12 field runoff plots established on an alfisol. The supporting practices factor (average of 0.66 for contouring) was directly transferable. Erosivity, expressed by the product of the storm total kinetic energy and the maximum 30-min intensity, was satisfactory for predicting soil loss. Preliminary crop management factors for maize and for maize with 3 t per ha residue were determined. These values were within the ranges quoted by sources throughout the world. The erodibility factor for soil at the site was 0.24 (English units) or 0.0314 t ha h per ha per MJ per mm.
W86-03597

EVALUATION OF FACTORS INFLUENCING WATER EROSION IN WEST AFRICA USING RAINFALL SIMULATION,

Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast).
J. Collinet, and C. Valentin.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 451-461, 3 fig, 6 tab, 16 ref.

Descriptors: *Erosion, *Soil loss, *Soil conservation, Storms, *Agriculture, *Rainfall simulators, Erosion control, Africa, Rainfall intensity, Precipitation, Antecedent moisture, Soil moisture, Universal Soil Loss Equation, Farming, Rainstorms, Vegetation, Mulching, Conservation.

In order to provide an improved understanding of the factors influencing water erosion in western Africa, field studies were carried out in three countries (Ivory Coast, Upper Volta, and Niger). Two types of rainfall simulators were used. Particular attention was given to the intensity-duration curves, the kinetic energy of the storms, and to the range of antecedent soil moisture conditions. Treatments were selected in accordance with the farming systems prevailing in the study areas. Results were consistent with those obtained under natural rainfall. They suggested that surface gravel and cobbles are very effective in reducing erosion. In the humid tropics, the erosive effects of storm rainfall are offset by the natural protection provided by the vegetative cover. The effectiveness of traditional conservative practices depends upon the soil water infiltration. Above certain threshold values, ridges collapse and as a result erosion is strongly enhanced. Likewise, the efficiency of residue mulch depends upon the texture of the topsoil. Consequently, the indiscriminate use of the Universal Soil Loss Equation which includes factors which are assumed to be independent can be highly hazardous. (Author)
W86-03598

TESTING THE APPLICABILITY OF A SOIL ERODIBILITY NOMOGRAM FOR SOME TROPICAL SOILS,

International Inst. of Tropical Agriculture, Ibadan (Nigeria).
A. Vanelslande, P. Rousseau, R. Lal, D. Gabriels, and B. S. Ghuman.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 463-473, 4 fig, 7 tab, 9 ref.

Descriptors: *Erosion, *Soil erosion, Soil types, Nigeria, Tropical regions, Runoff, Soil structure, Sand, Clays, Nomograms.

Soil erodibiity measurements using field runoff plots were made for three contrasting soils in Nigeria. The soils were sand-silt-clay mixtures, one nigh in clay content, two high in sand content. Rainfall intensity was monitored for each experimental site using a daily recording rain gage. Soil erodibility, determined from field measurements were 0.015, 0.04, and 0.04 (in SI units) for the clay soil and the two sandy soils, respectively. Soil erodibility estimated from a nomogram were 0.039, 0.025, and 0.18 for the same three soils, respectively. The considerable differences between estimated and field results show that the nomogram should be modified to be used for tropical soils.
W86-03599

IMPACT OF SEDIMENT ON RESERVOIR LIFE,

Binnie and Partners, London (England).
J. D. Pitt, and G. Thompson.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 541-548, 4 fig, 4 ref.

Descriptors: *Sedimentation, *Reservoir silting, *Sediment discharge, *Silting, Model studies, Mathematical models, Tarbela Reservoir, Oued Isser Reservoir, Algeria, Sediment transport.

Sedimentation in reservoirs can be studied with mathematical and physical models. Reservoir half life as a function of the average sediment concentration of the inflow, reservoir volume, and mean annual inflow are shown in a set of curves. Reservoirs fall into three classes: those with storage in excess of 50% of mean annual inflow, having half lives in hundreds of years; 5-50% of mean annual inflow, having half lives in decades; and smaller reservoirs, having half lives <20 years. For the largest reservoirs, sediment studies should consider possible land use changes and the effect of internal sediment flows. For the mid-size reservoirs, sediment sluicing is useful. For the smallest reservoirs, it is essential to maintain reservoir capacity. A modification of the Corps of Engineers program HEC6 is used to model the distribution of sediment deposits and a typical cross section in the Tarbela Reservoir.
W86-03604

PREDICTING THE DISTRIBUTION OF DEPOSTIED SEDIMENT IN SOUTHERN AFRICAN RESERVOIRS,

Rand Afrikaans Univ., Johannesburg (South Africa). Dept. of Civil Engineering.
G. W. Annandale.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 549-558, 6 fig, 4 tab, 24 ref.

Descriptors: *Sedimentation, *Reservoir silting, *Silting, Model studies, South Africa, Borland-Miller model, Reservoir storage, Storage.

The Borland-Miller (1958) method for predicting distribution of deposited sediment in reservoirs was evaluated using data from several South African reservoirs. The method was unreliable and did not provide sufficient information to assess the influence of sediment deposition on flood lines. A semi-empirical method based on the principle of minimum stream power was proposed. It allowed dis-

tribution of sediment as a function of distance from the dam wall for various rates of change in reservoir width with distance. The general behavior of the dimensionless cumulative curves was verified qualitatively. The semi-empirical method was recommended for preliminary design of reservoirs where relatively large quantities of deposited sediment are expected.
W86-03605

SEDIMENT DEPOSITION IN MAJOR RESERVOIRS IN THE ZAMBEZI BASIN,

Hydraulics Research Station, Wallingford (England).
P. Bolton.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 559-567, 2 fig, 8 ref.

Descriptors: *Sedimentation, *Reservoir silting, *Silting, Lake Kariba, Lake Cabora Bassa, Zambezi Basin, Reservoir storage, Storage, Erosion.

The rates of sediment deposition were estimated for Lake Kariba and Lake Cabora Bassa in the Zambezi basin, Zimbabwe. Lake Kariba, with a mean annual sediment input in the range of 7 to 70 million tons, is expected to fill with sediment in 1,600 to 16,000 years. The dead storage capacity of Kariba, 116 billion cu m, is 60% of total capacity. Since the reservoir has a longitudinal profile and a relatively small drawdown (9 m maximum), all incoming sediment is likely to reach dead storage. Lake Cabora Bassa, with a sediment input about 3 times that of Lake Kariba and a dead storage of 12.5 billion cu m at a level of 295 m, will probably fill within 60-600 years. However, it is feasible to establish a minimum level of 305 m, which would increase the reservoir life to 350-3500 years. Much of the sediment accumulation in Cabora Bassa is likely to occur in the live storage area. As silt accumulates, it will be necessary to increase the annual drawdown to provide the current degree of downstream flood protection. Thus, sedimentation will affect Lake Cabora Bassa within its economic life.
W86-03606

SEDIMENT STORAGE REQUIREMENTS FOR RESERVOIRS,

Ministry of Water Resources and Development, Harare (Zimbabwe).
T. C. Kabell.
IN: Challenges in Atrican Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 569-576, 2 fig, 2 tab.

Descriptors: *Sedimentation, *Sediment control, *Reservoir silting, *Silting, Reservoir storage, Storage, Zimbabwe, Water storage.

Reservoir sedimentation is a serious problem in Zimbabwe, leading to diminished draft or even total loss of live storage capacity. The correct solution undoubtedly lies in improved conservation and land use practices, but unless and until such measures are adopted, adequate allowace for sedimentation must be included in water storage works. Sediment loads are known to vary widely between different rivers and from season to season, but there is a lack of sediment load data for Zimbabwe. It is proposed that until more reliable figures of sedimentation rates are available, reservoirs should be designed to include a provision for sedimentation based on the mean annual runoff from the drainage basin. The sediment storage requirements have been estimated from surveyed volumes of silt deposited in a number of reservoirs over a period of several years. (Author)
W86-03607

FEASIBILITY OF FLUSHING SEDIMENTS THROUGH RESERVOIRS,

Hydraulics Research Station, Wallingford (England).
W. R. White, and R. Bettess.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 577-587, 7 fig, 2 tab, 4 ref.

Descriptors: *Sediment control, *Reservoir silting, *Silting, *Flushing, *Sedimentation, Model studies, Reservoir storage, Storage, Kamativi Dam, Gwai River, Zimbabwe.

The effect of sediment flushing of reservoirs was studied using a computational model, which was applied to the proposed Kamativi Dam on the Gwai River, Zimbabwe. The Gwai drainage basin has an area of 38,600 sq km and a mean annual runoff of 580 million cu m. Results showed that, without sediment flushing, the reservoir's useful life would be about 30 years. Sediment flushing would extend the reservoir life significantly. Using large-capacity low level outlets could establish a state of dynamic equilibrium so that adequate water supplies could be provided for an indefinite period. For flushing to be effective, water levels must be maintained at low levels during a period of high river flow. Thus, sediment flushing is not appropriate where a reservoir is used for over-year storage, where the required water yield of the reservoir is comparable with the annual river flow or where periodic interruptions to the use of the reservoir cannot be tolerated.
W86-03608

USER'S MANUAL FOR THE INSTREAM SEDIMENT-CONTAMINANT TRANSPORT MODEL SERATRA,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-03630

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-03648

SEDIMENTS OF THE UPPER MISSISSIPPI RIVER: THEIR SOURCES, DISTRIBUTION, AND CHARACTERISTICS,

Winona State Univ., MN.
D. N. Nielsen, R. G. Rada, and M. M. Smart.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 67-98, 20 fig, 18 ref.

Descriptors: *Environmental effects, *Sediment transport, *Erosion, Rivers, Mississippi River, Geology, Hydrology, Land use, Glacial sediments, Tributaries, Sediment yield, Chippewa River, Wapsipinicon River, Suspended sediment, Particle size, Bed load, River beds, Channel morphology, Navigation, Locks, Dams.

The geology, hydrology, and land use of the Upper Mississippi River Basin are described and related to the kind and amount of sediment delivered to the river. Sources of sediment are in tributary basins. Non-bedrock sources (eroded soil, loess, glacial drift, colluvium, and alluvium) are quantitively greater than bedrock sources. Tributaries with bed-load discharges equal to or greater than suspended-load discharges cause sediment transport problems and affect channel morphology in the Mississippi. Tributaries with more cohesive, finer sediments have little effect on channel morphology. However, they contribute greater volumes of fine sediment which is deposited in backwater areas. Total sediment yield increases from the northern to southern end of the basin because of increased runoff, agricultural activity, and differences in surface materials. The average particle size of suspended sediments is relatively uniform at equivalent flows and in tributaries of similar geology, land use, etc. Valleys containing glacial outwash produce suspended sediment of larger average particle size. The islands in the river are a result of overloading of the channel with coarse bed load and channel avulsion during high flows. Navigation dams have produced pools which are collecting fine sediment. Tail water areas have degraded because of sediment trapping in the pool and excess energy in the discharges.
W86-03740

RECENT RATES OF SEDIMENTATION IN THE MISSISSIPPI RIVER,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. R. McHenry, J. C. Ritchie, C. M. Cooper, and J. Verdon.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 99-117, 3 fig, 7 tab, 9 ref.

Descriptors: *Sedimentation rates, *Environmental effects, *Lakes, Rivers, *Aquatic habitats, Habitats, Mississippi River, Lake Pepin, Marshes, Backwater.

Mean sedimentation rates in several backwater lakes and pools in the Upper Mississippi River Valley were 3.4 cm/year during 1954-64 and 1.8 cm/year in 1965-75. In spite of the decrease in sedimentation, many of these lakes are expected to become marshes on the order of 50-100 years. Before the backwater lakes were formed by the construction of locks and dams, sediment deposition on the floodplains was largely unnoticed. Within the last few years the noticeable sedimentation has caused public concern. Maximum soil conservation measures are necessary to preserve the riverine habitat as long as possible.
W86-03741

INTERACTION WATER-SILICATE MINERALS IN THE UNSATURATED ZONE CONTROLLED BY THERMODYNAMIC DISEQUILIBRIA,

Kiel Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2K.
W86-03756

ROLE OF BOTTOM SEDIMENTS IN MODIFYING SOLUBLE PHOSPHATE LOADS TO A DENDRITIC, HYPERTROPHIC RESERVOIR,

National Inst. for Water Research, Pretoria (South Africa).
A. J. Twinch.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 381-392, 4 fig, 1 tab, 16 ref.

Descriptors: *Phosphates, *Phosphorus, *Bottom sediments, *Adsorption, *Simulation analysis, *Reservoirs, *Computer models, *Lake sediments, Sediment transport, Models, Model studies, Rivers, Hydrologic models, Phosphorus removal, Dissolved solids, Fluvial sediments.

A survey of phosphate uptake/release characteristics of sediments in a riverine section of a dendritic impoundment was undertaken to assess their role in modifying soluble phosphate concentrations in the inflowing river water. A sharp gradient in soluble phosphate concentration occurs along a 5 km riverine stretch between the river inflow (>1mg/liter) and the main body of the reservoir (about 0.5 mg/liter). The results of this study suggest that direct phosphate uptake by bottom sediments may be partly responsible for this phenomenon. A simulation model was developed to quantify this phosphate uptake at varying river flow rates and reservoir water levels. The simulation runs suggest that up to 50% of the total soluble phosphate load could be retained by sediments in the riverine section. However, this is insufficient to account for the observed gradient and other factors must also be important in controlling the decline in phosphate concentration. (Author)
W86-03787

CALIBRATION OF HYDROLOGY AND SEDIMENT TRANSPORT ON SMALL AGRICULTURAL WATERSHEDS USING HSPF,

Camp, Dresser and McKee, Inc., Boston, MA.

D. E. Schafer, D. A. Woodruff, R. J. Hughto, and G. K. Young.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 54-68, 6 fig, 2 tab, 11 ref.

Descriptors: *Mathematical models, *Agricultural watersheds, *Calibrations, Sediment transport, Agricultural runoff, Hydrologic models.

This paper discusses the capabilities of the Environmental Protection Agency's Hydrology Simulation Program-FORTRAN (HSPF) for modeling runoff and sediment transport on three small agricultural watersheds: Mississippi 802, Oklahoma C-4, and Oklahoma C-5. HSPF appears to be suitable for simulating runoff and sediment from agricultural watersheds. However, the model should be verified on each of these watersheds before being used as a predictive tool. An independent data set for verification would provide a test for the calibrated parameter values, and further analyze the model's applicability to these particular watersheds and to agricultural watersheds in general. The ability of the model to simulate the hydrologic response and sediment removal from the watersheds is considered reasonably good. Large percent differences between measured values were extremely high. This is particularly evident during the initial months of simulation in which initial conditions may be partially responsible for poor simulation. Overall good model performance is best illustrated by the double mass analysis plots. These show that, aside from undersimulation during model start up, parallel lines can be drawn to the lines of one-to-one correspondence of measured and simulated values. Sediment simulation errors on Oklahoma Watersheds C-4 and C-5 were found to be significantly related to errors in their respective hydrology calibrations.
W86-03825

PROCEEDINGS OF THE CONFERENCE ON COASTAL EROSION AND WETLAND MODIFICATION IN LOUISIANA: CAUSES, CONSEQUENCES, AND OPTIONS.

Louisiana Universities Marine Consortium, Chauvin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-152777. Price codes: A12 in paper copy, A01 in microfiche. Conference held October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. Edited by Donald F. Boesch. 256 p.

Descriptors: *Wetlands, *Erosion, *Louisiana, Bank erosion, Erosion control, Erosion rates, Marshes, Coastal marshes, Salt marshes, Tidal marshes, Management planning, Planning, Sea level, Fisheries, Waterfowl.

The causes and consequences of coastal erosion and wetlands modification in Louisiana, and the mitigative options to slow the loss of coastal lands are discussed. Specific topics covered include sedimentation and sea-level rise, geological and human factors, mudflat and marsh progradation, canal dredging, the effects of coastal alteration on marsh plants, effects of wetlands deterioration on fish and wildlife resources, economic aspects of land loss, future sea-land changes, dune vegetation and stabilization, and reversal of coastal erosion by rapid sedimentation and shoreline in Louisiana during the early 1980's was 130 sq km/yr. (Halterman-PTT)
W86-03850

SEDIMENTATION AND APPARENT SEA-LEVEL RISE AS FACTORS AFFECTING LAND LOSS IN COASTAL LOUISIANA,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. H. Baumann, and R. D. DeLaune.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 2-13, 5 fig, 14 ref.

Descriptors: *Wetlands, *Marshes, Coastal marshes, Salt marshes, Sea level, Water level, *Louisiana, Accretion.

The conversion of marsh to open water habitat as a result of natural phenomena is discussed. Rates of apparent sea-level dating, artificial marker horizons, and water level data. The study sites are not vertically accreting at a rate needed to maintain intertidal elevation, and have subsequently been subjected to net submergence since at least the mid-1950's. Rates of apparent sea-level rise at the two study areas were 1.2 and 1.3 cm/yyr from 1954 to present. Sedimentation rates through the same period were approximately 0.7 cm/yr over most of the area of investigation, though streamside marshes aggraded at a rate of 1.35 cm/yr. The transformation of marsh to open water will be complete in a few decades if present trends continue. A research strategy that will narrow management alternatives is briefly outlined. (Halterman-PTT)
W86-03851

ASSESSMENT OF GEOLOGICAL AND HUMAN FACTORS RESPONSIBLE FOR LOUISIANA COASTAL BARRIER EROSION,

Louisiana Geological Survey, Baton Rouge.
S. Penland, and R. Boyd.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 14-38, 24 fig, 22 ref.

Descriptors: *Erosion, Bank erosion, *Beach erosion, *Louisiana, Erosion control, Erosion rates, Management planning, Planning, Louisiana, Sea level.

Coastal barrier land loss and sediment loss are described and modeled. Land loss results from the natural process of deltaic transgression and marine erosion, combined with the impact of human development. A three-stage model is described for the evolution of abandoned Mississippi deltas. Coastal barrier sediment loss, hence land loss, is attributed to several mechanisms, including longshore loss into spits and tidal deltas, landward loss through overwash and a subsiding lagoon, offshore loss due to an inequality in offshore/onshore transport capacity, and subsidence of the deltaic sand sources. Human impacts are also discussed. (Halterman-PTT)
W86-03852

MUDFLAT AND MARSH PROGRADATION ALONG LOUISIANA'S CHENIER PLAIN: A NATURAL REVERSAL IN COASTAL EROSION,

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
J. T. Wells, and G. P. Kemp.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS/82/59, September 1982. p 39-51, 6 fig, 16 ref.

Descriptors: *Sedimentation, *Sea level, *Louisiana, Water level, Silting, Deposition, Suspended load, Sediments, Silt, Mud, Mud flats.

The new influx of fine-grained sediment into the chenier plain coast of southwestern Louisiana is discussed. A major ramification of this is localized coastal progradation along what had previously been the most rapidly retreating shoreline in the United States. Silts and clays from the Atchafalaya River are now accumulating as mudflats along the coast. These transitory mudflats provide a buffer to incoming storm waves and serve as a temporary storehouse for littoral sediments. Accelerated growth of the chenier plain is expected when the subaerial Atchafalaya Delta outgrows Atchafalaya Bay, thus allowing an even greater volume of sediments to enter the dynamic shelf region seaward of the bay. The present coastal erosion is expected to reverse within 50 to 100 years. (Halterman-PTT)
W86-03853

WETLAND LOSS DIRECTLY ASSOCIATED WITH CANAL DREDGING IN THE LOUISIANA COASTAL ZONE,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 6G.
W86-03854

CANALS AND WETLAND EROSION RATES IN COASTAL LOUISIANA,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 6G.
W86-03855

LEGAL IMPLICATIONS OF COASTAL EROSION IN LOUISIANA,

Louisiana State Univ., Baton Rouge. Sea Grant Legal Program.
For primary bibliographic entry see Field 6E.
W86-03860

EFFECTS OF COASTAL STRUCTURES ON SHORELINE STABILIZATION AND LAND LOSS - THE TEXAS EXPERIENCE,

Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2L.
W86-03863

SAND DUNE VEGETATION AND STABILIZATION IN LOUISIANA,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
I. A. Mendelssohn.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 187-207, 16 fig, 26 ref.

Descriptors: *Beach erosion, *Barrier Island, *Louisiana, *Erosion control, Louisiana, Erosion, Sea level, Environmental effects, Water level, Bank erosion, Vegetation effects, Vegetation.

Louisiana's barrier dune vegetation, and its use for dune building and stabilization on Timbalier Island is discussed. Previously, the use of hard structures, such as groins, jetties, and seawalls, to control or reduce barrier island erosion in Louisiana had met with limited success. The use of vegetation to stabilize substrates offers a sound alternative to the hard structure approach to erosion abatement. The importance of this program is discussed, with a focus on marine processes which erode the abandoned delta and concentrate a restricted quantity of coarse-grained sediments into highly mobile barrier islands, spits, and beaches which overlie unconsolidated delta silts and clays. Subsequent subsidence in concert with a eustatic increase in sea level, generates a rapid apparent sea-level rise, equivalent to 1 m/100 yr. This process has produced a very serious barrier island erosion problem. (Halterman-PTT)
W86-03864

REVERSAL OF COASTAL EROSION BY RAPID SEDIMENTATION: THE ATCHAFALAYA DELTA (SOUTH-CENTRAL LOUISIANA),

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
H. H. Roberts, and I. I. I. Van Heerden.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 214-231, 14 fig, 14 ref. DACW 29-77-C-0163.

Descriptors: *Sedimentation, *Deposition, *Sea level, *Louisiana, *Marshes, *Deltas, Benefits Flood data, Flood discharge, Flow discharge, Flooding, Mississippi River, Atchafalaya River.

Systematic monitoring of changes within the delta system of the Atchafalaya Bay over a four year period has shown that delta growth is proportional to flood volume and duration. Land loss was reversed during a major flood in 1979. The formation of deltas by channel bifurcation and bar fusion in several areas has elevated water levels near the coast during floods, causing sediment-rich water to be transported into surrounding marshes. New growth is evident at the downdrift chenier plain, and appears to be a result of rapid sedimentation since the 1950's. (Halterman-PTT)
W86-03865

2K. Chemical Processes

HYDROCHEMICAL AND ISOTOPIC CONTENT OF BASALT GROUNDWATERS BENEATH THE HANFORD SITE, WASHINGTON,

Rockwell International, Richland, WA. Energy Systems Group.
F. A. Spane, D. L. Graham, and R. W. Bryce.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-015795. Price codes: A03 in paper copy, A01 in microfiche. RHO-BW-SA-190, March 1982. 26 p, 10 fig, 10 tab, 19 ref. DE-AC06-77RL01030.

Descriptors: *Geochemistry, *Water analysis, Radioactive waste disposal, Groundwater movement, Basalt Waste Isoloation Project, Columbia River, Hanford Site, Washington, Baseline studies, Spatial variation, Isotope studies.

Major inorganics, trace elements, dissolved gas, and stable and unstable isotopes were studied in basaltic groundwaters involved with the Basalt Waste Isolation Project, Columbia River basin. Three groundwaters were sampled: Saddle Mountains (sodium-calcium bicarbonate type), Wanapum (sodium bicarbonate-chloride type), and Grande Ronde (sodium chloride type). Vertical and areal variations occurred within short intervals. The hydrochemical differences exhibited for the basalt formations are attributable to variations in groundwater residence time, geochemistry of the flow continuum, and thermodynamic relationships that control rock/water interactions. The overall dilute nature and low concentration of conservative constituents in groundwater within the Saddle Mountains Basalt suggest a local origin for these shallow basalt groundwaters. In comparison, increased chloride, fluoride, and sulfate and decreased carbonate content with depth, indicate that groundwaters in the Grande Ronde Basalt are part of an intermediate to regional groundwater flow system. (Cassar-PTT)
W86-03517

GEOCHEMISTRY AND GEOHYDROLOGY OF THE WEST DECKER AND BIG SKY COAL-MINING AREAS, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
R. E. Davis.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4225, 1984. 109 p, 31 fig, 14 tab, 35 ref.

Descriptors: Spoil banks, *Strip mine wastes, Strip mines, Coal mines, *Groundwater, Impaired water quality, *Water levels, *Dissolved solids, West Decker Mine, Big Sky Mine, *Montana.

In the West Decker Mine area, water levels west of the mine at post-mining equilibrium may be almost 12 feet higher than pre-mining levels. Dissolved-solids concentration in water from coal aquifers is about 1,400 milligrams per liter and from mine spoils is about 2,500 milligrams per liter. About 13 years will be required for ground water moving at an average velocity of 2 feet per day to flow from the spoils to the Tongue River Reservoir. The increase in dissolved-solids load to the reservoir due to mining will be less than 1 percent. In the Big Sky Mine area, water levels at post-mining equilibrium will closely resemble pre-mining levels. Dissolved-solids concentration in water from coal aquifers is about 2,700 milligrams per liter and from spoils is about 3,700 milligrams per liter. About 36 to 60 years will be required for ground water moving at an average velocity of 1.2 feet per day to flow from the spoils to Rosebud Creek. The average annual increase in dissolved-solids load to the creek due to mining will be about 2 percent, although a greater increase probably will occur during summer months when flow in the creek is low. (USGS)
W86-03545

OCCURRENCE AND DISTRIPUTION OF FLUORIDE IN GROUNDWATERS OF KENYA,

Nairobi Univ. (Kenya). Dept. of Dental Surgery.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 75-86, 4 fig, 2 tab, 18 ref.

Descriptors: *Geochemistry, *Water pollution sources, *Fluorides, *Water quality, *Groundwater, Water supply, Public health, Boreholes, Wells, Kenya, Rift Valley, Water pollution effects.

Water samples from 1286 boreholes from different parts of Kenya were analyzed for their fluoride concentrations. The majority of the samples (61.4%) had fluoride ion concentrations above 1.0 parts per million, while 19.5% had above 5.0 ppm. Excess levels of fluoride were found to occur in most parts of the country, especially in the Nairobi, Rift Valley, Eastern and Central Provinces which contain approximately 59.5% of Kenya's population. The high fluoride areas tended to coincide with the geographic locations of volcanic rock in and around the Rift Valley region. It was also observed that the deeper the boreholes, the greater the tendency for higher concentration of fluoride in groundwater. The findings show that there is need to defluoridate groundwater in most regions of the country for the health of the majority of the Kenyan population if, as demanded by the increase in population, groundwater resources are to be exploited. (Author)
W86-03569

HYDROCHEMICAL BALANCES OF FRESHWATER SYSTEMS: PROCEEDINGS OF THE UPPSALA SYMPOSIUM.

Naturvetenskapliga Forskningslaboratoriet i Studsvik, Nykoeping (Sweden).
For primary bibliographic entry see Field 5B.
W86-03753

ROLE OF NATURAL ORGANICS ON WATER INTERACTION WITH SOIL AND ROCK,

Kiel Univ. (Germany, F.R.).
G. Matthess.
In: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 11-21, 36 ref.

Descriptors: *Soil water, *Chemical properties, *Organic acids, *Groundwater, *Geochemistry, *Geohydrology, *Humic acids, Biochemistry, Organic compounds, Organic matter, Soil organic matter, Biodegradation, Percolation, Groundwater pollution, Soil horizons, Adsorption.

The geochemical, physical and biological processes which control the interaction between the subterranean water and the solid phases in the unsaturated and saturated zones are affected in many respects by the presence of solid or dissolved organic matter. Organic substances in the Earth's crust are derived from biological materials. Humic substances are the major organic constituents of soils and sediments. The non-humic substances in soils and sediments are carbohydrates, proteins, peptides, amino acids, fats, waxes, and low molecular weight organic acids. The geochemical processes that are affected by the presence of organic substances are solution-precipitation, acid-base reaction, oxidation-reduction, complexation, and adsorption-desorption. The biochemical processes that are affected by organic substances are biochemical degradation and cell synthesis. The physical processes that are influenced by organic substances are advection, dispersion, filtration, and gas transport. The geochemical and biochemical reactions during percolation of infiltrated rainwater through the unsaturated zone down to groundwater table establish the quality of the underlying groundwater. The content of dissolved organic substances increases in the seepage water of the organic horizons of the soils. The contents of oxidizable organic substances are partly controlled by the vegetation or type of tree cover.
W86-03754

INTERACTION WATER-SILICATE MINERALS IN THE UNSATURATED ZONE CONTROLLED BY THERMODYNAMIC DISEQUILIBRIA,

Kiel Univ. (Germany, F.R.).
W. Ohse, G. Matthess, A. Pekdeger, and H. D. Schulz.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 31-40, 6 fig, 9 ref.

Descriptors: *Minerals, *Silica, *Kaolinite, *Glacial sediments, *Silicates, *Sediment-water interfaces, *Interstitial water, *Thermodynamics, Sediments, Computer models, Clay minerals, Subsoil, Soil horizons, Chemical properties, Aeration zone.

Pore waters from the unsaturated zone of Quaternary glacial outwash sediments were won by centrifugation. Mineral stabilities of the main silicate minerals with respect to dissolved inorganic species were carried out on the basis of chemical thermodynamics with the computer program WATEQF (Plummer et al., 1976). The calculations show tendencies of mineral disequilibria, which result in corroded grain surfaces or in precipitates as detected by scanning electron microscopy (SEM) and energy dispersive analysis of X-rays (EDAX). Below the weathered zone the pore waters approach saturation with respect to feldspar, mica and amorphous silica, whereas quartz oversaturation exists in the total profile. The undersaturation of the pore waters with respect to feldspar in the top horizons is combined with a relative enrichment of kaolinite in these sediments. After a weathering period of about 60,000 years a general decrease of the corrosion state of feldspars, dependent upon saturation state of pore waters versus depth, is established. (Author)
W86-03756

HYDROGEOCHEMICAL EVOLUTION AND VARIABILITY OF GROUNDWATER IN EXPERIMENTAL BASINS OF S. W. WESTERN AUSTRALIA,

For primary bibliographic entry see Field 2F.
W86-03757

COMPARATIVE STUDY OF SEQUENTIAL REDOX PROCESSES IN THREE BRITISH AQUIFERS,

British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-03758

SIMULATION OF PHYSICOCHEMICAL INTERACTIONS IN A WATER-ROCK SYSTEM IN ASSESSING GROUND-WATER QUALITY,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
G. S. Vartanyan, S. R. Krainov, and G. V. Kulikov.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 71-78, 3 fig, 19 ref.

Descriptors: *Physicochemical properties, *Water quality, *Simulation analysis, *Thermodynamics, *Chemical reactions, *Groundwater hydrology, *Theoretical analysis, *Earth-water interfaces, Groundwater, Rocks, Model studies, Geohydrology, Mathematical studies, Chemical properties.

Principles of simulating physicochemical interactions in a water-rock system are discussed. It is shown that simulation of this kind provides close agreement between estimated and real distributions of elements in groundwater. Thus, the simulation can be used in theoretical studies of hydrochemical processes and for predicting changes in groundwater chemical composition. Maximum agreement between estimated and real distributions of elements in groundwater is attained by approximating existing water-rock systems to state of chemical equilibrium. The degree of this approximation increases with a decrease in the rate of groundwater seepage, as well as with an increase in groundwater temperature and in the ratio between solid and liquid phases (S/L ratio). In non-equilibrium systems, simulation results may indicate the trends and final effects of the processes occurring in the system during its evolution to equilibrium. Quantitative agreement between simulation data and real concentrations of elements in non-equilibrium systems may be reached by using algorithms comprising the principles of chemical thermodynamics, physicochemical hydrodynamics and kinetics, making allowance for the strong impact which the HGD (hydrogeodeformation) earth field has on these processes. (Author)
W86-03739

SOME IMPLICATION OF THE ROLE OF KINETICS IN ENHANCING ELEMENT TRANSPORT,

Nairobi Univ. (Kenya). Dept. of Geology.
M. P. Tole.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 79-86, 4 fig, 10 ref.

Descriptors: *Thermodynamics, *Model studies, *Metals, *Chemical precipitation, *Earth-water interfaces, *Geochemistry, *Kinetics, *Leaching, Models, Hydrologic models, Minerals, Chemical reactions, Dissolved solids, Geohydrology, Mathematical studies, Chemical properties, Leachates.

Thermodynamic methods have been used to predict the quantities of elements that can be transported in solution under various conditions of temperature, pressure, and solution composition. Recent studies show that equilibrium is often not attained under conditions prevalent during the dispersion of metals away from ore deposits. Based on silicate dissolution studies, a dissolution precipitation model was derived to explain observed mineral-water interaction kinetics. With this method, the rate of release of elements from the solid mineral during dissolution is initially linear with time, until saturation with respect to another solid phase containing the released elements is attained. Two processes then become operative - a continued release (linear rate) of the elements from the dissolving mineral, and removal of the released elements by precipitation. These relations give rise to a kinetic contribution to the quantities of metals in solution over and above those that would be predicted by thermodynamics alone. The magnitude of this kinetic enhancement factor is dependent upon the relative magnitudes of the dissolution rate constant for the dissolving mineral and the precipitation rate constant for the precipitated mineral and can be of the same order of magnitude (or more) as the thermodynamic equilibrium factor. A systematic study of mineral-solution interaction kinetics is required to provide basic data to enable the prediction of the processes of leaching of ore deposits and the concentrations of metals to be expected in solution during geochemical studies.
W86-03760

HYDROCHEMICAL PROCESSES IN GROUNDWATER DISCHARGE AREAS,

Uppsala Univ. (Sweden).
For primary bibliographic entry see Field 2F.
W86-03762

RESPIRATORY GAS CONTENT (O_2 AND CO_2) AND IONIC COMPOSITION OF RIVER WATER IN THE PLAIN OF ALSACE (EASTERN FRANCE),

Centre National de la Recherche Scientifique, Strasbourg (France). Lab. de Physiologie Respiratoire.
For primary bibliographic entry see Field 2F.
W86-03763

HYDROCHEMISTRY OF SPRINGS FROM DOLOMITE REEFS IN THE SOUTHERN ALPS OF NORTHERN ITALY,

Vrije Univ., Amsterdam (Netherlands).
C. A. J. Appelo, H. E. Beekman, and W. A. Oosterbaan.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 125-138, 7 fig, 2 tab, 14 ref.

Descriptors: Minerals, *Calcium, *Magnesium, *Springs, *Isotopic tracers, *Dolomite, *Water chemistry, *Geohydrology, *Chemical properties, Chemical reactions, Geologic fractures, Aquifers, Carbon dioxide, Isotope studies, Groundwater, Geochemistry.

The evolution of spring water composition for pure dolomite rock of Northern Italy was studied using data on dissolution kinetics from laboratory experiments and carbon isotopes to determine reaction mechanisms. Ca/Mg ratios of spring water show congruent dissolution of dolomite. Surface water sampled at high altitudes before infiltration into the dolomite has low Ca and Mg concentrations and lower than atmospheric CO_2 pressures. Concentrations of these minerals in springs around the reefs and delta C13-values in a number of springs are consistent with open system dissolution during flow through fissures from high altitude to spring level. Therefore, the fissures must be large enough to permit air circulation. Dissolution experiments with polished dolomite slabs immersed in water charged with air for a period of two months confirmed a rapid rate of dissolution for dolomite. Under field conditions, only a few days would be needed to reach concentrations of dolomite near saturation. Some springs have lower delta-C13 levels and show small Ca and Mg concentration increases. Such springs are considered to reflect an additional flow component due to the drainage of vegetated soil in the area surrounding the reef.
W86-03765

DESIGN OF A HYDROCHEMICAL DATA COLLECTION PROGRAMME,

Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 7A.
W86-03767

RELIABILITY OF INFORMATION IN HYDROGEOCHEMICAL INVESTIGATIONS,

Akademiya Navuk BSSR, Minsk.
For primary bibliographic entry see Field 7A.
W86-03769

CONDITIONS AND FREQUENCY OF SAMPLING FOR ELUCIDATIONS OF TRANSPORT MECHANISMS AND ELEMENT BUDGETS IN UPLAND DRAINAGE BASINS,

Aberdeen Univ. (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 7A.
W86-03770

USE OF DIFFERENT PHYSICAL SEPARATION TECHNIQUES FOR TRACE ELEMENT SPECIATION STUDIES IN NATURAL WATERS,

Oslo Univ. (Norway). Dept. of Chemistry.
B. Salbu, E. Steinnes, and H. Bjornstad.
In: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 203-213, 3 fig, 1 tab, 21 ref.

Descriptors: *Trace elements, *Water analysis, *Separation techniques, *Ultrafiltration, *Electrodialysis, *Electrophoresis, *Gels, *Centrifugation, Membrane filters, Dialysis, Membrane processes, Chemical properties.

Hydrochemical balance studies require knowledge of the speciation of the elements concerned, namely the distribution between soluble and suspended forms and among different soluble species. The separation of truly soluble forms of trace elements from the fraction associated with the particulate phase in natural freshwater is usually not possible by membrane filtration. Alternative techniques such as ultrafiltration, centrifugation, dialysis in situ or in the laboratory, electrodialysis, free-liquid electrophoresis, gel filtration, or a combination of separation steps based on these techniques are required. Each of these separation techniques is critically evaluated with respect to its feasibility for speciation studies in natural waters. In general, separations that can be carried out at the sampling site are preferable. Choosing the proper combination of separation techniques to characterize the systems involved will become increasingly important and more analytical work is needed in this field.
W86-03771

MASS-BALANCE APPROACH TO THE UNDERSTANDING OF GEOCHEMICAL PROCESSES IN AQUEOUS SYSTEMS,

Ustredni Ustav Geologicky, Prague (Czechoslovakia).
For primary bibliographic entry see Field 5B.
W86-03773

PHYSICO-CHEMICAL CHARACTERISTICS OF SURFACE WATERS AND HYDROLOGICAL BEHAVIOR OF A SMALL GRANITIC BASIN (VOSGES MASSIF, FRANCE): ANNUAL AND DAILY VARIATIONS,

Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 5B.
W86-03775

GEOCHEMICAL STUDIES IN THE DRAINAGE BASIN OF THE RIO VOUGA (PORTUGAL). I. GENERAL HYDROGEOCHEMISTRY FROM ITS ORIGIN TO THE RIA DE AVEIRO,

Utrecht Rijksuniversiteit (Netherlands).
C. H. Van der Weijden, H. L. Ten Haven, H. A. Boer, C. F. A. Hopstaken, and S. P. Vriend.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 263-276, 7 fig, 3 tab, 9 ref.

Descriptors: *Geochemistry, *Geohydrology, *Chemical properties, *Trace elements, *River basins, *Weathering, *Estuaries, *Minerals, Aluminum, Manganese, Iron, Fertilizers, Rocks, Water analysis, Hydrologic data collections.

A hydrogeochemical survey in the drainage basin of the Rio Vouga (Portugal) was carried out during the summer of 1981. Waters and composite rock samples were analyzed for major constituents and some trace elements. The dominant rock types of the basin are granite and metasediments. A comparison of water and rock chemistry, using discriminant function analysis of the data obtained on the water chemistry, showed that distinction between granitic and metasedimentary waters is possible. However, partial weathering of rock-forming minerals as well as contributions of marine aerosols and of fertilizers to the water chemistry obfuscate straightforward relationships. A brief survey of water chemistry in the Ria de Aveiro revealed that the elements Al, Fe, and Mn behave conservatively during estuarine mixing, which is probably caused by conservative mixing of colloidal matter in this lagoon. (Author)
W86-03776

EVALUATION OF THE INTENSITY OF SOME RECENT EXOGENIC GEOLOGICAL PROCESSES IN THE U.S.S.R. BY THE HYDROGEOCHEMICAL BALANCES METHOD,

Akademiya Nauk SSSR, Moscow. Geologicheskii Inst.
V. P. Zverev.

IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 277-285, 7 tab, 8 ref.

Descriptors: *Geochemistry, *Weathering, *Kinetics, *Groundwater, *Chemical reactions, *Geohydrology, *Subsurface water, *Mineral water, Rocks, Minerals, Hydrologic data collections, Chemical properties, River basins, Leaching.

A study of the hydrogeochemical balance in the territory of the U.S.S.R. and its separate regions enabled a regional evaluation to be made of the role of subsurface waters in the redistribution of matter in the upper parts of the earth's crust. The intensity of the processes of chemical weathering of the major types of rock-forming minerals was calculated for large platform and mountain-folded regions. The kinetics of chemical weathering and formation of secondary products was obtained from detailed hydrogeochemical balance investigations of key areas. In interactions between subsurface waters with mountain rocks, a transformation of the latter takes place. As a result, chemical elements, in strictly definite amounts for each case, pass into a solution and form a subsurface constituent of the hydrogeochemical balance of separate ions. The hydrogeochemical balance was used for the quantitative estimation of discharge of subsurface waters with an abnormal chemical composition on the basins of the rivers Velichabai and Tutkhun. The balance method allowed the investigation of the natural discharge of thermomineral and mineral waters. The data obtained agreed well with estimations of reserves of types of subsurface waters studied by means of the hydrodynamic method.
W86-03777

STUDY OF THE HYDROCHEMICAL REGIME AND ITS LONG-TERM VARIATIONS IN THE CASE OF SOME RIVERS IN U.S.S.R.,

Hydrochemical Inst., Rostov-na-Donu (USSR).
A. M. Nikanorov, and V. V. Tsirkunov.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 287-293, 3 fig, 1 tab, 6 ref.

Descriptors: *Anions, *Cations, *Ions, *Seasonal variation, *Geochemistry, *Dissolved solids, *Rivers, *Ion transport, Baseline studies, Salinity, Chemical properties, Water analysis, Water quality, Hydrologic data collections, Water pollution effects.

Seasonal and long term (1950-1980) variations in concentrations of major cations and anions for 10 large rivers in the U.S.S.R. were studied along with the relation between hydrochemical and hydrological regimes and transport of major ions. The basic method of investigation of long-term variations was detection of linear trends from the records of flow-weighted annual concentrations. For 13 rivers for which 20-yr water quality records were available and which were not associated with major sources of pollution (background rivers) linear trends were found to be insignificant, with relative values of 1.0-1.5%. A tendency towards an increase in concentration of chloride may be explained by the start of anthropogenic impact, which may change the low concentration of background rivers. In the rivers Don, Kura and Terek, the relative value of linear trends for Cl(-), SO4(--), Na(+) and K(+) was 2-4%. Insignificant negative trends were observed for the rivers Yenisei, Lena and Ob. In rivers exposed to heavy anthropogenic impact, an increase (by 10-40%) of the major ions transport was observed in spite of the considerable (25-35%) decrease in water flow. The greatest increase was observed in the transport of Cl(-), SO4(--), and Na(+) and K(+).
W86-03778

STUDY OF ANTHROPOGENIC INFLUENCE ON WATER QUALITY IN SOME RIVERS OF THE BALTIC SEA BASIN,

Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 5B.
W86-03779

HYDROCHEMICAL BUDGETING IN STUDIES OF GROUND-WATER RENEWABILITY IN AREAS OF GLACIAL FORMATION SYSTEMS,

Polish Academy of Sciences, Warsaw. Geological Sciences Inst.
For primary bibliographic entry see Field 2F.
W86-03783

MODEL EXPERIMENTAL STUDY OF HYDROCHEMICAL PROCESSES IN THE SATURATED ZONE,

Higher Inst. of Mining and Geology, Sofia (Bulgaria).
B. L. Velikov.
In: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 359-367, 4 fig, 3 tab, 11 ref.

Descriptors: *Heavy metals, *Cations, Water pollution sources, *Saturated zone, *Hydrologic models, *Organic acids, *Ion transport, *Fate of pollutants, Groundwater movement, Groundwater recharge, Humic acid, Fulvic acid, Ions, Models, Model studies, Mathematical models, Water pollution.

Results are presented from a model study carried out under dynamic conditions, of the migration of heavy-metal ions Mn(2+), Ni(2+), Cu(2+), Zn(2+), Cd(2+), Hg(2+), Pb(2+), and Fe(3+), with and without natural chelate-forming agents (dissolved humic acids) in order to study the role of various hydrochemical processes, mainly in the saturated zone of alluvial aquifers. The collected data are interpreted according to the recently developed techniques of 'the three characteristic points.' The elimination (binding) forms of the heavy-metal ions with the filtration medium were analyzed with the aid of a differential extraction sequence. Results indicated that in the presence of dissolved humic (fulvic) acids as normal hydrogeochemical ingredients, homogeneous chelate formation prevails, thereby reducing the filtration medium - water interactions and thus increasing the migration capability of these toxic inorganic pollutants. The modified extraction sequence as well as the analyses of the solid-phase composition and tests of the influence of migration forms on plant uptake aid in more satisfactory prediction of the hazard posed by secondary metal-ion remobilization and pollution. The present study may also be of use in predicting hydrochemical processes for the artificial recharge of groundwater reserves and their purification to obtain potable supplies.
W86-03785

SALINE GROUNDWATER DISCHARGES FROM CRYSTALLINE ROCKS NEAR THUNDER BAY, ONTARIO, CANADA,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W86-03786

HYDROCHEMICAL RELATIONSHIPS BETWEEN RAINWATER, FLOODS, GROUNDWATER AND LITHOLOGY IN THE AVEDAT GROUP ON THE NEGEV HIGHLANDS, ISRAEL,

Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 2A.
W86-03789

ADVANCES IN THE IDENTIFICATION AND ANALYSIS OF ORGANIC POLLUTANTS IN WATER, VOLUME 1.

For primary bibliographic entry see Field 5A.
W86-03791

2L. Estuaries

CURRENTS IN SUISUN BAY,

California Univ., Berkeley. Dept. of Civil Engineering.
R. A. Denton.
Publication No. 85-3wr, September, 1984. 226 p. 18 fig, 20 ref, 12 append.

Descriptors: *Water currents, *Bays, *Hydrodynamics, *Tides, Aquatic habitats, Data processing, Conductivity, Flushing, Water pollution effects, Time series analysis, Water quality standards, *California.

This is the second report in a planned series on the hydrodynamics of the San Francisco Bay. A number of changes have been proposed for Suisun Bay that could have an effect on the water quality in the region, for example, a proposed deepening of the shipping channel, a suggested tidal barrier, and a proposed San Luis Drain into the bay near Chipps Island. These factors illustrate the need for a better understanding of the hydrodynamics in Suisun Bay. The hydrodynamic circulation in Suisun Bay is typical of a progressive wave in a partially mixed estuary. The main flows are along a few well-defined channels, separated by shallow gravel banks and mud flats, and also occur between islands. Evidence is found of tidal trapping in Grizzly Bay. There is a difference in the phase of the tidal currents going into Grizzly Bay and those passing through the Suisun Cutoff north of Ryer Island. The net effect of these phase differences when averaged over a tidal cycle is to increase the dispersion of pollutants. The data processing and archiving techniques used were developed for an earlier report on the current in the South San Francisco Bay. The original data were first converted into a standard 30-minute averaged file for each meter deployment. Time series plots, Eulerian progresive vector diagrams, and current roses were prepared. The current and conductivity data provide a substantial base for further analyses of flushing mechanisms. (Fazio-Omniplan)
W86-03448

CURRENTS IN SAN PABLO BAY,

California Univ., Berkeley.
R. A. Denton.
California State Water Resources Control Board, Sacramento Aquatic Hiabitat Program, Publication No. 85-4wr, March, 1985. 51 p. 28 fig, 17 ref, 6 append.

Descriptors: *Water currents, *Bays, *Flow characteristics, *Wind velocity, *Current meters, *Hydrologic data collections, Flushing, Water pollution effects, Tides, Tidal currents, Saline water intrusion, Salinity, Density currents, *California.

Eleven stations in San Pablo Bay were deployed in March-May 1979 and May-November 1980 to provide seasonal measurements and variations of current, conductivity, temperature and salinity. The average tidal current cycle can be used to model the typical tidal excursions and mean residual currents for studies of pollutant dispersion and its effect on the bay's ecology. San Pablo Bay has two main flows bordered by large mudflat areas. It also has significant salt and brackfish tidal marshes which support numerous food organisms. Seasonal changes in salinity cause seasonal changes in fish populations; larger freshwater inflows in winter allow more freshwater fish varieties to extend seaward. The bay's flow is typical of a progressive wave in a partially mixed estuary, with the slack velocities occuring several hours after high and low tide and at different times along the main channel and the shallow area to the north. The exchange between the strong main channel flows and the weaker flows in the shallows increases the longitudinal dispersion of pollutants in the main channel. Conversely, pollutants released in the shallows will take a relatively long period to be dispersed and diluted. Pollutant dispersion is usually only critical during periods of low Delta outflow. The current and conductivity data provide a substantial base for further analyses of flushing mechanisms. Suggestions for future research include studying the correlation between tidal elevation, flow velocity and salinity, and the effect of wind stresses on the flushing process and on residual currents in the shallows. (Atkins-Omniplan)
W86-03449

VERIFICATION OF THE CHESAPEAKE BAY MODEL: CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
N. W. Scheffner, L. G. Crosby, D. F. Bastian, A. M. Chambers, and M. A. Granat.
Technical Report HL-81-14, December 1981. Final Report. 275 p, 33 fig, 8 tab, 4 append, 14 ref.

Descriptors: *Chesapeake Bay, *Hydraulic models, *Estuaries, *Model testing, *Salinity currents, *Tidal hydraulics, Bays, Tides, Models, Model studies, Salinity, Hydrographs, Tidal currents, Saline-freshwater interfaces, Tributaries, Rivers.

The Chesapeake Bay model, a fixed-bed model constructed to a horizontal scale ratio of 1:1000 and a vertical scale ratio of 1:1000, reproduced the Chesapeake Bay from the ocean to the head of tides for each tributary. Reproduction extended to the +20 ft contour. The model was equipped with the necessary appurtenances to reproduce accurately and measure tidal heights, tidal currents, salinity distributions, and freshwater inflows. Due to the immense size of the model (8.6-acre model housed in a 14-acre building), complete computer control and data aquisition capabilities were provided. Severe limitations in prototype data in addition to substantial wind contamination of those data necessitated a detailed data analysis program which resulted in a modified approach to physical model verification. This was accomplished in the following two separate modes of operation: verification for tidal heights and tidal velocities using an M2 constituent tide and a constant long-term freshwater inflow, and verification for salinities using a typical 28-day tidal cycle (with long-period wind energy filtered out) and inflow hydrographs reproduced in 2-wk time-steps. A bubbler system was incorporated in the model to statistically reproduce the vertical mixing caused by wind fields acting on the prototype. Excellent verification of the model was achieved. (Author)
W86-03459

SIMULATION OF ESTUARINE SILT TRANSPORT ACCORDING TO STORM WATER RUNOFF,

For primary bibliographic entry see Field 2J.
W86-03465

INLAND TRAVEL OF TIDE-DRIVEN SALINE WATER IN THE ALTAMAHA AND SATILLA RIVERS, GEORGIA, AND THE ST. MARYS RIVER, GEORGIA-FLORIDA,

Geological Survey, Doraville, GA. Water Resources Div.
M. H. Brooks, and J. B. McConnell.
, 1983. 17 p, 8 fig, 3 tab, 5 ref.

Descriptors: *Tidal rivers, *Saline water intrusion, *Specific conductivity, Low flow, *Spring tides, Altamalia River, Satilla River, *Georgia, Camden County, Glynn County, McIntosh County, Florida, Nassau County.

The inland travel of saline water from the ocean into the Altamaha and Satilla Rivers in Georgia, and the St. Marys River in Georgia-Florida, was investigated in November 1981. Abnormally high tides coupled with low river flows probably resulted in near maximum inland travel of saline water into these rivers. The maximum tide heights during the days of the investigations, measured by a tide-stage recorder at Fernandina Beach, Florida, were 6.3 feet (November 13) and 5.8 feet (November 14) above sea level. Mean daily flows of the Altamaha, Satilla, and St. Marys Rivers at stream-gaging stations in the vicinity of the study reaches were 2,080, 84, and 109 cubic feet per second, respectively. Specific conductance served as an indicator of ocean-derived saline water in the rivers and was used to determine the chlorinity gradients of the river reaches. The maximum distance saline water traveled inland during the high tides was about 24 river miles in the Altamaha River, 51.5 river miles in the Satilla River, and 40.2 river miles in the St. Marys River. (USGS)
W86-03561

ECOLOGICAL SOLUTIONS TO ENVIRONMENTAL MANAGEMENT CONCERNS IN THE PINELANDS NATIONAL RESERVE: PROCEEDINS OF A CONFERENCE,

Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
Held on April 18-21, 1982. Camden/Cherry Hill, New Jersey, 47 p, December, 1982. Edited by Ralph E. Good. DEB-8200529.

Descriptors: *Pinelands National Reserve, *Ecology, *Environment, *Information exchange, Ecosystems, Wetlands, Forest fires, Nutrients, Water quality, Hydrology, Ecological distribution.

Pinelands ecosystems support 39 species of mammals, 59 species of reptiles and amphibians, 91 species of fish (including estuarine species), 299 species of birds and over 800 vascular plant taxa. Much of the area is still sparsely settled, at least by local criteria, although New York City and Philadelphia are both less than 100 miles away. In this sense the Pinelands represent an interesting cultural anomaly. The goal of the conference was to develop recommendations for an organized collection of ecological and environmental information about the Pinelands. There are two interrelated mandates for achieving this goal: (1) to provide a data base for initially formulating and subsequently justifying, even under the most intense scientific and legal scrutiny, the best management plan for the Pinelands, and (2) to enhance and further the science of ecology by understanding the population and ecosystem properties unique to the Pinelands, and by employing, where possible, reciprocal transfers of information to and from the Pinelands and other ecosystems. Clearly the best management plan will depend upon our understanding of the properties and processes of the Pinelands. This volume is a compilation of syntheses of the conference presentations with a brief text of background material.
W86-03616

MARICULTURE IN OLD RICE FIELD IMPOUNDMENTS: AN ANALOGY FOR DREDGED MATERIAL CONTAINMENT AREAS,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
J. M. Dean, C. A. Wilson, and N. C. Alon.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 143-152, 1 fig, 4 ref.

Descriptors: *Ponds, *Dredging, *Fish ponds, *Fish farming, *Aquaculture, *Aquatic habitats, Lakes, Brackish water, Rice fields, Aquatic life, Aquatic animals, South Carolina, Estuarine environment, Minnows, Clams, Invertebrates, Scallops, Shellfish, Waterfowl, Ducks, Crabs, Oysters, Crawfish, Prawns, Shrimp.

Thousands of acres of South Carolina's estuarine coastline were impounded for rice production before the start of the twentieth century. This acreage, owned by private concerns, State agencies, and the Federal government, has been used for extensive aquaculture production since rice cultivation was abandoned. The most common use has been active management for waterfowl, and significant returns have been realized from hunting leases. Historically, a variety of organisms of interest to aquaculturists have been introduced into the ponds. Our research has shown that blue crabs, mullet, and shrimp survive at a higher rate and grow larger than do their wild counterparts. Additional studies have indicated that cage-grown oysters are also adaptable to rice-field culture. Other species, such as bait minnows, clams, and scallops, could be raised in the brackish water impoundments while prawns and crawfish would be suitable for freshwater impoundments. Experimental aquaculture has, so far, been limited to a very low management extensive type of culture. Dredged material containment areas (DMCA) would do better to combine intensive and extensive cultures. Existing impoundment aquaculture provides a management model, while the development and success of DMCA aquaculture would contribute to solving current impoundment problems. (Author)
W86-03711

PROCEEDINGS: 2ND ANNUAL GULF OF MEXICO INFORMATION TRANSFER MEETING.

Minerals Management Service, Metairie, LA. Gulf of Mexico OCS Regional Office.
For primary bibliographic entry see Field 10D.
W86-03841

PROCEEDINGS OF THE CONFERENCE ON COASTAL EROSION AND WETLAND MODIFICATION IN LOUISIANA: CAUSES, CONSEQUENCES, AND OPTIONS.

Louisiana Universities Marine Consortium, Chauvin.
For primary bibliographic entry see Field 2J.
W86-03850

SEDIMENTATION AND APPARENT SEA-LEVEL RISE AS FACTORS AFFECTING LAND LOSS IN COASTAL LOUISIANA,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2J.
W86-03851

ASSESSMENT OF GEOLOGICAL AND HUMAN FACTORS RESPONSIBLE FOR LOUISIANA COASTAL BARRIER EROSION,

Louisiana Geological Survey, Baton Rouge.
For primary bibliographic entry see Field 2J.
W86-03852

MUDFLAT AND MARSH PROGRADATION ALONG LOUISIANA'S CHENIER PLAIN: A NATURAL REVERSAL IN COASTAL EROSION,

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
For primary bibliographic entry see Field 2J.
W86-03853

EFFECT OF COASTAL ALTERATION ON MARSH PLANTS,

Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
R. H. Chabreck.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 92-98, 1 tab, 11 ref.

Descriptors: *Marsh plants, *Wetlands, *Marshes, *Louisiana, Salt marsh, Coastal marshes, Salt tolerance, Saline water intrusion, Salinity, Vegetational effects, Environmental effects.

The Louisiana coastal marsh is subdivided into four vegetative types: saline, brackish, intermediate, and fresh. The types occur in bands generally paralleling the coastline and contain characteristic water salinity levels and plant communities. Activities of man coupled with natural processes, such as subsidence and erosion, have removed many natural tidewater barriers and reduced freshwater flow through the marshes. As a result, saltwater intrusion from the Gulf of Mexico has increased and the boundaries of vegetative types have been altered. The saline vegetative type has greatly increased in size and the brackish and intermediate types have shifted inland. This has caused a drastic reduction in the size of the fresh vegetative type. (Author)
W86-03856

EFFECTS OF WETLAND DETERIORATION ON THE FISH AND WILDLIFE RESOURCES OF COASTAL LOUISIANA,

Fish and Wildlife Service, Lafayette, LA.
D. W. Fruge.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7,

1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 99-107, 33 ref.

Descriptors: *Marshes, *Wetlands, *Coastal marshes, *Louisiana, *Environmental effects, Water fowl, Ducks, Geese, Fish, Shellfish.

Wetland deterioration, which is partially attributable to natural causes, has been greatly accelerated by human influences such as navigation channel, excavation, agricultural drainage, and construction of mainline Mississippi River levees that have presented freshwater and sediment overflow into adjacent subdelta marshes. The serious declines in estuarine-dependent fish and shellfish harvest, fur catch, waterfowl habitat, and related fish and wildlife productivity which would be caused by continued wetland deterioration are discussed. The magnitude of the use of these coastal wetlands by ducks, geese, fish and shellfish is described. The future of marsh restoration to be financed by the state of Louisiana through its Coastal Environmental Protection Trust Fund is discussed. (Halterman-PTT)
W86-03857

SOME CONSEQUENCES OF WETLAND MODIFICATION TO LOUISIANA'S FISHERIES,

Louisiana Dept. of Wildlife and Fisheries, Baton Rouge.
B. Barrett.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana: FWS/OBS-82/59, September 1982. p 108-111, 5 ref.

Descriptors: *Wetlands, *Erosion, *Fisheries, *Louisiana, Fish, *Marshes, *Coastal marshes, Environmental effects, Dams, Reservoirs.

Agencies of the State and Federal Governments as well as local interests have long recognized that Louisiana's wetlands are undergoing adverse ecological changes. These changes are the result of both natural processes and the works of man. The dominant ecological change taking place in the coastal area is habitat alteration--wetlands are eroded and replaced by water. Now there are many proposals to reduce erosion rates which include freshwater introduction, jetties, and additional restrictions on activities. Freshwater introduction may be the most efficient means of reducing land loss rates. Fresh water, particularly from the Mississippi River, would reduce saltwater intrusion and contribute nutrients and sediments to the estuaries and wetlands. Changes in water regimes, however, could drastically alter animal populations as occurred in Sabine Lake. The water cycle was changed by the constructions of the Toledo Bend reservoir and dam which resulted in a drastic reduction in shrimp harvest in this lake. (Author)
W86-03858

WETLAND LOSSES AND COASTAL FISHERIES: AN ENIGMATIC AND ECONOMICALLY SIGNIFICANT DEPENDENCY,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. E. Turner.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 112-120, 6 fig, 1 tab, 17 ref. Publication No CEL-SG-82-010.

Descriptors: *Wetlands, *Erosion, *Fisheries, *Economic aspects, *Louisiana, *Marshes, Coastal marshes, Environmental effects, Management planning, Cost analysis, Costs.

Louisiana's coastal fishing industry landings are limited by the area of coastal wetlands, not open water. The relationship is not sufficiently understood, but is demonstrable through the life history patterns of all the commercially important species, organism density in the vicinity of altered and natural wetland-water edges, experiments in predation, and correlation analysis of landings data and wetland area should be conserved in order to maximize for the largest potential fisheries yields. The impact of previous wetland losses are not well documented because of lack of good landings data that accounts for both year-to-year environmental influences and a changing fishing effort. At a projected 1% wetland loss rate over the next 20 years, the commercial fishing industry will experience a potential one billion dollar loss spread throughout the industry (exclusive of the recreational level). Thus with a mere 10% reduction in the present loss rates, the annual savings would be 5 million dollars. (Author)
W86-03859

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,

Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
For primary bibliographic entry see Field 6G.
W86-03861

FUTURE SEA LEVEL CHANGES ALONG THE LOUISIANA COAST,

Louisiana State Univ., Baton Rouge. Dept. of Geology.
D. Nummedal.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 164-176, 7 fig, 1 tab, 41 ref.

Descriptors: *Sea level, *Water level, *Louisiana, Sediments, Tectonics, Model studies, Louisiana, Marine climates, Oceanography, Climates, Glaciations.

The relative elevation of sea and land has been changing throughout time in response to two fundamentally different groups of factors. Global factors include changes in the volume of the ocean basins due to tectonic processes and changes in the total amount of ocean water due to glaciation. Local factors include subsidence of continental margins and the compaction of recent sediments. During this century, global sea level (eustatic) appears to have been rising at a rate of 1.2 mm/yr. Along the south-central Louisiana coast the land surface appears to be sinking at a rate of about 8 mm/yr. Recent global climatic modelling strongly suggests that we are about to enter a period of rapid warming due to increased amounts of carbon dioxide in the atmosphere. As a consequence, eustatic sea-level rise is predicted to accelerate both because of steric expansion of the ocean water and continued melting of polar ice caps. For the next 40 years the eustatic sea-level rise may average 10 mm/yr. The local relative sea level in coastal Louisiana would therefore rise at about twice its present rate over this time period. At this rate local sea level will, in the year 2020, stand some 70 to 75 cm higher than now. (Author)
W86-03862

EFFECTS OF COASTAL STRUCTURES ON SHORELINE STABILIZATION AND LAND LOSS - THE TEXAS EXPERIENCE,

Texas Univ. at Austin. Bureau of Economic Geology.
R. A. Morton.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 177-186, 6 fig, 7 ref.

Descriptors: *Wetlands, *Beach erosion, *Coastal structures, Barrier islands, *Texas, Erosion, Marshes, Coastal marshes, Environmental effects, Resource management.

Recent studies indicate that Texas is losing about 120 ha (300 acres) of wetlands and 40 ha (100 acres) of gulf-front property annually. Although total land losses in Texas are considerably less than those in Louisiana, they are still substantial and the reason many shoreline protection structures have been erected. The structures have not always produced the desired effects, however. Instead, some have accelerated erosion of nearby beaches. Groins have generally been ineffective because sand supply is inadequate where beaches are eroding. With one exception, seawalls built on Gulf of Mexico beaches have failed or have been severely damaged during storms. Most bulkheads and seawalls have protected the adjacent property, but at the expense of publicly-owned recreational beaches that are eroded by the reflected wave energy. Because of similarities in geologic setting and physical processes along the gulf coast, the effects of these structures can be evaluated and the results applied to Louisiana where shoreline stabilization is being considered to mitigate land loss. (Author)
W86-03863

COMPARISON OF EFFECTIVENESS OF MANAGEMENT OPTIONS FOR WETLAND LOSS IN THE COASTAL ZONE OF LOUISIANA,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. W. Day, and N. J. Craig.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 232-239, 1 fig, 1 tab, 22 ref.

Descriptors: *Wetlands, *Management planning, *Louisiana, *Resources management, Resources development, Canals, Dredging, *Atchafalaya River.

The effectiveness of three management options for the control of wetland loss in the coastal zone of Louisiana is discussed. These wetlands are currently experiencing an overall net loss of approximately 130 sq km/yr. Various management options have been suggested to combat the problems, including management of the current land building of the Atchafalaya River; controlled diversion schemes on the lower Mississippi River; and strict regulatory control of canals within the coastal zone. Studies of these options reveal that regulatory control of new canals could reduce the loss rates approximately 30 to 40 sq km/yr, in contrast to 1 to 3 sq km/yr for controlled diversion plans, and approximately 18 sq km/yr for land building by the Atchafalaya River. (Halterman-PTT)
W86-03866

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

PREPARATION OF ION-EXCHANGE MEMBRANES WITH EXTREMELY LOW AREAL RESISTANCES,

Southern Research Inst., Birmingham, AL.
Project 4361, Report 6, Final Report to Bureau of Reclamation, Washington, DC. Office of Water Research. 63 p, 7 fig, 9 tab, 2 app. 4361. 14-34-0001-9411.

Descriptors: *Desalination apparatus, *Ion-exchange, *Membranes, *Areal resistance, Cation exchange, Resins, *Semipermeable membranes.

This is the final report on a research program whose primary objective was the evaluation of the service lifetimes of ion-exchange membranes developed under a previous contract. These membranes have extremely low areal resistances and appeared to be advantageous for seawater desalination. The approach used was to reinforce ion-exchange polymers that were known to be low in resistance but were too weak and dimensionally unstable for use. To evaluate the service lifetimes, properties of the experimental membranes were compared with commercial membranes produced by two manufacturers (Tokuyama Soda, Inc., and Ionac Chemical Co.). All of these membranes were used simultaneously in an electrodialysis stack to desalt a sodium chloride solution that simulated seawater (0.6 N NaCl). Findings indicated that the experimental low-resistance cation-exchange membranes

retained their low resistances and high transference numbers better than both the Ionac membranes and the Tokuyama control membranes. Since the experimental cation-exchange membranes had much lower resistances than the Tokuyama membranes (1.2 ohm-sq cm compared with 2.5 ohm-sq cm), these new membranes appear to warrant further development. In the first lifetime evaluation, the experimental anion-exchange membranes lost their physical strength. The loss of strength was determined to be caused by hydrolysis of the polyester nonwoven reinforcing fabric. This hydrolysis was catalyzed by the amines of the anion-exchange resin. Studies were then focused on the stabilities toward amine-catalyzed hydrolysis of a wide selection of nonwoven fabrices with suitable thicknesses and void volumes. Polypropylene fabrics were the most stable, but the ion-exchange polymer would not adhere well to the polypropylene. Nylon 6-6 fabrics also appeared to be stable, and good pinhole-free membranes were made with these fabrics. However, these improved anion-exchange membranes also degraded in strength during 1000 hours of service. It was concluded that it is improbable that good anion-exchange membranes with acceptable lifetimes can be developed by reinforcing low-resistance ion-exchange polymer with currently available nonwoven fabrics.
W86-03615

IMPROVED SURCHARGE COMPUTATION, IN EXTRAN,
Camp, Dresser and McKee, Inc., Annandale, VA.
J. A. Aldrich, and L. A. Roesner.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 179-190, 4 fig, 3 ref.

Descriptors: *Storm runoff, *Urban hydrology, *Mathematical models, *Computer programs, *Computer models, *EXTRAN, Pressure flow, Storm water, Navier-Stokes equation.

The Extended Transport Block of the Stormwater Management Model (EXTRAN) is one of a few models able to dynamically route gradually varied flow through urban drainage systems. This is accomplished by explicitly solving the full Navier-Stokes equation for a wide variety of hydraulic conditions. This paper describes the need for, and the operation of, a modification to the surcharge computation routine via a surcharge iteration loop. The loop dramatically improves the accuracy of EXTRAN under severe surcharge conditions, while using less computer time. Balancing the fraction of the average surcharge flow and the maximum number of iterations for accuracy and computer time, is problem-dependent and requires a certain amount of user experience.
W86-03832

3B. Water Yield Improvement

INVESTIGATION OF THE FEASIBILITY OF SECONDARY RECOVERY OF GROUND WATER FROM THE OGALLALA AQUIFER: A REPORT TO THE SIXTY-EIGHTH LEGISLATURE.
Texas Dept. of Water Resources, Austin.
LP-185, November 1982. 58 p, 11 fig, 5 ref.

Descriptors: *Feasibility studies, *Secondary recovery, *Water yield improvement, *Groundwater, *Aquifer characteristics, *Aquifers, Capillary capacity, Capillary water, Mathematical models, Aeration zone, Economic feasibility.

The Texas Legislature directed the Department of Water Resources to investigate the feasibility of secondary recovery of ground water from the Ogallala aquifer. It appears that injection of air into the unsaturated zone of the aquifer offers, in some locations, exciting possibilities of increasing the volume of water recoverable from the aquifer by conventional well pumping. The reason for the extra water is not understood. The cost of such recovery probably is economically feasible only for municipalities whose existing water supply is almost exhausted. Sites with a saturated clay layer overlying the injection zone appear to offer good prospects of secondary recovery by air injection. Test hole drilling and core analysis showed that the moisture content for material between the bottom of the root zone (about 10 ft below land surface) and the 1980 water table ranged from 10-40% by volume with an average of about 25%. Using the average value, the 3.35 billion acre-ft of currently unsaturated material in the Ogallala Formation would contain about 840 million acre-ft of capillary water. A literature review identified five potential secondary recovery techniques: air drive, surfactant/foam, thermal, vibration, and electro-osmosis. Laboratory tests showed that applying 2 pounds per square inch air-drive pressure resulted in a 20% increase in water yield over that obtainable by gravity drainage alone. (Fazio-Omniplan)
W86-03442

SCPP FORECASTING SUPPORT FOR THE PERIOD 1 DECEMBER 1978 THROUGH 30 SEPTEMBER 1984,
Electronic Techniques, Inc., Fort Collins, CO.
Bureau of Reclamation, Washington, DC. October 1984. 294 p, 69 fig, 36 tab, 44 ref, 6 append. 9-07-85-V0021.

Descriptors: Precipitation, *Weather modification, *Cloud seeding, Orographic precipitation, Radar, Rawinsondes, Forecasting, Sierra Cooperative Pilot Project, Colorado, Mountains, Meteorological data collections, Data collections.

A summary of work done for the Sierra Cooperative Pilot Project covers field services, data reduction, and analysis. Tables summarize radar, rawinsonde, and forecasting operations. General support analysis remained relatively consistent over the six years of the contract. Descriptions and examples of Precipitation Echo Types (PET), time-height section variable calculations, and time and space cross sections are provided. Specific analyses performed in support of the project's randomized seeding experiment in convection are summarized: analysis of the PETs by season, weather type and synoptic features; radar and meteorological descriptions of experimental days; detailed analysis of radar data from individual clouds; and definitions of radar response variables. Other analyses apply either to experiments in convection or toward developing a seeding experiment in nonconvective cloud systems. These are summarized as studies of covariates of target area precipitation, targeting seeding effects by modifying the NAWC GUIDE model, and simulation of seeding signals by crystal trajectory calculations using flow model winds. Model winds are compared with aircraft and rawinsonde observations. Weather type occurrences and precipitation for the entire study period are compared to historical averages. (Cassar-PTT)
W86-03495

3C. Use Of Water Of Impaired Quality

TREATMENT OF COMBINED INDUSTRIAL AND DOMESTIC WASTEWATER FOR REUSE IN SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W86-03890

3D. Conservation In Domestic and Municipal Use

WATER 2000: CONSERVATION PROGRAM.
New Castle County Water Resources Agency, DE.
Volume IV, A Water Plan for New Castle County, DE. April 1982. 64 p, 7 tab, 17 ref.

Descriptors: *Water conservation, *Delaware, *Public participation, *Administration, *Future planning, *Longterm planning, Management planning, Nonstructural alternatives, Attitudes, Projections, Seasonal depletion, Optimum development plans, Local governments, Jurisdiction.

WATER 2000 is a cooperative planning effort between water suppliers and State and local agencies to achieve and maintain a balance between water resources and water use while minimizing both costs to the public and conflicts with other community goals. The plan is designed to meet the area's needs to the year 2000 and beyond. Per capita water use for public supply has increased 42% since 1954 and 16% since 1974 even with a declining population during 1974-78. At this rate, demand could exceed 200 gallons per capita/day by 2000; however, a drought or peak summer load could put a strain on the system. In looking to the future, three management alternatives have been recommended: demand management, aimed at maximizing the use of existing supplies; facility management to improve extant distribution systems; and resource management to develop new water sources. This paper is most concerned with demand management/increasing public awareness. A threefold information and education program is planned to (1) increase public awareness of the benefits of water conservation; (2) reduce per capita water demand; and (3) minimize the need for additional water sources, storage and treatment facilities. The means to carry out the program include printed material, the news media, personal contact, special events and school programs which will be undertaken by a number of different jurisdictions, agencies and organizations in the public and private sectors. The costs and staff time would be assured by the implementing body. A successful program in New Castle County can serve as a model for other areas. (Atkins-Omniplan)
W86-03445

DROUGHT-RELATED IMPACTS ON MUNICIPAL AND MAJOR SELF-SUPPLIED INDUSTRIAL WATER WITHDRAWALS IN TENNESSEE, (PART A AND PART B),
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 6D.
W86-03560

3E. Conservation In Industry

WATER RECYCLING IN THE PULP AND PAPER INDUSTRY IN CALIFORNIA,
Camp, Dresser and McKee, Inc., San Francisco, CA.
J. T. O'Rourke.
California Water Resources Control Board, Sacramento Office of Water Recycling. January 1982. 188 p, 7 fig, 15 tab, 45 ref, 5 append.

Descriptors: *California, *Recycling, *Pulp and paper industry, *Water supply, *Water conservation, *Wastewater renovation, *Water reuse, Industrial water, Water use, Economic aspects, Legal aspects, Municipal wastewater, Effluents, Mills, Water quality, Pricing.

The pulp and paper industry in california is the second largest industrial user of freshwater, using approximately 56 billion gallons per year and, as such, is a primary candidate for water conservation by recycling or by wastewater reclamation and reuse. The Office of Water Recycling wanted to determine if the pulp and paper industry presents a potentially significant, easily identifiable opportunity for water conservation by water and wastewater reuse. The report examines the economic, political, and technical aspects of implementing reuse. The most widely practiced method of conservation continues to be in-plant reuse, the primary reasons being economic and legal/institutional: i.e., the practice reduces costs to the mill operator both for water purchase and wastewater treatment, to the mill operator; and the practice is totally controllable by the operator. The gap between existing and potential reuse is not caused by lack of technical knowhow, but by economic and institutional conditions at individual facilities. Techniques employed during the study were a literature review, statistical data collection, and detailed review of several existing projects, including site visits. The single economic/legal/institutional change with the most impact would be the elimination or significant alteration of the antipar-

alleling statutes. The most direct economic impact would be made by grant-funding programs of water conservation in the pulp and paper industry. (Fazio-Omnipian)
W86-03437

CHEMISTRY IN WATER REUSE: VOLUME 1,
For primary bibliographic entry see Field 5D.
W86-03520

EVALUATION OF THE PUBLISHED LITERATURE IN THE WATER REUSE/RECYCLE AREA,
Versar, Inc., Springfield, VA.
E. F. Rissmann, and E. F. Abrams.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 1-14, 3 fig, 2 tab, 28 ref.

Descriptors: *Water conservation, *Water reuse, *Literature review, *Recycling, Conservation, Industrial wastewater, Wastewater renovation, Pulp and paper industry, Metal-finishing wastes, Inorganic chemicals, Oil refineries, Steel industry, Food processing industry.

A literature search on water reuse disclosed over 2000 references, including 73 discrete case histories. Most case histories applied to six industrial categories: pulp and paper, electroplating, inorganic chemicals, petroleum refining, iron and steel, and food products. Most work involved the removal of inorganic contaminants from wastewater. The few references to organics removal concerned acetates and phenolic-type materials. Problems in recycle technology include the buildup of dissolved salts and disposal of large volumes of waste solids such as gypsum, red muds, and ore residues. Future growth in water reuse is expected to occur in the industries already using this technology.
W86-03521

CONTROL AND MEASUREMENT OF ORGANIC MICROPOLLUTANTS IN SOUTH AFRICAN WATER RECLAMATION PLANTS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W86-03522

GROSS ORGANICS MEASUREMENTS FOR MONITORING OF WASTEWATER TREATMENT AND REUSE,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 5A.
W86-03523

HYPERFILTRATION OF TEXTILE PROCESS WATER FOR REUSE,
Clemson Univ., SC.
For primary bibliographic entry see Field 5D.
W86-03535

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PROCEEDINGS OF WORKSHOP ON ALGAL MANAGEMENT AND CONTROL,
Environmental Monitoring Systems Lab., Las Vegas, NV.
March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 313 p. Interagency No. EPA-IAG-78-R-X0383.

Descriptors: *Biocontrol, *Algal control, *Algicides, *Conferences, *Water quality management, Biological properties, Algae, Algal toxins, Eutrophication, Water management, Aeration, Zooplankton.

A workshop was held 9-12 March 1980 in Pacific Grove, California to review state-of-the-art techniques for the management and control of lacustrine algal populations, to establish the functional availability and limits of various algal management and control techniques, and to determine research needs in relation to the further development of algal management and control techniques. The workshop consisted of formal reviews of approaches or perspectives to be considered in the management and control of algal populations; plenary discussions; and formal panel deliberations. The topics discussed included: control measures for objectional algal blooms, selective algicides, state-of-the-art summary of phosphorus inactivation as a lake restoration technique, aeration circulation for control of algal production, control of non-point nutrient caused algal problems especially by dilution, limits to the control of algal populations by grazing zooplankton, algal control through trophic-level interactions, extracellular metabolite involvement in plankton community structure, cyanophages as potential biological control agents of nuisance blue-green algae, and the utilization of bacteria in managing cyanobacterial populations. A bibliography of algicides and algal management and control topics is also given. (Geiger-PTT)
W86-03483

STREAMFLOW AUGMENTATION AT FOSTERS BROOK, LONG ISLAND, NEW YORK - A HYDRAULIC FEASIBILITY STUDY,
Geological Survey, Syosset, NY. Water Resources Div.
K. R. Prince.
Available from Dist. Br., 604 So. Pickett St., Alexandria, VA 22304. USGS Water Supply Paper 2208, 1984. 43 p, 17 fig, 5 tab, 14 ref.

Descriptors: *Surface-groundwater relationships, Surface waters, *Flow augmentation, *Streamflow, Unsaturated flow, *Infiltration, *Seepage, Nassau County, Long Island, Fosters Brook, *New York, Hydraulic feasibility studies.

A 27-day streamflow-augmentation test was conducted in December 1979 at Fosters Brook, near the south of Long Island, to investigate the hydraulic feasibility of pumping ground water to supply flow to an ephemeral stream during dry periods. Measurements of soil moisture in the unsaturated zone beneath the streambed indicate that infiltration rate and soil-moisture content are interrelated. Soil moisture in the unsaturated zone ranged from 20 percent at the start of the test to 41 percent, nearly the saturation point, 20 days later. During the first 24 hours of the test, the stream reached a maximum length of 2,050 feet but, after 13 days, had decreased to 1,300 feet as a result of seepage losses. The relationship between discharge and stream length was linear within the range of discharges investigated (0.54 to 1.63 cubic feet per second). (USGS)
W86-03551

FINAL ENVIRONMENTAL IMPACT STATEMENT: REGIONAL FLOOD CONTROL TONAWANDA CREEK, GENESEE COUNTY, NEW YORK,
Corps of Engineers, Buffalo, NY. Buffalo District.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120213, Price codes: A20in paper copy, A01 in microfiche. November 1981. 453 p, 10 plates, 14 append.

Descriptors: *Flood cotrol, *Reservoirs, *Protection, *Wildlife, *Environmental effects, *Stream improvement, Batavia, New York, Tonawanda Creek, Dams, Flood protection, Flood-control storage, Storage, Storm runoff, Construction, Dam effects, Detention reservoirs, Earth dams, Fish, Aquatic habitats, Channel improvement, Economic impact, Wetlands, Habitats, Invertebrates, Benthos, Social impact.

The Batavia Reservoir Compound modified alternative plan is recommended for reducing flood damage in the Tonawanda Creek Watershed, New York. The $25.8 million project consists of two shallow, normally dry detention reservoirs arranged in series. Each of the two earthen dams would have a principal and emergency spillway and a reservoir. The main channel of the connecting creek would be cleared of snags and debris to provide a channel cpacity of 2000 cu ft per sec. The reservoirs are designed to detain a 500-year flood 2-8 days longer than under existing conditions. This would reduce annual flood damages by 74%. Average annual benefits are $3.3 million. Construction of embankments and dikes requires clearing and stripping of 126 acres in addition to filling 44 acres of wetlands, eliminating some food and cover used by wildlife. Channel clearance would cause temporary silting of the stream and destroy some aquatic habitat.
W86-03626

SAND DUNE VEGETATION AND STABILIZATION IN LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2J.
W86-03864

COMPARISON OF EFFECTIVENESS OF MANAGEMENT OPTIONS FOR WETLAND LOSS IN THE COASTAL ZONE OF LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W86-03866

4B. Groundwater Management

GROUND WATER IN CARBONATE ROCKS AND REGOLITH IN THE FAIRVIEW AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-03548

ARTIFICIAL RECHARGE OF GROUNDWATER RESOURCES IN SEMIARID REGIONS,
Maiduguri Univ. (Nigeria). Dept. of Agricultural Engineering.
O. B. Jacenkow.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 111-119, 8 fig, 2 tab, 6 ref.

Descriptors: *Recharge, *Groundwater recharge, *Water storage, *Groundwater management, *Water management, *Geohydrology, Artificial recharge, Groundwater storage, Hydrology, Arid lands, Semiarid lands, Wells, Cavity wells, Borno, Nigeria, Excess rainfall, Rainfall, Precipitation, Evaporation.

Storage of rain water in confined aquifers was investigated in the semiarid Borno State, Nigeria. In this region 70% of the yearly average precipitation (380 mm in the south to 1029 mm in the north) falls in July, August, and September. Potential evaporation is 1907.1 mm per year. Well levels have been falling steadily since 1979. Rainfall exceeds evaporation during July and August, with a 152.4 mm excess. Interception of only 1% of this excess would provide an additional 90 million cu m of water, about the same as the present yearly abstraction. To minmize clogging during aquifer recharge, cavity wells are suggested. Instead of a filter screen, the cavity well has a cavern formed in the permeable layer by intense pumping. These wells are effective as recharge or discharge wells and may be unclogged by pumping.
W86-03572

OPTIMIZATION OF CONJUNCTIVE USE OF GROUNDWATER AND SURFACE WATER RESOURCES IN THE VAAL BASIN,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
W. A. J. Paling.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium,

July 1984. IAHS Publication No. 144, 1984. p 121-128, 5 fig, 4 ref.

Descriptors: *Recharge, *Groundwater recharge, *Conjunctive use, *Wastewater disposal, *Water storage, *Groundwater management, *Water management, *Geohydrology, Artificial recharge, Vaal River, Johannesburg, South Africa, Rivers, Reservoirs, Water supply.

A scheme for supplementing water supplies from the Vaal River, South Africa, with groundwater involves recharge with secondary sewage effluent. This river, which is a water supply for 6 million persons in the Johannesburg area, has a highly irregular flow. A barrage and a reservoir allow a sustained yield of 37.7 cu m per sec. The Suurbekom compartment of the aquifer is most suitable for recharging, since it is not involved in gold mining and does not underlie a population center. It is proposed to transport secondary effluent to this compartment at 3 cu m per sec. Maximum net storage of the dam is 2200 million cu m; maximum reliable draft, 37.7 cu m per sec. Assuming the maximum groundwater abstraction rate to be 5.71 cu m per sec and with unlimited groundwater resources, the sustained conjunctive yield could be increased to 43.38 cu m per sec, an improvement of 15%. Accepting the limitation of an underground reservoir of 250 million cu m storage and a replenishment of 3 cu m per sec of effluent, conjunctive drawoff would be 42.24 cu m per sec, an improvement of 12%.
W86-03573

MEASUREMENT OF SOIL LOSS FROM EXPERIMENTAL BASINS IN MALAWI,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 2J.
W86-03590

4C. Effects On Water Of Man's Non-Water Activities

GEOCHEMISTRY AND GEOHYDROLOGY OF THE WEST DECKER AND BIG SKY COAL-MINING AREAS, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-03545

HYDROLOGY OF AREA 1, EASTERN COAL PROVINCE, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03547

WATER RESOURCE DATA AND TREND ANALYSIS FOR THE BLUE CREEK WATERSHED PROJECT, PIKE COUNTY, ILLINOIS: PHASE II,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5G.
W86-03610

IMPACTS OF FLOODING REGIME MODIFICATION ON WILDLIFE HABITATS OF BOTTOMLAND HARDWOOD FORESTS IN THE LOWER MISSISSIPPI VALLEY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W86-03634

4D. Watershed Protection

VELD BURNING AND SEDIMENT YIELD FROM SMALL DRAINAGE BASINS,
Durban-Westville Univ. (South Africa). Dept. of Geography.
H. K. Watson.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 323-333, 1 fig, 9 tab, 9 ref.

Descriptors: *Erosion control, *Sediment yield, *Vegetation, *Rainfall-runoff relationships, *Soil conservation, Conservation, Soil erosion, Firebreaks, Stream discharge, Runoff, Organic matter, Natal Drakensberg, Mountain watersheds, Watershed management.

The following parameters were monitored in two adjacent and physiographically comparable drainage basins in the Natal Drakensberg: rainfall, vegetation cover, stream discharge, sediment yield and the organic and dissolved solids components of the total stream load. An original splitting system design was employed to obtain measurements of the stream load components. Both drainage basins were monitored for a period prior to the application of an autumn burn treatment to one of them, and for a full annual cycle after the treatment. A significant reduction in the rate of subsurface water movement and in the baseflow discharge volume may be attributed to the firebreak treatment. The treatment did not appear to have any substantial effect on storm runoff, nor on the sediment, organic and dissolved solids of the stream load components. (Author)
W86-03588

GULLY EROSION IN THE AGULU-NANKA REGION OF ANAMBRA STATE, NIGERIA,
Anambra State Univ. of Technology, Awka (Nigeria). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2J.
W86-03589

SEDIMENT YIELD ESTIMATION AND THE DESIGN OF SEDIMENT CONTROL STRUCTURES IN RURAL AFRICA,
Steffen, Robertson and Kirsten, Inc., Johannesburg (South Africa).
A. Ward, and B. Middleton.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 415-425, 35 ref.

Descriptors: *Erosion, *Erosion control, *Sediment control, *Sediment yield, *Model studies, *Environmental effects, Computer models, SEDIMOT-II model, Africa, Design criteria, Vegetation, Agriculture, Urbanization, Mining, Runoff, Rainfall-runoff relationships, Soil loss, Rural areas.

A computer-based technique, SEDIMOT-II, is a single event distributed parameter model which simulates runoff, erosion, and sediment transport on a disturbed basin. Hydrographs and sedimentgraphs are prepared for individual sub-basins. Then these flows are routed to sediment control structures to evaluate the sediment trap efficiency of the controls. Sediment control options include check dams, sediment dams, and vegetative filters. Evaluation of sedimentation problems involves development of preventive measures, design of control measures, impact assessments, and design of remedial measures. Preventive measures well suited to rural areas are drainage control, terracing, tillage practices, and mulching. Some impacts which may be assessed include irrigation schemes, agricultural development, silviculture, mining, industrial or urban development, construction of weirs and dams, and upstream impacts on existing hydraulic structures. Remedial measures most often required in rural areas are weir and impoundment desilting, gully reclamation, and dirt road maintenance.
W86-03595

SHEET EROSION FROM ARABLE LANDS IN ZIMBABWE: PREDICTION AND CONTROL,
Institute of Agricultural Engineering, Harare (Zimbabwe).
For primary bibliographic entry see Field 2J.
W86-03596

MULCH REQUIREMENTS FOR EROSION CONTROL WITH THE NO-TILL SYSTEM IN THE TROPICS: A REVIEW,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
R. Lal.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 475-484, 3 fig, 4 tab, 28 ref.

Descriptors: *Erosion control, *Soil conservation, *Agriculture, *Mulching, *Cover crops, *Vegetation, *Cultivation, No-till, Tropical regions, Terracing, Soil erosion, Runoff, Slopes, Africa, Farming.

Mulch farming and no-till systems have proved suitable for reducing runoff and soil erosion to within tolerable limits in West Africa. Graded channel terracing as practiced in Africa is ineffective at slope gradients exceeding 5%. Intense storms with return periods of 5-10 years cause enormous damage to the arable lands and structures. Mulching has been successfully used to prevent excessive soil erosion in tea plantations and pineapple plots. Mulching reduced runoff by 11-35 times and erosion by 18-750 times, depending on slope. However, mulch rates of 4-6 t per ha are difficult to procure. Some creeping and low growing legumes recommended as cover crops on steep lands are Mucuna utilis, Panicum colaratum, Psophocarpus palustris, and Stizolobium deeringianum. No-tillage reduces runoff by 70-90% and soil erosion by 97% when compared with conventional plowing. No-till is not an effective erosion control measure unless 2-4 t per ha per crop of mulch is also applied.
W86-03600

RUNOFF, EROSION AND SOIL FERTILITY RESTORATION ON THE MOSSI PLATEAU (CENTRAL UPPER VOLTA),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
E. Roose, and J. Piot.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 485-498, 1 fig, 4 tab, 20 ref.

Descriptors: *Erosion control, *Soil conservation, *Cultivation, *Soil loss, *Rainfall-runoff relationships, Sediment transport, Runoff, Agricultural engineering, Mossi Plateau, Upper Volta, Deserts, Arid lands, Sudan, Sheet erosion, Fallowing, Cropland, Vegetation, Conservation, Land use.

Field studies of erosion on the Mossi plateau, central Upper Volta, indicated that traditional methods (numerous low filtering structures and restoration of soil fertility) are the most suitable strategies for stopping desertification at the Sahel border. At the four sites in the study area rainfall variability and intensities are high, the ferruginous soils or vertisols have low permeabilities, and the vegetation cover is poor as a result of overgrazing, bush fires, and extensive cultivation. Runoff on four study plots was 20-40% per year on overgrazed and extensively cultivated lands. Runoff reached 70% during heavy showers. Soil losses were considerable even at the <2% slope. Fine particles, organic matter, and nutrients were selectively carried away, leaving a sandy or gravelly skeleton unable to retain water and nutrients. Soil losses were more dependent on the amount of vegetative cover and the roughness of the soil surface than on the soil type or cultivation practices. Compared with bare soil, erosion is reduced to 40% under millet, maize, and sorghum; to 30% under peanut; to 20% under creeping niebe; to 1-4% under young fallow or Congo pea; to 5% under burnt savanna; and to <1% under protected savanna.
W86-03601

SURFACE EROSION AND SEDIMENT CONTROL AT OPEN-CAST MINES IN SOUTHERN AFRICA,
Steffen, Robertson and Kirsten, Inc., Johannesburg (South Africa).

A. Ward, A. Smith, and J. Caldwell.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 517-527, 2 fig, 3 tab, 14 ref.

Descriptors: *Erosion control, *Sediment control, *Coal mining, *Sediment yield, *Soil loss, *Soil conservation, Soil stabilization, Conservation, Sedimentation, Runoff, Rainfall-runoff relationships, Drainage systems, South Africa.

Severe erosion from surface mining of coal occurs in the following locations: topsoil stockpiles, spoil piles, waste dumps, bare topsoil areas, steep outslopes, ramps, and haul roads. Many sediment control techniques are available. Surface stabilization reduces erosion until a vegetative cover can be established. Methods of achieving this include mulches and chemical stabilizers (expensive and temporary), and matting and netting (good for steep slopes). Landscaping activities should be done with agricultural equipment rather than heavy mining equipment. Drainage control is very important in reducing the volume and velocity of flows crossing disturbed areas and to prevent mixing of clean and dirty flows. Clean systems divert water from undisturbed areas away from disturbed areas; dirty systems collect water from disturbed areas and convey it to treatment facilities. Sediment can be removed from a flow by gravity settling, cyclones, check dams, vegetative filters (grass and reeds), barriers and fences (hay bales, etc.), and filter fabric fences (semipermeable fabrics). Removing colloidal particles from sediment requires sediment ponds or chemical flocculation. The methodology described has been applied to a proposed South African mine site. Calculations show that, without careful management and sediment control, severe erosion would occur. For this particular site, diversion ditches, terracing, and sediment ponds are suggested.
W86-03602

INDIGENOUS SOIL CONSERVATION STUDIES IN SIERRA LEONE,

Reading Univ. (England). Dept. of Geography.
A. C. Millington.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 529-538, 5 tab, 15 ref.

Descriptors: *Erosion control, *Soil conservation, *Agriculture, Sierra Leone, *Soil loss, Conservation, Slopes, Drainage, Bunding, Cultivation, Sheet erosion, Mulching, Cover crops, Terracing, Sediment control.

The indigenous soil conservation practices in Sierra Leone were surveyed. The 44 categories of conservation strategies were divided into mechanical (impedance of sheet flow, site selection, modification of the cultivation system) and biological (adjustment of cultivation techniques such as timing of different tasks, mulching, and cover cropping). Use of a single conservation method was most common (61.18%). Five levels of sophistication were described, each using more complicated combinations of individual methods. Bunding with sticks and/or stones was the most commonly used technique. Slightly less favored were, in descending order, drainage of excess surface water, mulching and cover cropping. Experiments on bunding techniques showed that the sticks or stones used in construction are commonly available. Labor required for bunding techniques was on the order of 15-30 man hours to build a 100 m length compared with 808 man hours to construct 100 m of bench terracing. Soil losses were 4.40-29.49 t per ha per year, contour bunding being most effective. Using no conservation technique, soil losses were up to 55.1 t per ha per year.
W86-03603

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

STUDIES ON ANALYTICAL METHOD OF ACRYLAMIDE MONOMER AND ACCUMULATION INTO FISH,

Tsukuba Univ. (Japan). Inst. of Community Medicine.
For primary bibliographic entry see Field 5B.
W86-03466

ANALYSIS OF CHLORINATED ORGANIC COMPOUNDS FORMED DURING CHLORINATION OF WASTEWATER PRODUCTS,

North Texas State Univ., Denton.
W. H. Glaze, J. L. Burleson, J. E. Henderson, P. C. Jones, and W. Kinstley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-144444, Price codes: A09 in paper copy, A01 in microfiche. EPA-600/4-82-072, December 1982. 180 p, 40 fig, 34 tab, 169 ref, 2 append.

Descriptors: *Wastewater analysis, *Wastewater composition, *Chlorinated hydrocarbons, Chlorination, Wastewater treatment, Water treatment, Gas chromatography, Chromatography, Mass spectrometry, Hydrocarbons.

Chemical byproducts produced during the chlorination of municipal wastewater were examined in a study that employed several specially modified analytical methodologies. Volatile byproducts were examined by the use of gas chromatography with selective detectors and gas chromatography/mass spectrometry (GC/MS). Using XAD resins for concentration of trace organics in the wastewater samples before and after chlorination, a number of chlorinated aromatic and aliphatic compounds were found after chlorination and superchlorination. A rapid and convenient microextraction method was developed that is suitable for the analysis of trihalomethanes and other volatile halogenated organics at the microgram/l level in water. Also, a computer program was developed that may be used in conjunction with a GC/MS computertized data system for thee identification of polyhalogenated compounds present as minor components in a complex chemical mixture. A procedure also was developed to determine the concentrations of amino acids in wastewaters, sludges and septage, before and after chlorination. Two chlorinated derivatives of tyrosine were found in a superchlorinated septage sample. Nonvolatile compounds in natural waters and municipal wastewaters, before and after chlorination, were studied by high performance liquid chromatography. Fractions collected before chlorination of the sample showed that trihalomethane formation potential was spread throughout the natural polymer. (Author)
W86-03496

DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN INDUSTRIAL DISCHARGES AND OTHER AQUEOUS EFFLUENTS,

Norsk Inst. for Vannforskning, Oslo.
L. Berglind.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-135608. Price codes: A02 in paper copy, A01 in microfiche. Nordic PAH Project Report No 16, January 1982. 18 p, 5 tab, 11 ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Aromatic compounds, *Drinking water, *Surface water, *Water pollution sources, Hydrocarbons, Pollutant identification, Water analysis, Wastewater analysis, Industrial wastes, Carcinogens, Wastewater, Industrial wastewater, Runoff, Effluents, Precipitation.

As a part of an inter-Nordic research program on polycyclic aromatic hydrocarbons (PAH) in the environment, different sources of PAH to Norwegian waters have been investigated. Some samples of surface water and drinking water have also been analyzed. PAH concentrations in an aluminum smelter daily discharge were estimated to be 73 kg of which 6.5 kg are carcinogenic. In a ferro alloy smelter, the PAH concentrations in the daily discharge were 9.7 kg of which about 0.9 kg are carcinogenic. The PAH concentration in the daily discharge of an ironworks was estimated to be 93.4 kg of which 19.2 kg are carcinogenic. The total PAH discharge from the coke works to the Ranafjord was estimated to be about 23 kg/day of which 0.4 kg are carcinogenic. The discharge of PAH from an oil refinery was estimated to be 0.26 kg/day of which 0.002 kg are carcinogenic compounds. PAH concentrations in runoff from a Norwegian highway ranged from 1772-11604 ng/1. PAH concentrations in various surface water and drinking water samples are also given. (Geiger-PTT)
W86-03506

REPORT OF ANALYSES FOR LIGHT HYDROCARBONS IN GROUND WATER,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
E. L. Dromgoole.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-017300, Price codes: A02 in paper copy, A01 in microfiche. DPST-81-141-19, April 1982. 14 p, 3 fig, 2 tab, 110 ref. DE-AC09-76SR00001.

Descriptors: *Groundwater, *Water quality, *Groundwater pollution, Water pollution, Hydrocarbons, Chemical analysis, Water analysis, Chemical composition, United States, Gas chromatography.

The analyses of 11,659 groundwater samples, collected in 47 western states as part of the National Uranium Resource Evaluation hydrogeochemical and stream sediment reconnaissance program, are described. The analytical techniques, for determination of methane, ethane, propane and butane, along with the descriptive statistics used, are briefly described. The coverage maps and sampling site locations are provided. The data are supplied separately on microfiche along with an explanation of the data codes. (Halterman-PTT)
W86-03512

CONTROL AND MEASUREMENT OF ORGANIC MICROPOLLUTANTS IN SOUTH AFRICAN WATER RECLAMATION PLANTS,

National Inst. for Water Research, Pretoria (South Africa).
J. F. van Rensburg, A. J. Hassett, and S. J. Theron.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 17-34, 6 fig, 5 tab, 35 ref.

Descriptors: *Pollutant identification, *Water conservation, *Water reuse, *Water analysis, *Activated carbon, Conservation, Industrial wastewater, Chromatography, Wastewater renovation, *South Africa, Adsorption, Organic compounds, Water treatment, Recycling.

Several analytical techniques have been evaluated for the determination of organic micropollutants in South African water reclamation plants. An organic pollution index (OPI) was used to express data. In this way water samples were divided into safe and possibly unsafe categories. This allowed the safe samples to be analyzed with less expensive methods than required for the possible unsafe samples. The OPI was suggested as an early warning against pending breakthrough in granular activated carbon treatment systems. The reclamation plants investigated were capable of effectively removing organic industrial and other pollutants in shock-load quantities.
W86-03522

GROSS ORGANICS MEASUREMENTS FOR MONITORING OF WASTEWATER TREATMENT AND REUSE,

TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
M. Michail, and E. Idelovitch.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 35-64, 9 fig, 6 tab, 36 ref.

Descriptors: *Pollutant identification, *Water conservation, *Wastewater analysis, *Water analysis, *Monitoring, Water reuse, Water treatment, Ultraviolet absorbance, Wastewater treatment, Organic carbon, Tel Aviv, *Israel, Biochemical oxygen demand, Chemical oxygen demand, Potassium permanganate, Oxygen demand, Chemical analysis.

Nine types of water from the Dan region sewage reclamation project at Tel Aviv, Israel, were analyzed using six gross organic parameters: BOD, COD, total organic carbon, dissolved organic carbon, potassium permanganate consumption, and ultraviolet (UV) absorbance at 254 nm. The water samples included raw wastewater, secondary effluent, tertiary effluent, reclaimed water, and tap water. Good to very high correlation coefficients were obtained for most parameters. Results indicated that UV absorbance was suitable for routine monitoring of gross organics in wastewater treatment and reuse. UV is particularly useful for monitoring of organic matter in municipal raw wastewater feeding the treatment plant, for detection of organic-laden industrial wastes, for monitoring of activated sludge plant performance with respect to carbonaceous matter, for monitoring of the organic quality of reclaimed water, for tracing effluent movement in aquifers, and for monitoring of advanced wastewater treatment plant performance with respect to organics. When using UV absorbance to measure gross organics, it was suggested that good correlations be established for each type of water.
W86-03523

DETERMINATION OF CARBOHYDRATES AND PRIMARY AMINES IN RIVER WATER,

Minnesota Univ., Minneapolis. Dept. of Chemistry.
L. E. Conroy, W. J. Maier, and Y-T. Shih.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 65-84, 8 fig, 6 tab, 19 ref. NSF/ENV 77-04496.

Descriptors: *Fate of pollutants, *Pollutant identification, *Organic carbon, Rivers, Mississippi River, Carbohydrates, Amines, Dissolved solids, Anthrone method, Seasonal variation, Fluorescamine.

For assay of soluble organic species in river water, the anthrone test and the fluorescamine reagent proved most sensitive and reliable for carbohydrates and amines, respectively. Water samples were taken at four locations in the Upper Mississippi River from the headwaters to the Twin Cities area. These sites represented, in order from headwaters to downstream, natural background, agricultural drainage, urban runoff, and a major wastewater discharge. Total soluble carbohydrates increased from 289 micrograms per liter in the headwaters to 792 micrograms per liter at the furthest downstream station. Total primary amine levels were 7-20 times less than carbohydrate levels. The total concentrations of amines were 25.72, 39.68, 33.84, and 32.75 micrograms per liter, progressing downstream. Seasonal variation in percentage of molecular size was noted. This was related to the change in the source of organic matter (groundwater vs. runoff). The distribution of dissolved organic carbon was as follows: the 1K-10K fraction was the largest, the <1K fraction was second in importance, and very little was in the >10K fraction.
W86-03524

ULTRAVIOLET MULTIWAVELENGTH ABSORBANCE MEASUREMENTS FOR MONITORING TRACE ORGANICS IN WATER,

Minnesota Univ., Minneapolis.
W. J. Maier, and L. E. Conroy.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 85-145, 26 fig, 9 tab, 24 ref, 2 append.

Descriptors: *Fate of pollutants, *Pollutant identification, *Organic carbon, *Water analysis, Rivers, Mississippi River, Ultraviolet absorbance, Dissolved solids, Seasonal variation.

Comparison of model compounds identified by absorbance matching shows the same chromophoric units, indicating that the organic constituents of the 1-10K molecular size fractionates of Upper Mississippi River water have similar absorbance characteristics regardless of season or geographical location. Five major model compounds, namely vanillin, 3,4-dimethoxyacetophenone, tannic, p-anisic and mellitic acids (VATAM), and no others, are consistently identified by ultraviolet absorbance matching calculations. None of these compounds are found in the <0.5K fractions. In the 0.5-1K fractions the same five model compounds are present, but at lower concentrations and in different proportions. The similarities in UV spectral and molecular size characteristics of organics in this river stretch with total flow times of 20-30 days and flow variations of 86 to 883 cu m per sec lead to the following hypothesis: (1) VATAM-characterized polymers are formed throughout the whole watershed, (2) the polymers are chemically and biologically relatively stable, (3) they predominate the 1-10K molecular size range, (4) they account for most of the total organic carbon but are less significant in winter, and (5) the presence of a greater diversity of chromophores and a correspondingly smaller concentration of VATAM polymer in winter is ascribed to slower chemical-biological reaction rates.
W86-03525

DEVELOPMENT OF A TOC/COD ANALYZER FOR PROCESS APPLICATIONS,

Life Systems, Inc., Cleveland, OH.
J. B. Lantz, R. J. Davenport, R. A. Wynveen, and W. J. Cooper.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 147-163, 8 fig, 3 tab, 7 ref.

Descriptors: *Pollutant identification, *Monitoring, *Organic carbon, *Water analysis, Wastewater analysis, Chemical oxygen demand, Automation, Measuring instruments.

An analyzer for total organic carbon/chemical oxygen demand has been developed. The analytical package incorporates six processes: electrochemical generation of the persulfate from an acidic electrolyte, continuous sampling and mixing of the sample with the electrolyte and persulfate, removal of inorganic carbon from the sample, oxidation of the organics, measurement of the carbon dioxide produced and persulfate consumed in the oxidation, and elimination of water introduced during sampling. The apparatus is designed to operate over a concentration range of 0.5-500 mg per liter total organic carbon and 100-1500 mg per liter COD. The system has many automatic features for on-line monitoring and interface with computer control systems.
W86-03526

CHEMICAL AND MICROBIOLOGICAL MONITORING OF A SOLE-SOURCE AQUIFER INTENDED FOR ARTIFICIAL RECHARGE, NASSAU COUNTY, NEW YORK,

Geological Survey, Towson, MD. Water Resources Div.
B. G. Katz, and G. E. Mallard.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 165-183, 4 fig, 5 tab, 19 ref.

Descriptors: *Pollutant identification, *Water analysis, *Water pollution sources, Water quality, Recharge, *Artificial recharge, Aquifers, Nassau County, *New York, Groundwater recharge, *Water reuse, Monitoring, Baseline studies, Septic tanks, Cesspools, Organic compounds, Chlorinated hydrocarbons, Bacterial analysis.

The Cedar Creek water reclamation project in Nassau County, New York, was designed to study the feasibility of recharging the groundwater reservoir with reclaimed water. Baseline information on water quality was gathered by sampling in observation wells at depths of 50, 100, and 200 ft below land surface. Preliminary results indicated that groundwater at the recharge site contained elevated concentrations of nitrate, chloride, sulfate, and ammonium ions; however, the concentrations of these ions generally decreased with depth. Chlorinated hydrocarbons (low-molecular weight, pesticides, and polychlorinated biphenyls) were present in significant concentrations in the upper glacial aquifer and Magothy aquifer. Fecal indicator bacteria were found in very few cases in low numbers. Sources of pollution in this area are cesspool and septic tank effluent, domestic cleaners and solvents, fertilizers, insecticides for pest control, and storm water runoff.
W86-03527

QUALITY ASSURANCE FOR WATER AND WASTEWATER ANALYSES,

Environmental Protection Agency, Cincinnati, OH.
J. A. Winter.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 187-205, 2 fig, 5 tab, 6 ref.

Descriptors: *Pollutant identification, *Quality control, *Water analysis, *Wastewater analysis, Water reuse, Chemical analysis, Monitoring.

The EPA quality assurance program for analysis of water and wastewater has the following major functions: develop/select methodology, conduct an equivalency program for approval of alternative test procedures, develop manuals and guidelines, maintain a quality control check sample program, conduct method validation studies, conduct performance evaluation studies, and maintain the EPA repository for toxic and hazardous materials. In the future, laboratories involved in water reuse research and development may be required to participate in quality assurance activities. In preparation for formal involvement in a program, laboratories should take advantage of relevant method validation and performance studies as available and of the wide range of quality control samples in the EPA program for water and wastewater monitoring.
W86-03528

PRIORITY POLLUTANT METHODOLOGY QUALITY ASSURANCE REVIEW,

Environmental Protection Agency, Kansas City, MO. Region VII.
R. D. Kleopfer, J. R. Dias, and B. J. Fairless.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 207-227, 9 tab, 16 ref. 68-01-3857, 4689, and 3852.

Descriptors: *Pollutant identification, *Wastewater analysis, *Organic compounds, *Quality control, Chromatography, Pesticides, Insecticides, Metals, Phenols, Cyanide, Trace levels.

The results of 10,000 measurements by seven laboratories on 104 of the 114 organic priority pollutants, all the metals, and total phenol and cyanide are summarized. The wastewater samples are screened for organics by analyses of five fractions: pesticides (26 compounds), base/neutrals (46 compounds), acids (11 phenols), purgeables (29 volatile organics), and direct aqueous injection (2 compounds). Except for purgeable organics, overall recovery decreases and the relative standard deviation increases in going from the method standard to the matrix spiked analysis. Analysis of purgeable and acid organic compounds produces the highest recoveries with the smallest matrix effect. The analysis of base/neutral compounds and pesticides gives the lowest recoveries because they react among each other and with hydroxide and water. Base/neutral compounds also carry over into the acid fraction in the presence of emulsions. Analysis of purgeable organics by the EPA protocol has

been most successful; acid and pesticide analyses, moderately successful; and base/neutral analysis less successful, especially with samples from the leather tanning and timber industries. Metals analyses are not difficult at the 25 ppb level used. Analyses of several compounds presented problems and are recommended for further investigation: dichloromethane, bis(chloromethyl) ether, N-nitrosodimethylamine, di-n-butylphthalate, bis(2-ethylhexyl) phthalate, 1,2-diphenylhydrazine, benzidine, hexachlorocyclopentadine, endrin aldehyde, anthrene and phenanthrene, chrysene and benzo(a)anthracene, and benzo(b)fluoranthrene and benzo(k)fluoranthrene.
W86-03529

QUALITY ASSURANCE IN THE EVALUATION OF POLLUTION CONTROL TECHNOLOGY: EXPERIENCES AT THE INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY, U.S. ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OHIO,

Industrial Environmental Research Lab.-Cincinnati, OH.
P. E. Mills.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 229-244, 1 fig, 3 tab, 25 ref.

Descriptors: *Pollutant identification, *Quality control, *Wastewater analysis, *Industrial wastewater, Water conservation, Recycling, Industrial Environmental Research Laboratory, Chemical analysis, Measuring instruments, Monitoring.

The quality assurance program of the Industrial Environmental Research Laboratory (IERL), Environmental Protection Agency, is designed to improve, assure, assess, and document the quality of measurements made and reported in connection with its research. Some of the program's function are to (1) review sampling and analytical plans, (2) approve quality assurance review forms, (3) provide audit samples, (4) approve alternative analytical methods, (5) aid in development of new instruments and methods, (6) conduct audits at field sites and analytical laboratories, and (7) provide quality assurance training. IERL is involved in several projects related to recycle/reuse of industrial wastewater. Research priorities include addition of chemicals to the priority pollutant list, development of better continuous monitoring techniques, selection of representative monitoring parameters, selection of standard reference materials representative of recycle/reuse matrixes, sponsoring of interlaboratory comparisons of new methods and reference materials, and development of testing procedures for sludge.
W86-03530

USE OF LOG-NORMAL STATISTICS IN ENVIRONMENTAL MONITORING,

For primary bibliographic entry see Field 7C.
W86-03531

BIOLOGICAL EVALUATION OF METHODS FOR THE DETERMINATION OF FREE AVAILABLE CHLORINE,

Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
M. C. Snead, V. P. Olivieri, and W. H. Dennis.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 401-427, 10 fig, 3 tab, 34 ref.

Descriptors: *Pollutant identification, *Chlorine, *Disinfection, *Water analysis, Residual chlorine, Chloramines, Viruses, Biofac process, Membranes.

All of the methods tested for measurement of free chlorine residuals--N,N-diethyl-p-phenylene diamine (DPD), syringaldazine (FACTS), amperometric titration, and membrane electrode--yield false positive determinations with one or more of the inorganic chloramines. A fundamental understanding of chlorine chemistry and the particular test procedure employed is an absolute necessity. The Steadifac modification of the DPD procedure reduces the frequency and magnitude of false positives obtained. Thioacetamide appears to selectively decolor the product of the DPD-monochloramine reaction. The biological calibration procedure, Biofac, clearly differentiates and quantifies free chlorine, and may have possible extension for other disinfectants. The FACTS procedure was the most specific for free chlorine. Variability of reagent preparations of FACTS limits the quantitative use of this test, in its present form, to the laboratory. Specificity of the DPD reagent was found to vary with the form of the reagent, with the tablet reagent consistently yielding fewer false positives than the powder reagent. The membrane electrode compares favorably with the other procedures for the measurement of free chlorine in the absence of combined chlorine, but was not as specific as DPD and FACTS in the presence of combined chlorine. (Author)
W86-03539

CHLORINE DIOXIDE CHEMISTRY: GENERATION AND RESIDUAL ANALYSIS,

Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-03540

DETERMINATION OF CHLORINE DIOXIDE,

Fischer and Porter, Co., Warminster, PA.
R. G. Stevenson, L. L. Dailey, and B. J. Ratigan.
IN: Chemistry in Water Reuse: Volume I, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 453-476, 11 fig, 58 ref.

Descriptors: *Pollutant identification, *Chlorine dioxide, Residual chlorine, Measuring instruments, Monitoring, Automation, Spectrophotometry, Titrimetric methods, Electrochemistry, Membrane amperometric probe.

Several methods for determination of chlorine dioxide are evaluated for their use in automated or continuous analysis. Direct spectrophotometry at 360 nm is reasonably accurate within the limits of 6-60 mg per liter, provided the cell size is adapted to the concentration. Spectrophotometry with chromagenic reagents is sensitive and accurate but has several drawbacks for continuous monitoring. Titrimetric methods are often used. However, iodine-producing substances interfere with the iodometric method. Several sources of error and possible corrective measures are given. Except for amperometric endpoint detection, electrochemical methods are seldom used for chlorine dioxide determination. Two flow-through amperometric cells seem suitable for continuous electrochemical analysis. The membrane amperometric probe, with no moving parts and no reagent feed, is available for continuous monitoring.
W86-03541

GROUNDWATER QUALITY EVOLUTION IN THE UPPER AQUIFER OF THE COASTAL DUNE AREA OF THE WESTERN NETHERLANDS,

Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
For primary bibliographic entry see Field 2F.
W86-03761

ADVANCES IN THE IDENTIFICATION AND ANALYSIS OF ORGANIC POLLUTANTS IN WATER, VOLUME 1.

Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Lawrence H. Keith. 2 v (1170 p).

Descriptors: *Pollutant identification, *Water analysis, *Wastewater analysis, *Organic compounds, *Chromatography, Gas chromatography, Liquid chromatography, Mass spectrometry, Ion exchange, Resins, Master Analytical Scheme, Aromatic compounds, Phenolic compounds, Pesticides, Industrial wastewater, Chlorine compounds, Trihalomethanes, Polychlorinated biphenyls, Tracers, Environmental tracers, Extraction.

Most of the advances in identification and analysis of organic pollutants in water have involved refinements of existing technology. The Master Analytical Scheme is the subject of several papers, divided into an overview, isolation/concentration, precision and accuracy, quantitative aspect, and quality control. A general approach for determination of pesticides in wastewater has been successfully applied to five general classes of compounds. High-resolution gas chromatographic methods have been developed for phenolic compounds; acid-extractable priority pollutants; volatile, base/neutral, and acidic pollutants; and polychlorinated biphenyls. Isotope dilution of organic molecules and tagging with dysprosium compounds are techniques used as environmental tracers. Microextraction techniques are effective and time saving in preparing water samples for organics analysis. This permits chromatography without preconcentration of the sample. Resins are also used to concentrate organic compounds, particularly polyaromatic hydrocarbons, for chromatographic analysis. High-performance liquid chromatography is applied to analysis of nitrophenols, humic-fulvic natural materials, and nitrosamines. Fluroimmunoassay is being developed for determination of very low levels of organic pollutants. Derivatization proved useful in labeling potential mutagens in drinking water with 4-nitrophenol and for determination of linear alcohol ethoxylates.
W86-03791

VALIDATION AND PRIORITY POLLUTANT ANALYSIS,

Dow Chemical U.S.A., Midland, MI.
R. O. Kagel.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 1-13, 1 fig, 1 tab, 21 ref.

Descriptors: *Pollutant identification, *Legal aspects, *Organic compounds, *Water analysis, Regulations.

There are sound technical arguments for the validation of priority pollutant methodology. These arguments are intricately entwined with legal issues that will ultimately be argued in the courts. The technical issues should be resolved by the technical community. The merits of these issues are what lawyers should be left to resolve, rather than the issues themselves. Roisman, former environmentalist lawyer who heads the Justice Department's toxic waste section, recently gave some guiding philosophy behind the government's legal-environmental movement in that area when he said: 'Government is perfectly prepared to punish the innocent for the sins of the guilty.' An analytical result may very well be the infinitesimally fine line that separates the guilty from the innocent. Unless the analytical methodology is properly validated and the result statistically meaningful, that fine dividing line might as well be determined by chance, a flip of the coin or a roll of the dice. (Author)
W86-03792

MASTER ANALYTICAL SCHEME: AN OVERVIEW OF INTERIM PROCEDURES,

Environmental Research Lab., Athens, GA.
A. W. Garrison, A. L. Alford, J. S. Craig, J. J. Ellington, and A. F. Haeberer.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 17-30, 1 fig, 2 tab, 5 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, *Chromatography, Master Analytical Scheme, Gas chromatography, Standards, Wastewater analysis, Effluents.

The Master Analytical Scheme (MAS) provides protocols for the gas chromatography/mass spectrometry analysis of purgeable, extractable, neutral intractable, and ionic intractable organics in surface and drinking water and in industrial, energy-related and municipal effluents. Nominal lower quantifiable limits are 0.1 micrograms/liter for drinking water, 1 microgram/liter for surface water, and 10 micrograms/liter for the effluents. One unique feature of the MAS is its comprehensiveness. Another is its qualitative-quantitative aspect--an extensive data base of response and re-

covery factors allows computer estimation of concentration without recourse to standards for each analyte. This interim MAS will be refined to correct deficiencies observed during analysis of environmental samples. (Author)
W86-03793

MASTER ANALYTICAL SCHEME: DEVELOPMENT OF EFFECTIVE TECHNIQUES FOR ISOLATION AND CONCENTRATION OF ORGANICS IN WATER,

Gulf South Research Inst., New Orleans, LA.
J. E. Gebhart, J. F. Ryan, R. D. Cox, E. D. Pellizzari, and L. C. Michael.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 31-48, 6 fig, 8 tab, 7 ref. 68-03-2704.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, *Chromatography, Master Analytical Scheme, Gas chromatography, Amines, Carboxylic acids, Organic acids, Extraction, Ion exchange, Resins, Wastewater analysis.

The Master Analytical Scheme methodology states that a water sample for analysis of organic compounds is divided into a minimum of three aliquots. One aliquot is analyzed for purgeable or highly volatile compounds; one for intractable or water-soluble, nonextractable, nonpurgeable compounds; and one for extractable organics. Analysis of purgeable organics uses gas stripping followed by gas chromatography/mass spectrometry/computer using capillary columns. The intractables are divided into several types. Nonionic intractables (e.g., methanol) are isolated by fractional distillation and analyzed on a Carbowax 1500 column. Ionic intractables, separated by ion exchange resin techniques, include the following groups: volatile primary and secondary amines, volatile carboxylic acids, nonvolatile organic acids, and halogenated carboxylic acids. Three procedures are available for analysis of extractable organics: resin columns for clean samples, batch liquid/liquid extraction treated by a bottle-stirbar technique for more contaminated samples, and a flow-under continuous liquid/liquid extraction method for emulsion-forming samples. Recovery data are given for compounds fitting these categories.
W86-03794

MASTER ANALYTICAL SCHEME: AN ASSESSMENT OF FACTORS INFLUENCING PRECISION AND ACCURACY OF GAS CHROMATOGRAPHY/MASS SPECTROMETRY DATA,

Gulf South Research Inst., New Orleans, LA.
J. F. Ryan, J. E. Gebhart, L. C. Rando, D. L. Perry, and K. E. Tomer.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 49-66, 5 fig, 11 tab, 2 ref. 68-03-2704.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, *Mass spectrometry, *Chromatography, Gas chromatography, Precision, Accuracy, Coefficient of variation, Master Analytical Scheme, Retention time, Standards, Amines, Hydrocarbons, Aromatic compounds, Phenolic compounds.

The data in this paper present the most significant aspects of the work on precision and accuracy in quantification. Results of a number of additional experiments that produced additional conclusions are: (1) Total ion current (TIC) relative response ratio values are no more precise than selected ion current (SIC) relative response ratio values; additionally, TIC quantification measurements are susceptible to error because of chromatographic peak heterogeneity. For these reasons, the Master Analytical Scheme is based on SIC relative response ratio values. (2) Mass difference between the selected quantifying ion of an internal standard and the selected quantifying ion of the unknown compound had no effect. No reduction was found in the percent coefficient of variation when the Dalton value separation was small rather than large. (3) No concentration dependence of relative response ratio was observed over a two-order-of-magnitude range. Although relative response ratio precision is not enhanced by a chemical similarity between internal standard and compound of interest, it is enhanced by the retention time proximity between the two. Finally, relative response ratio can vary considerably over different days (and be corrected when necessary) but be precise on a single day. (Author)
W86-03795

QUANTITATIVE ASPECTS OF THE MASTER ANALYTICAL SCHEME FOR ORGANICS IN WATER,

Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
K. B. Tomer, J. T. Bursey, L. C. Michael, L. S. Sheldon, and E. D. Pellizzari.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 67-85, 3 fig, 14 tab, 5 ref. 68-03-2704.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, Master Analytical Scheme, Chromatography, Quantitative analysis, Mass spectrometry, Wastewater analysis, Precision, Accuracy.

The first-generation Master Analytical Scheme has been applied to a series of water samples in one laboratory and to replicate water samples analyzed independently by three laboratories. The accuracy found was, on the most part, within the limits expected on the basis of propagation of error. The Master Analytical Scheme, therefore, promises to be an extremely useful tool for the qualitative-quantitative analysis of organics in a broad range of water samples. (Author)
W86-03796

QUALITY OF MASTER ANALYTICAL SCHEME DATA: PURGEABLES AND VOLATILE ORGANIC ACIDS,

Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
L. C. Michael, R. Wiseman, and L. S. Sheldon.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 87-114, 11 fig, 14 tab, 5 ref. 68-03-2704.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, Wastewater analysis, Master Analytical Scheme, Chromatography, Gas chromatography, Mass spectroscopy, Organic acids, Quality control, Standards.

Quality assurance procedures were applied to method development, validation, and application phases for purgeable and volatile acid segments of a Master Analytical Scheme for the analysis of organic compounds in water. Recovery data demonstrate the applicability of the various techniques to diverse water types. Error propagation estimates for purge-and-trap indicate a relative standard deviation of +23 to -28%, excluding gas chromatography/mass spectrometry/computer. A similar estimation for volatile acid analysis reveals a relative standard deviation of + or - 11%. For each sample to be analyzed, preanalysis sample scouting (headspace analysis for purgeables and conductivity measurements for volatile acids) was used to determine the optimum sample volume and level of internal standard to be added. Gas chromatography/mass spectrometry/computer analysis was performed to demonstrate the applicability of the purge-and-trap and volatile acid Master Analytical Scheme protocols to complex and diverse water types. A total of 19 environmental water samples, unspiked and spiked with mode compounds and deuterated internal standards, were analyzed. (Author)
W86-03797

DEVELOPMENT OF METHODS FOR PESTICIDES IN WASTEWATER: APPLICABILITY OF A GENERAL APPROACH,

Midwest Research Inst., Kansas City, MO.
H. Miller, P. Cramer, A. Drinkwine, A. Shan, and G. Trischan.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 115-138, 4 fig, 14 tab, 4 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Pesticides, *Water analysis, Insecticides, Triazines, Carbamates.

A standard approach for analyzing pesticides in water and wastewater samples was developed and tested on several classes of compounds: organochlorine, organonitrogen, organophosphorous, triazines, and carbamates/ureas. The steps in the method utilized one-liter sample volumes extracted with three 60-ml aliquots of methylene chloride followed by Kuderna-Danish concentration, and standardized Florisil cleanup, if required. Generally, recoveries for clean water extraction, seven-day stability, and spiked wastewater were good. The major source of reduced recovery was cleanup. Some pesticides, particularly the organophosphorus type, were retained on the Florisil or alumina column. Detection limits obtained when using the protocol were as follows (concentrations in micrograms/liter): 0.1-1.0, 80%; 1-10, 94%; and 10-100, 100%. Analysis of a group of 10 triazines was given as a case study.
W86-03798

DETERMINATION OF PHENOLIC WATER POLLUTANTS BY GLASS CAPILLARY GAS CHROMATOGRAPHY,

W. Giger, and C. Schaffner.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor, MI. 1981. p 141-154, 6 fig, 2 tab, 14 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Organic compounds, *Phenolic compounds, *Industrial wastewater, Chromatography, Gas chromatography, Quantitative analysis, Chlorophenols, Pulp wastes, Chemical wastewater.

A method for the quantitative determination of lipophilic phenols, including priority pollutants and consensus voluntary reference compounds, used methylene chloride extraction of the water sample using 2,4,6-tribromophenol as an internal standard, followed by gas chromatography with a flame ionization detector. Identification was by mass spectrometry. Recoveries were as follows: phenol, 29%; 2-chlorophenol, 83%; 2,4-dichlorophenol, 92%; 4-chloro-3-methylphenol, 46%; 2,4,6-trichlorophenol, 89%; 2,3,4,6-tetrachlorophenol, 92%; pentachlorophenol, 83%; 4-chlorophenol, 26%; 1-naphthol, <5%; 4-phenylphenol, <5%; and 2,6-di-tert-butyl-4-methylphenol, 60%. Chromatograms of several industrial wastewater samples are shown.
W86-03799

CHROMATOGRAPHIC CONSIDERATIONS FOR THE ANALYSIS OF ACID-EXTRACTABLE PRIORITY POLLUTANTS,

Hewlett-Packard Co., Avondale, PA. Avondale Div.
R. R. Freeman.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 155-169, 11 fig, 1 tab, 13 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Organic compounds, *Phenolic compounds, Quantitative analysis.

Underivatized phenols were quantitatively analyzed at the microgram/liter level using fused-silica open tubular columns with a cool on-column sampling system. The chromatographic conditions were chosen to accomodate for the sample concentrations. Above 5 ng the suitable techniques were an on-column or splitless injection and a fused-silica open tubular column characterized by an acidic column (acid-to-neutral surface) coated with a gum nonpolar stationary phase. At this level glassware should be acid-deactivated for use with

chlorophenols and nitrophenols. At the sub-nanogram level the analysis was difficult but possible with on-column injection, a nonpolar fused-silica column, and a silica detector interface.
W86-03800

PART-PER-TRILLION ANALYSIS OF VOLATILE, BASE/NEUTRAL AND ACIDIC WATER CONTAMINANTS ON A SINGLE FUSED-SILICA CAPILLARY COLUMN,

Montgomery (James M.), Inc., Pasadena, CA.
A. R. Trussell, F-Y. Lieu, and J. G. Moncur.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 171-186, 6 fig, 2 tab, 3 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Chromatography, Fused silica columns, Chlorinated hydrocarbons, Pesticides, Aromatic compounds.

The most commonly used chromatographic techniques for the analysis of purgeable and extractable organic water contaminants call for the use of four different packed columns. The techniques presented in this paper represent a simplified chromatographic procedure which yields improved sensitivity and resolution. A single fused-silica open tubular capillary column can be used for analysis of volatile, base/neutral/acidic, and pesticide fraction organic contaminants in water. Many of the compounds tested could be recovered from water at the low part-per-trillion level range. Considerable time saving is afforded by the use of the single column for both volatile and extractable water contaminants. Coinjection of both base/neutral and acid fractions in the same chromatographic run allows further time saving. (Author)
W86-03801

ANALYSIS OF POLYCHLORINATED BIPHENYLS BY GLASS CAPILLARY AND PACKED-COLUMN CHROMATOGRAPHY,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
M. D. Mullin, and J. C. Filkins.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 187-196, 8 fig, 25 ref. R-806579.

Descriptors: *Pollutant identification, *Organic compounds, *Polychlorinated biphenyls, *Chlorinated hydrocarbons, Aroclors, Chromatography, Glass capillary chromatography, Gas chromatography.

A high-resolution glass capillary gas chromatography was used to identify commercial polychlorinated biphenyl mixtures, Aroclors 1242 and 1260. Chromatographic conditions were varied to achieve desired results--higher pressure decreased analysis time but decreased resolution; hydrogen as a carrier gas produced shorter analysis times and greater sensitivity than nitrogen.
W86-03802

HIGH-RESOLUTION GAS CHROMATOGRAPHY AND NEGATIVE ION CHEMICAL IONIZATION MASS SPECTROMETRY OF POLYCHLORINATED BIPHENYLS,

Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
E. D. Pellizzari, K. B. Tomer, and M. A. Moseley.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 197-218, 18 fig, 4 tab., 14 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Polychlorinated biphenyls, Chlorinated hydrocarbons, Aroclors, Chromatography, Negative ion chemical ionization, Mass spectrometry, Gas chromatography.

An investigation into the preparation of better capillary columns for resolving polychlorinated biphenyl (PCB) isomers was conducted. Excellent resolution and temperature stability were obtained for an Apiezon L phase (0.1-micron film thickness) coated on a silanized surface of a Pyrex capillary 0.20 mm i.d. x 50 m in length. Studies were conducted on moderating and reagent gases used in negative ion chemical ionization/mass spectrometry for enhancing either m/z 35/37 or molecular ions of PCB using a magnetic sector and quadrupole gas chromatography/mass spectrometry systems. Open and closed sources were compared. Oxygen-enhanced methane gave best conditions for optimum molecular ion intensities, while pure methane was most suitable with an open source design for enhanced m/z 35.37. The combination of high-resolution gas chromatography and negative ion chemical ionization/mass spectrometry provides an instrumental method for environmental analysis which can be used for identifying or verifying PCB isomers, determining the number of chlorines in a chromatographic peak, and quantifying each individual isomer in a sample. (Author)
W86-03803

DETERMINATION OF PRIORITY POLLUTANTS IN INDUSTRIAL WASTEWATERS BY STABLE-ISOTOPE DILUTION GAS CHROMATOGRAPHY/MASS SPECTROMETRY,

S-Cubed, La Jolla, CA.
B. N. Colby, and A. E. Rosecrance.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 221-230, 3 fig, 5 tab, 3 ref. 68-02-3153, 68-02-2689.

Descriptors: *Pollutant identification, *Organic compounds, *Wastewater analysis, *Industrial wastewater, Isotope dilution, Chromatography, Gas chromatography, Mass spectrometry, Quality control, Standards.

Isotope dilution quantification was shown to improve precision, accuracy, and quality control in determination of priority pollutants in industrial wastewater compared with existing methods (internal standard and no internal standard). Tests were run on water solutions containing varying concentrations of benzene, toluene, chloroform, and 1,2-dichloroethane. Using actual wastewater samples spiked with labeled priority pollutants, it was demonstrated that isotope dilution produced the same recoveries as samples spiked with unlabeled compounds. The character and source of wastewater did not affect the precision or accuracy of the isotope dilution method. Incorporating isotope dilution into a quality control program would reduce the number of sample analyses by 70% without reducing the amount of data obtained.
W86-03804

STABLE ACTIVABLE TRACERS FOR ENVIRONMENTALLY SIGNIFICANT ORGANIC MOLECULES,

Oregon State Univ., Corvallis. Dept. of Chemistry.
L. M. Ghannam, W. D. Loveland, and D. J. Baumgartner.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 231-238, 3 fig, 2 tab, 20 ref.

Descriptors: *Pollutant identification, *Tracers, *Organic compounds, *Bioaccumulation, Oysters, Environmental tracers, Dysprosium compounds, Partition coefficients, Accumulation.

Dysprosium(III) triadibenzolmethane monohydrate and dysprosium(III) triacetylacetonate trihydrate were tested as stable activable tracers for bioconcentration experiments. Both compounds remained soluble and undissociated for 10 days in seawater. Solubilities in octanol and in water for the trisdibenzolmethane compound were 6.176 and 0.006218, respectively; for the triacetylacetonate compound, 34.441 and 1.742, respectively. Octanol/water partition coefficients were 994 and 19.77 for the triadibenzolmethane and triacetylacetonate compounds, respectively. Bioconcentration factors of the tracers in European oyster were in the same range as pesticides with similar partition coefficients.
W86-03805

MICROEXTRACTION AS AN APPROACH TO ANALYSIS FOR PRIORITY POLLUTANTS IN INDUSTRIAL WASTEWATER,

Southwest Research Inst., San Antonio, TX.
J. W. Rhodes, and C. P. Nulton.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1983. p 241-252, 1 fig, 3 tab, 5 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Organic compounds, Extraction, Microextraction, Sample preparation.

A one-step extraction procedure (called microextraction) was developed for analysis of priority pollutants in wastewater samples. Extraction used 200-1000 microliters of solvent for a 10-100-ml sample. After agitation, a few microliters were removed from the organic phase for injection into a gas chromatograph. The microextraction technique showed several advantages over the exhaustive extraction: simplicity of extract preparation, minimal use of glassware and solvent, no problem with emulsions, no necessity for solvent concentration, and no column cleanup of extracts. Equations are given to calculate the extraction efficiency of a solute from a water sample.
W86-03806

EVALUATION OF THE MICROEXTRACTION TECHNIQUE TO ANALYZE ORGANICS IN WATER,

Little (Arthur D.), Inc., Cambridge, MA.
K. E. Thrun, and J. E. Oberholtzer.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI, 1981. p, 253-266, 7 fig, 6 tab, 4 ref. 68-01-5011.

Descriptors: *Pollutant identification, *Wastewater analysis, *Organic compounds, Sample preparation, Extraction, Microextraction, Phthalates, Industrial wastewater, Phenolic compounds, Benzene, Toluene, Ethylbenzene.

Microextraction of organics in water with small amounts of solvent (10-100 ml) and large sample-to-solvent ratios (100:1 or greater) was effective as a cleanup-concentration step in analytical procedures for a variety of compounds. Saturation of the solution with sodium sulfate improved recoveries of the substances studied: benzene, toluene, ethylbenzene, and o-xylene. Recoveries were generally high. However, recoveries that were low were quite reproducible. Using a spiked sample allowed correction for incomplete recovery. The microextraction technique is particularly suitable for nonvolatile substances that have relatively high partition coefficients (greater than 150 to obtain a 60% extraction efficiency at 100:1 sample-to-solvent ratio). The technique was tried on a latex wastewater spiked with solvents. Intermittent 2-min shaking for 15 min produced 56% recovery of benzene, 40% recovery of toluene, and 28% recovery of ethylbenzene. Additional shaking was necessary to increase recovery to at least 90%. Extraction efficiencies for microextraction of phenols from clean water were generally higher than found in other methods. A series of phthalates were recovered efficiently after shaking for 15 min.
W86-03807

FURTHER OPTIMIZATION OF THE PENTANE LIQUID-LIQUID EXTRACTION METHOD FOR THE ANALYSIS OF TRACE ORGANIC COMPOUNDS IN WATER,

North Texas State Univ., Denton. Dept. of Chemistry.
W. H. Glaze, R. Rawley, J. L. Burleson, D. Mapel, and D. R. Scott.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 267-280, 6 fig, 4 tab, 12 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Chlorinated hydrocarbons, Extraction, Liquid/liquid extraction, Sample preparation, Trihalomethanes, Pentane, Trace levels.

A second generation liquid/liquid extraction method is more convenient and rapid for routine trihalomethane analysis. It is also less sensitive to changes in pH and ionic strength. The method involves two steps: water removal and pentane addition using a needle-syringe arrangement. After this addition the bottle is shaken and allowed to stand so that the phases separate. In a third-generation procedure the water removal and pentane addition is done in an ultrasomic bath so that the pentane disperses into fine droplets as it enters the water. The second-generation method is used with organic halides; the third-generation method for hydrocarbons and organic halides.
W86-03808

EXTRACTION OF ORGANIC COMPOUNDS FROM WATER USING SMALL AMOUNTS OF SOLVENT,

Ames Lab., IA.
G. A. Junk, I. Ogawa, and H. J. Svec.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 281-292, 2 fig, 5 tab, 11 ref. W-7405-Eng-82.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Chlorinated hydrocarbons, Aromatic compounds, Alcohols, Aliphatic compounds, Hydrocarbons, Ketones, Pesticides, Extraction, Microextraction, Sample preparation.

A microextraction technique for organics in water is done in 100-ml or 1000-ml flasks having precalibrated necks with inside diameters of 2-10 mm. Pentane is used as the extracting solvent. Recoveries of model compounds (halocarbons, aromatic hydrocarbons, alcohols, alkanes, ketones, and pesticides) added to water are generally good, except for substances which are more soluble in water. Addition of methanol up to about 10% to halocarbons in water does not change extraction efficiency.
W86-03809

ANIONIC AND NEUTRAL ORGANIC COMPONENTS IN WATER BY ANION EXCHANGE,

Ames Lab., IA.
G. A. Junk, and J. J. Richard.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 295-315, 9 fig, 7 tab, 21 ref. W-7405-Eng-82.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Pesticides, *Ion exchange, Insecticides, Herbicides, Resins, Anion exchange, Rivers.

An anion exchange resin (XAD-4), modified by chloromethylation followed by amination with trimethylamine, was then converted from chloride to hydroxide form. This prepared resin was used to isolate organic neutral and anionic components from water samples. Neutral compounds were eluted with diethyl ether; anionic components with HCL-saturated ether. The technique was used to recover organic compounds from a variety of waters. Recoveries of aliphatic acids, nitrophenols, chlorophenols, and substituted sulfonic acids added to distilled water were 86-97%. Near 100% extraction efficiency of 2,4-D, tetrachloroterephthalic acid, and N-1-naphthylphthalamic acid was obtained in wastewater from a pesticide disposal pit. The same three chemicals were recovered at efficiencies of 84% or greater in water containing sodium choride or sodium sulfate at levels of 1% and 5%. The only exception was tetrachloroterephthalic acid, which had recoveries of 20-51% in sodium chloride solution. Anion exchange and resin sorption procedures compared favorably in isolation of a number of neutral pesticides in river water, reservoir water, and urban runoff. However, results with digester water were not as agreeable, probably because of microparticulate matter present.
W86-03810

THERMAL DESORPTION FROM A XAD-4 ADSORPTION SUBSTRATE FOR WATER ANALYSIS BY CAPILLARY GAS CHROMATOGRAPHY,

Ames Lab., IA.
J. P. Ryan, and J. S. Fritz.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 317-327, 3 fig, 2 tab, 8 ref. 7405-Eng-82.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Aromatic compounds, *Resins, Hydrocarbons, Ion exchange, Adsorption, Thermal desorption, Chromatography, Gas chromatography.

Thermal desorption of organic compounds from XAD resin using a glass capillary gas chromatograph column provided greater resolution (compared with a packed gas chromatograph column) of a sample containing fluorene, phenanthrene, anthracene, tritan, and pyrene. The final desorption temperature was 210 degrees C; the desorption time was 20 min; the flow rate was 42 ml/min. An isothermal desorption at 200 degrees C gave maximum recovery of the compounds in 15 min at a desorption flow of 80 ml/min. A sample of Ames, Iowa, tap water analyzed by the method produced sharp peaks for indene (0.70 ppb), alkyl indanes, naphthalene (0.28 ppb), 1-methylnaphthalene (0.35 ppb), acenaphthene, and acenaphthylene.
W86-03811

COMPARISON OF SEVERAL METHODS FOR COLLECTION AND QUANTIFICATION OF POLYCYCLIC AROMATIC HYDROCARBONS FROM AQUEOUS MEDIA,

Oak Ridge National Lab., TN. Analytical Chemistry Div.
J. E. Caton, Z. K. Barnes, H. Kubota, W. H. Griest, and M. P. Maskarinec.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 329-344, 4 fig, 7 tab, 21 ref. W-7405-eng-26.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Aromatic compounds, Polycyclic aromatic compounds, Extraction, Liquid/liquid extraction, Resins, Chromatography, Reverse-phase chromatography.

Several methods for isolation of polycyclic aromatic hydrocarbons in water samples were compared: liquid/liquid extraction (LLE), polystyrene sorbent resins, and silica chemically modified with octadecylsilane for reverse-phase chromatography. Carbon-14 tracer was added to the stock solution of organic compounds. Polycyclic aromatics included in the mixture were naphthalene, acenaphthylene, acenapthene, phenanthrene, anthracene, fluorene, fluoranthene, pyrene, 1,2-benzanthracene, chrysene, benzo(a)pyrene, 1,2,5,6-dibenzanthracene, and benzo(g,h,i)perylene. For simplicity and high recovery the three LLE methods were best. Two resin methods produced variable recovery, but needed pH and ionic strength control; they were not labor-intensive. The methods using reverse-phase material produced variable lower recoveries but were not labor-intensive.
W86-03812

ANOMALOUS BREAKTHROUGH OF BENZO(A)PYRENE DURING CONCENTRATION WITH AMBERLITE XAD-4 RESIN FROM AQUEOUS SOLUTIONS,

Savannah River Ecology Lab., Aiken, SC.
P. F. Landrum, and J. P. Giesy.
IN: Advances in the Identification & Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 345-355, 2 fig, 4 tab, 29 ref. EPA-78-D-X0290, DE-AC09-76SR00819.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Resins, Aromatic compounds, Polyaromatic hydrocarbons, Ion exchange, Benzo(a)pyrene, Humic acids, Fulvic acids, Dissolved solids.

The study indicates that dissolved minerals (e.g., iron) and organics (e.g., humic and fulvic acids) can drastically alter the trapping efficiency and recovery of benzo(a)pyrene on Amberlite XAD-4 resin. This decreased trapping of a nonpolar compound is anomalous with the expected result. The influence of the abovementioned enviromental factors appears to increase with the decreased water solubility of the compound. There seems to be a hydrophobicity limit below which no apparent effect occurs. The more insoluble compounds are sorbed to particulates and dissolved organics which alter their trapping and elution efficiency on Amberlite XAD-4 resin. Thus, monitoring studies evaluating the amount of benzo(a)pyrene and perhaps polyaromatic hydrocarbons of equal or lower water solubility utilizing Amberlite XAD-4 resin for concentration must evaluate trapping and elution efficiency for the water to be studied. (Author)
W86-03813

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC ANALYSIS OF NITROPHENOLS,

Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (Germany, F.R.).
A. F. Haeberer, and T. A. Scott.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 359-370, 5 fig, 1 tab, 9 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Resins, *Phenolic compounds, *Nitrophenols, Chromatography, Ion exchange, Cesium silicate chromatography, Dye industry wastes, Liquid chromatography.

A reverse-phase high performance liquid chromatography method has been developed for the analysis of nitrophenols in water samples. The compounds are accumulated on mixed XAD 4/8 macroreticular resins followed by Kuderna-Danish evaporation. Cesium silicate chromatography facilitates the separation of phenolics from neutral and basic interfering substances. This cleanup method allows recovery of about 80% at the 10-ppb level. Chromatograms are shown for analyses from fortified and unfortified dye plant effluent, municipal effluent, and plastics industry extract. Compounds found in the plastic industry extract are phenol, 2-nitrophenol, 4-nitrophenol, 2-mitro-p-cresol, 2,4,6-trichlorophenol, and pentachlorophenol in a range of 7 to 260 ppb each.
W86-03814

SIZE EXCLUSION, REVERSE-PHASE AND WEAK ANION EXCHANGE CHROMATOGRAPHY OF NATIONAL ORGANICS IN WATER,

North Texas State Univ., Denton. Dept. of Chemistry.
W. H. Glaze, P. C. Jones, and F. W. Saleh.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 371-382, 6 fig, 1 tab, 13 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic matter, Fulvic acids, Humic acids, Chromatography, Ion exchange, Resins, Size exclusion chromatography, Ozonation.

A progress report on the study of the structure of aquatic humus is presented. Several high-performance liquid chromatography methods are evaluated for separation prior to using structure elucidation tools. A polynodal molecular size distribution for the humic material is not observed in size exclusion chromatography, provided ionic strength and column-solute effects are controlled. Reverse-phase separation of aquatic humus before and after ozonation shows the separation of several components, none of which have been identified. Weak anion exchange material analysis shows three peaks. As the molecular size of the components increases, the ratio of trihalomethane formation potential to total organic carbon also increases.
W86-03815

DEVELOPMENT OF TECHNIQUES FOR THE ISOLATION AND IDENTIFICATION OF NONVOLATILE ORGANICS IN DRINKING WATER,

Water Research Centre, Medmenham (England). Medmenham Lab.
C. D. Watts, B. Crathorne, R.I. Crane, and M. Fielding.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 383-397, 4 fig, 2 tab, 4 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Chromatography, Liquid chromatography.

A procedure is being developed for characterization of nonvolatile organics in drinking water. While the procedure is slow, it has the required sensitivity and specificity for identifying a wide range of compounds. The water sample is freeze dried and the residue extracted with methanol. Salts are removed with ion exchange resins either before freeze drying or from the methanol extract. The cleaned up extract is separated according to polarity by high performance liquid chromatography. The halogen-containing compounds are characterized separately from the high-ultraviolet absorbing fractions. The latter are subjected to mass spectrometry. This work, still in progress, will further explore the use of field desorption mass spectrometry in combination with collisional activation and linked scanning techniques for further identification of compounds in fractions.
W86-03816

EVALUATION OF TRACE ENRICHMENT METHODOLOGY IN CONJUCTION WITH REVERSE-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY FOR PRECONCENTRATION, SEPARATION AND QUANTIFICATION OF TRACE NON-VOLATILE ORGANIC COMPOUNDS IN AQUEOUS ENVIRONMENTAL SAMPLES,

Environmental Research Lab., Athens, GA.
J. A. Graham, and A. W. Garrison.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 399-432, 17 fig, 6 tab, 48 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Chromatography, Wastewater analysis, Resins, Trace levels, Liquid chromatography.

The analytical capabilities of trace enrichment on octadecyl-derivatized silica in conjunction with reverse-phase high-performance liquid chromatography was evaluated for routine analysis of trace nonvolatile organic compounds in water. Model compounds were determined in drinking water at 0.1- to 1-ppb levels with outstanding precision. Addition of ion-pairing reagent to the sample increased the recoveries for acidic compounds. Volumetric accumulation rates as high as 7.5 ml/min could be used without significant decrease in recovery. Although large sample volumes, 500-2000 ml, could be enriched, it was generally not necessary. Two problems were exposed during these studies. (1) A large amount of material was retained on the colums. The liquid chromatographic system could not handle the large amount of material recovered from treated municipal sewage. (2) Unexplainable variations in the recoveries of compounds enriched from different matrices limited the accuracy with which the methodology could be applied to quantitative determinations.
W86-03817

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITROSAMINES IN WATER AND WASTEWATER,

Environmental Research Lab., Athens, GA.
A. F. Haeberer, and T. A. Scott.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 433-445, 8 fig, 2 tab, 6 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Wastewater analysis, *Nitrosamines, Chromatography, Resins, Ion exchange, Liquid chromatography.

The determination of N-nitrosamines as the fluorescent derivatives of 7-chloro-4-nitrobenzo-2-oxa-1,3-diazole (NBD) shows some promise if loss of the intermediate amine salt can be minimized during the drying procedure or if only the nonvolatile N-nitrosamines are of interest. 1-Bromo-2-chloroethane was chosen as internal standard. The photoconductivity detector response curves are linear over three orders of magnitude. Resin accumulation produced 25-30% higher recoveries (46-83%) than classical liquid/liquid extraction for 1-ppb levels of the more hydrophilic N-nitrosamines (N-nitrosodimethylamine, N-nitrosomorpholine, N-nitrosopyrrolidine, N-nitrososiethylamine, N-nitrosopiperidine). Recoveries of a second group of N-nitrosamines at 0.4 ppb concentration ranged from 22% for N-n-butyl-N'-nitro-N-nitrosoguanidine to 84% for N-nitrosopiperidene. Compounds with recoveries of 70-82% included nitrosppiperazine, N-nitrosopyrrolidine, N-nitrosodiethylamine, N-nitroso-N-methylaniline, and N-nitrosodipyrpylamine.
W86-03818

DEVELOPMENTS IN THE ANALYSIS OF PRIORITY POLLUTANTS BY LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY AND IMMUNOASSAY PROCEDURES,

National Bureau of Standards (NML), Gaithersburg, MD.
R. G. Christensen, H. S. Hertz, D. J. Reeder, and E. White.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 447-453, 2 fig, 5 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, Chromatography, Immunoassay, Fluroimmunoassay, Aromatic compounds, Bioassay, Mass spectrometry.

Two methods of analyzing organic priority pollutants are liquid chromatography/mass spectrometry and fluoroimmunoassay. In the chromatography system solvent is concentrated by allowing it to flow down a heated stationary wire. The residual liquid is drawn into the mass spectrometer, spraying from a needle valve. Tests with a mixture of phenanthrene, 9-methylanthracene, and fluoranthene show a 20-fold concentration. Results are also given for analysis of shale oil components. Present work with fluroimmunoassay and dinitrophenol has allowed analysis at the 100-microgram/liter level. For use in pollutant analysis, the sensitivity must be increased to the submicrogram/liter or picogram/liter level.
W86-03819

DETECTION AND QUANTIFICATION OF ELECTROPHILES IN ENVIRONMENTAL SAMPLES: LABELING OF POTENTIAL MUTAGENS IN DRINKING WATER BY 4-NITROTHIOPHENOL,

Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
A. M. Cheh, and R. E. Carlson.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 457-465, 3 fig, 15 ref.

Descriptors: *Pollutant identification, *Water analysis, *Mutagens, Nitrophenol, Tracers, Environmental tracers.

4-Nitrophenol may be used to label electrophiles in drinking water concentrates. This labeling may be used to distinguish between thioethers formed by rapid or slow electrophile reaction with nitrophenol. Correlation of changes in the labeling pattern with changes in mutagenic activity measured by the Ames assay suggests that the more rapidly reacting electrophiles may possess unusual mutagenic activity and may be present at extremely low concentrations.
W86-03820

DETERMINATION OF LINEAR ALCOHOL ETHOXYLATES IN WASTEWATER AND SURFACE WATER,

Procter and Gamble Co., Cincinnati, OH.
V. T. Wee.
IN: Advances in the Identification and Analysis of Organic Pollutants in Water, Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. p 467-479, 3 fig, 3 tab, 16 ref.

Descriptors: *Pollutant identification, *Water analysis, *Organic compounds, *Surfactants, Neodol-45, Fate of pollutants.

An analytical method was developed for determining linear alcohol ethoxylates (carbon chain length, 14-15; ethylene oxide chain length, 7). It included a cleanup procedure followed by gas chromatography of the hydrogen bromide cleavage products of the surfactant. Results obtained from the method, which overestimates the concentration of linear alcohol ethoxylates. Morning influent samples from a domestic wastewater treatment plant contained 0.19 to 0.37 ppm of the surfactant; morning effluent, 0.006-0.012 ppm; afternoon influent, 0.47 ppm; afternoon effluent, 0.0085 ppm; activated sludge, 0.22 ppm; above sewage outfall, 0.0005 ppm; below sewage outfall, 0.0011 ppm; and river water, 0.0042 ppm.
W86-03821

ASSESSMENT OF THE MEASUREMENT UNCERTAINTY IN THE ESTIMATION OF STREAM REAERATION RATE COEFFICIENTS USING DIRECT TRACER TECHNIQUES,

National Council of the Paper Industry for Air and Stream Improvement, Inc., Medford, MA.
J. S. Hovis, R. C. Whittemore, L. C. Brown, and J. J. McKeown.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 36-53, 1 fig, 5 tab, 22 ref.

Descriptors: *Reaeration rate, *Instream aeration, Aeration, *Tracers, *Precision, *Error analysis, Errors, Accuracy.

The purpose of this research is to elucidate the major sources of error in the direct tracer methods of reaeration rate coefficient measurement. The error components in the direct tracer measurements fall into three broad categories: (1) protocol selection errors (accuracy considerations), (2) parameter estimation and reaeration model errors, and (3) random experimental errors (precision considerations). The significance of the propagation of random error through the reaeration coefficient calculation was demonstrated via an analysis of the effect of the amount of tracer gas lost on the reaeration coefficient's theoretical precision. In addition, theoretical calculations showing the length of time a radiotracer study must be followed in order to achieve a desired precision in the measured rate were presented. Actual direct tracer reaeration measurements ranged from + or - 1.0% to + or - 1000% (the former from replication studies at a moderate rate, the latter from a single low rate measurement on the Ouachita River). Errors in the hydrocarbon technique measurements ranged from + or - 4.3% to + or - 230% (the former from the Wisconsin replication study, the latter from a single measurement on the Ouachita River). The relationship between the amount of tracer gas lost and the measurement uncertainty of the Ouachita River Basin radiotracer measurements was found to parallel the theoretical precision calculations.
W86-03824

HYDROLOGIC MODELING FOR STUDIES OF POLLUTANT LOADINGS AND TRANSPORT IN LARGE RIVER BASINS,

Northern Virginia Planning District Commission, Annandale.
A. Cavacas, J. P. Hartigan, E. Southerland, and J.

A. Friedman.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 69-89, 14 fig, 3 tab, 18 ref.

Descriptors: *Mathematical models, *Hydrologic models, *Hydraulic models, *Pollution load, Hydrology, Chesapeake Bay.

This research describes the calibration/verification of the hydrology component of the River Basin Model. The continuous simulation hydrologic model was linked with a water quality model for studies of nonpoint pollution loadings and the transport of nutrient and organic loadings in tributary watersheds of the Chesapeake Bay. The River Basin Model represents the Susquehanna, Potamac, and James river basins as well as 33 other river basins which contribute freshwater inflows, nonpoint pollution loadings, and wastewater discharges to the Bay. The Model was used by the EPA Chesapeake Bay Program for assessments of management strategies for nonpoint pollution and wastewater treatment. This paper focuses on the hydrology/hydraulics modeling requirements for the river basin water quality modeling studies.
W86-03827

MEASUREMENT OF NUTRIENT CONCENTRATIONS IN SEDIMENT PORE WATER COLLECTED BY A DIALYSIS SAMPLER,

Japan Bottom Sediment Management Association, Tokyo.
Y. Kurimoto, and T. Kotake.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 150-160, 14 fig, 2 tab.

Descriptors: *Nutrients, *Cycling nutrients, *Interstitial water, Sediment sampler, Chemical analysis, Chemical composition.

In the release mechanism of nutrients it sometimes becomes necessary to investigate the behavior of nutrients in sediment pore water. In the past, the separation of pore water from sediment has been performed using the centrifuge or a filter press procedure. These methods release nutrients dynamically by artificial forces during water separation. However, the release action of nutrients from sediment pore waters using a dynamic (centrifuge) versus a static (dialysis) method will have a large effect on the results. Dynamic separation methods may not accurately reflect the actual static nutrient release processes occurring in nature. To solve this problem, a static separation was developed using a dialysis sampler. The results of comparative tests showed that the measured concentrations from centrifuge separation were larger than those using the dialysis sampler. These results suggest that nutrients are released dynamically during the centrifuge separation. (Halterman-PTT)
W86-03877

ACCUMULATION OF ACRYLAMIDE INTO FISH,

Tsukuba Univ. (Japan). School of Medicine.
For primary bibliographic entry see Field 5C.
W86-03878

WATER POLLUTION: INDUSTRY AND GOVERNMENT WORKING TOGETHER - A CASE STUDY OF MUNCIE, INDIANA'S INDUSTRIAL PRETREATMENT PROGRAM,

J. M. Craddock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142307, Price codes: A10 in paper copy, A01 in microfiche.
IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 214-229, 4 fig.

Descriptors: *Water treatment, *Water treatment facilities, Wastewater facilities, Sludge, Septic sludge, Sludge disposal, Land disposal, Heavy metals, Sewer systems, Wastewater treatment.

A joint program of water quality control, involving a metropolitan sewer district (MSD) and a Department of Water Quality (DWQ) is described. The responsibilities of the DWQ include: perform all lab testing for wastewater treatment plant; monitor the industrial dischargers using the MSD sewage system and wastewater treatment plant; enforce the applicable MSD ordinances relating to sewer use and pretreatment, and develop new ordinances if necessary; and monitor all streams and locate illegal dischargers. The sewer district portion of the joint project included a program to monitor uptake of heavy metals by crops grown in sludge-application fields, a study in which heavy metal concentrations in fish were monitored, and a program by which the effects of the sewage district discharges were assessed by monitoring benthic macroinvertebrate communities. (Halterman-PTT)
W86-03898

5B. Sources Of Pollution

ROLE OF ENVIRONMENTAL TRANSPORT AND FATE MODELS IN IMPLEMENTING THE TOXIC SUBSTANCES CONTROL ACT,

Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
W. P. Wood.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 49-58, 2 fig.

Descriptors: *Model studies, Pollutants, *Toxicity, Aquatic environment, Ecosystems, Distribution, Public health aspects, Mathematical models, Regulations, Legal aspects.

Various aspects of implementing the Toxic Substances Control Act are discussed, with emphasis on modeling activities. The Office of Toxic Substances is currently engaged in modeling activities which include identification of toxic materials, evolution of toxicity, modification and/or development, implementation, and validation. The choice of specific models for the various programs is based on selected criteria, including the following considerations: model input data requirements and accessibility of data; existence of computer code and technical support documentation; prior use in regulatory decision-making; use by other EPA program offices; skill level and level of effort required in exercising the model; and available validation studies. (Halterman-PTT)
W86-03420

PREDICTIVE FATE MODELS: THEIR ROLE IN THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S WATER PROGRAM,

Environmental Protection Agency, Washington, DC. Office of Water Planning and Standards.
M. W. Slimak, and C. Delos.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 59-71, 3 fig, 1 tab, 17 ref.

Descriptors: *Model studies, Pollutants, *Toxicity, Aquatic environment, *Fate of pollutants, Prediction, Path of pollutants, Public health aspects, Legal aspects.

The most important areas considered in the predictive fate models used in the U.S. Environmental Protection Agency's water program include the following: partitioning between environmental media; metals speciation; organic chemicals in aquatic systems; runoff; and solid waste disposal. The role of models used to make predictions in these areas is described, and the projects in which these modeling efforts are conducted and outlined. The projects include regulating drinking water, controlling point-source discharges of chemicals to surface waters, managing the appropriate design, construction and maintenance of sewage treatment plants and evaluating the role of nonpoint-source pollution, and enforcing the regulations emanating from the various water offices responsible for these programs. (Halterman-PTT)
W86-03421

IDENTIFICATION AND EVALUATION OF FUNDAMENTAL TRANSPORT AND TRANSFORMATION PROCESS MODELS,

Environmental Research Lab., Athens, GA.
L. A. Burns.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 101-126, 3 fig, 84 ref.

Descriptors: *Model studies, *Path of pollutants, Pollutants, Hydrodynamics, Sorption, Sediment transport, Volatility, Hydrolysis, Prediction, Toxicity.

The current state of knowledge of those aspects of transformation and transport processes required for inclusion in environmental models are outlined. Physical processes include hydrodynamic transport, sorption, sediment transport, benthic boundary layer transport, and volatilization. Chemical processes include direct photolysis, indirect photolysis, hydrolysis and reduction. Biological processes of concern are microbial transformations, algal transformations, biosorption, and bioaccumulation. This second order or system-independent approach makes it possible to study the fundamental chemistry of compounds in the laboratory and then, based on independent studies of the driving forces in aquatic systems, evaluate the probable behavior of the compound in systems that have never been exposed to them. (Halterman-PTT)
W86-03422

SIGNIFICANCE AND LIMITATIONS OF ENVIRONMENTAL COMPARTMENTALIZATION MODELS IN THE CONTROL OF NEW CHEMICALS BASED ON THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT MINIMUM PREMARKETING SET OF DATA,

Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W86-03423

EVALUATIVE MODEL FOR ESTIMATING ENVIRONMENTAL FATE,

Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
W. B. Neely, and D. Mackay.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 127-143, 2 fig, 7 tab, 22 ref.

Descriptors: *Model studies, Pollutants, *Fate of pollutants, Hydrodynamics, Toxicity, Fate of pollutants, Aquatic environment, *Path of pollutants, Prediction.

An evaluative model that may be used in the initial assessment of exposure is described and discussed. The role of this model in a tiered approach to hazard assessment is described, and the importance of its being easy to use, economical, understandable by all concerned, and capable of producing results that are comparable between laboratories is stressed. Use of this model allows investigators to rank chemicals on a scale that will have the same meaning, regardless of the location of the study. Furthermore, the calculation presented may be performed on any programmable hand calculator. (Halterman-PTT)
W86-03424

FATE AND TRANSPORT MODELING FOR TOXIC SUBSTANCES,

Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
J. L. Schnoor, N. B. Rao, K. J. Cartwright, and R. M. Noll.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 145-163, 12 fig, 1 tab, 11 ref.

Descriptors: *Model studies, Pollutants, *Pesticides, Alachlor, Atrazine, Dieldrin, Aquatic environment, Ecosystems, *Fate of pollutants, *Path of pollutants.

The testing and validating of a model of the fate and transport of toxics is discussed. A field validation study is described, as well as microcosm and laboratory studies, which were used to supplement field data collections under spring run-off conditions. The study-design presented was also developed to determine if laboratory-derived rate constants could be used directly in a field validation effort. The studies focused on simulating the pesticides alachlor, atrazine and dieldrin. The laboratory biodegradation tests were accurate within a factor of five in a field application of the model. The microcosm studies were successful in reproducing bioconcentration effects, but microcosms should not be relied on for fate studies because of the large growth of biomass that inevitably results. (Halterman-PTT)
W86-03425

SIMPLIFIED MODEL OF THE FATE OF PARTITIONING CHEMICALS IN LAKES AND STREAMS,

HydroQual, Inc., Mahwah, NJ.
D. M. Di Toro, D. J. O'Connor, R. V. Thomann, and J. P. St. John.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 165-190, 5 fig, 2 tab, 8 ref.

Descriptors: *Model studies, Pollutants, Aquatic environment, Ecosystems, *Fate of pollutants, *Path of pollutants, Sorption, Sedimentation, Sediment transport, Sediments, Silt, Silt load.

The problem of analyzing the fate of chemicals discharged into receiving waters, specifically lakes and streams, is addressed. The focus is on contemporary industrial chemicals and the mechanisms that affect their distribution in the aquatic environment. Since these chemicals are associated with suspended and sedimented particles, the analyses include these mechanisms as an integral of the formulation, as well as the other kinetic, transfer and transport processes of importance. The primary factors included in the model are sediment capacity ratio, particulate concentration ratio, unequal particulate concentration ratio, sediment decay, and unequal partitioning. The application of this model to streams and rivers is illustrated. (Halterman-PTT)
W86-03426

HYDROLOGIC TRANSPORT MODELING,

Hydrocomp, Inc., Mountain View, CA.
N. H. Crawford.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 199-214, 8 fig, 19 ref.

Descriptors: *Model studies, *Path of pollutants, *Fate of pollutants, *Aquatic environment, *Hydrologic models, Management planning, Environmental policy, Pollutants, Prediction, Hydrodynamics.

A summary of the development of hydrologic transport modeling (and the current state-of-the-art) as well as the prospects for large scale use of models in environmental regulation, is presented. Historic developments and new trends in model algorithms are described and the regulatory use of models and future directions for model development are discussed. Continuous and steady-state models, benefits and cost analysis, and legal and physical considerations in large-scale model applications are emphasized. Problems in the areas of data gathering, calibration, geographic variability and error assessment for intensive use of models are discussed. (Halterman-PTT)
W86-03427

MODELING CHEMICAL REACTIONS AND TRANSPORT IN GROUNDWATER SYSTEMS: A REVIEW,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient, N. K. Springer, C. J. Cook, and M. B. Thomson.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 215-246, 6 fig, 2 tab, 50 ref.

Descriptors: *Groundwater, Pollutants, *Model studies, *Fate of pollutants, *Path of pollutants, Distribution patterns, Microbial degradation, Sorption, Kinetics, *Groundwater movement.

The governing equations of groundwater flow and transport are described, followed by a presentation of chemical reaction processes. Mathematical models, both analytical and numerical, are discussed in detail, followed by model applications and field validation problems. Two primary situations where the equations governing groundwater flow and transport can be used are: to assess the impact of subsurface waste disposal at proposed sites that have not yet been contaminated; and to assess the impact of already contaminated sites in terms of predicting plume migration and recommending remedial measures. The specific chemical and biological processes that were included in the model development include phase equilibrium, kinetics, sorption of organic and inorganic pollutants, and the removal or transformation of organic pollutants from the subsurface environment through the action of microorganisms. (Halterman-PTT)
W86-03428

COMPLEX EFFLUENT FATE MODELING,

Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
H. L. Bergman, and J. S. Meyer.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 247-267, 7 fig, 1 tab, 32 ref.

Descriptors: *Fate of pollutants, *Model studies, Pollutants, Aquatic environment, Ecosystems, Effluents, Mathematic models, Physical models, Path of pollutants, Spatial distribution.

The complex-effluent problem of modeling the fate of potentially hazardous chemical constituents found in complex-effluent mixtures is discussed. To further define this problem and the concept of a complex effluent, it is suggested that an effluent is truly complex when one or both of the following conditions apply: a number of potentially hazardous chemical constituents cannot be identified within reasonable time or cost; and a reasonable possibility exists that the environmental fate of a number of constituents could be affected markedly by complex kinetic interactions, such as synergism. It is suggested that the objectives of a complex-effluent modeling strategy should be to identify constituents posing an environmental fate problem, and to predict expected exposure concentration of each constituent posing a problem. The modeling problem posed by complex-effluent mixtures are illustrated by providing some examples, reviewing modeling strategies, and discussing trade-offs between mathematical and physical models. (Halterman-PTT)
W86-03429

TESTING MODELS OF THE FATE OF CHEMICALS IN AQUATIC ENVIRONMENTS,

Georgia Univ., Athens. Inst. of Ecology.
R. R. Lassiter.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI 1982. p 287-301, 5 fig, 4 tab, 9 ref.

Descriptors: *Fate of pollutants, *Model studies, Pollutants, Aquatic environment, Ecosystems, Effluents, Mathematic models, Physical models, *Path of pollutants, Spatial distribution.

Testing models of the environmental fate of chemicals to provide a basis for judging their adequacy for a given purpose is discussed. The focus of this discussion is on theoretical models, which do not depend on prior observation for their ability to predict, but on the existence of relevant theory. An approach to model testing is described which entails the following steps: design the content of the model test; devise a statement of no difference between model predictions and observations; use regression of observations on predictions and test working-level null hypotheses of intercept equals 0 and slope equals 1; and, finally, interpret tests and draw conclusions. (Halterman-PTT)
W86-03430

FIELD VALIDATION AND ERROR ANALYSIS OF CHEMICAL FATE MODELS,

Anderson-Nichols and Co., Inc., Palo Alto, CA.
A. S. Donigian.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 303-323, 6 fig, 1 tab, 3 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Model studies, *Model testing, Aquatic environment, Pollutants, Ecosystems, Prediction, Hydrologic models, Groundwater, Errors.

An overview of concepts that should be considered in any validation or verification effort of chemical fate models in any model application to problems of chemical fate and persistence in the environment, is presented. The primary focus is on models of physical, chemical and biological processes that effect the fate and transport of chemicals in terrestrial and aquatic systems. Validation, or verification, is discussed in terms of common procedures currently used and of the ultimate goal or purpose of model validation. Emphasis is on error analysis, i.e., investigation of the source of errors, or differences between model results and observed data. Various categories of errors are discussed and examples are presented. (Halterman-PTT)
W86-03431

FIELD VALIDATION OF EXPOSURE ANALYSIS MODELING SYSTEM (EXAMS) IN A FLOWING STREAM,

Procter and Gamble Co., Cincinnati, OH.
L. M. Games.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 325-346, 10 fig, 2 tab, 10 ref.

Descriptors: *Model studies, *Fate of pollutants, *Path of pollutants, Aquatic environment, Pollutants, Mathematical models, Prediction, Sedimentation, Kinetics, Linear alkylbenzene sulfonate, LAS.

Because of the complexity of the aqueous environment and the numerous processes that can occur, field validation studies should be done in a way that limits the variables involved. An attempted field validation of an evaluative model (the U.S. Environmental Protection Agency's EXAMS model), which it was hoped would meet these criteria, is described. The focus of this work is on the data required to use the model and a sensitivity analysis for several laboratory-measured variables plus a single-model calibration term. Test results indicate that, unfortunately, the model calculations are most sensitive to the least understood parameters that were provided as input: the dispersion coefficient and sediment biodegradation rate constants. Improvements in modeling will depend on a better understanding of these phenomena. (Halterman-PTT)
W86-03432

ASSESSMENT OF TRANSPORT AND FATE OF TOXIC MATERIALS IN AN EXPERIMENTAL STREAM ECOSYSTEM,

Michigan State Univ., East Lansing.
W. E. Cooper, and R. J. Stout.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 347-378, 19 fig, 6 tab, 1 ref.

Descriptors: *Model studies, *Model testing, Aquatic environment, Pollutants, Ecosystems, Prediction, *Fate of pollutants, *Path of pollutants, Biodegradation, Degradation.

The diversity of system responses that might be observed when stressing a large ecosystem with a toxicant is demonstrated. The benefits of a recycling system, as opposed to a flow-through system, are discussed. Results of artificial stream studies indicate that p-cresol caused significant shifts in DO, pH, bacterial densities and algal biomass.

These caused diurnal oscillations in biodegradation of p-cresol, which resulted in no steady-state conditions; therefore, no constant rate functions would serve as adequate model parameters. Models utilizing degradation rates that are functions of state variables, and therefore are time varying, are required to predict the observed results. The need for more data on various factors affecting degradation, before the utility of physical and mathematical models of the fate, transport and effects of organic toxicants can be evaluated, is discussed. (Halterman-PTT)
W86-03433

LEGAL VALIDATION OF ENVIRONMENTAL FATE MODELS,

ERM-Southeast, Inc., Brentwood, TN.
For primary bibliographic entry see Field 5G.
W86-03434

CORPUS CHRISTI INNER HARBOR WATER QUALITY SURVEY, AUGUST 1982,

Texas Dept. of Water Resources, Austin.
J. W. Bowman, and D. A. Jensen.
LP-197, January 1985. 94 p, 28 fig, 13 tab, 1 append.

Descriptors: *Harbors, *Texas, *Water pollution sources, *Water quality, *Surveys, Surface water, Hydrologic data, Cimatology, Chemical analysis, Bottom sediments, Metals, Pesticides, Bacterial analysis, Heavy metals, Volatile solids, Oil, Grease, Benthos, Benthic fauna, Nutrients, Contamination, Corpus Christie(Texas).

As part of continuing surveillance and effort to maintain and enhance the quality of Texas' surface water, District 12 of the Texas Department of Water Resources conducted a water quality survey of the Corpus Christi Inner Harbor (Segment 2484) August 8-14, 1982. The Corpus Christi Inner Harbor is a dredged, man-made, dead-end channel approximately 8.6 miles long. Since the study of August 10, 1973, water quality has improved which is attributed to reduced loading to the Inner Harbor from wastewater sources and removal of some contaminated sediments in the bottom of the harbor. Sediments are still contaminated with heavy metals, organics, and polychlorinated biphenyls. District 12 recommends that during future dredging of the Inner Harbor, dredged material be contained in leveed settling lagoons with decantation back to the Harbor. Water and sediment quality data were collected at 15 locations and from all known and permitted discharges to the Harbor. Benthic macroinvertebrate data were collected at six of the 15 locations. The levels of total organic carbon in the water ranged from < 5 mg/l to 6 mg/l. All laboratory pH analyses of the water samples were within the standards for Segment 2484 (6.5 to 9.0). Values of nutrients (phosphorus, ammonia, nitrates, and nitrites) at all survey stations were low. No pesticides were detected in the sediment. (Fazio-Omniplan)
W86-03440

POLYCHLORINATED BIPHENYLS (PCBS),

California State Water Resources Control Board, Sacramento. Toxic Substances Control Program.
For primary bibliographic entry see Field 5G.
W86-03446

RICE HERBICIDES: MOLINATE (ORDRAM) AND THIOBENCARB (BOLERO),

California State Water Resources Control Board, Sacramento. Toxic Substances Control Program.
For primary bibliographic entry see Field 5G.
W86-03447

CURRENTS IN SUISUN BAY,

California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W86-03448

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUSTANCES: PROCEEDINGS OF THE 8TH U.S./JAPAN EXPERTS MEETING,

Army Engineer Inst. for Water Resources, Fort Belvoir, VA.
For primary bibliographic entry see Field 5G.
W86-03461

STUDIES ON ANALYTICAL METHOD OF ACRYLAMIDE MONOMER AND ACCUMULATION INTO FISH,

Tsukuba Univ. (Japan). Inst. of Community Medicine.
M. Fujiki, J. Asada, and T. Shimizu.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Toyko, Japan. July 1984. p 147-166, 16 fig, 5 tab, 19 ref.

Descriptors: *Fate of pollutants, *Pollutant identification, *Fish, *Acrylamide, Carp, Killifish, Polymers, Accumulation, Bioaccumulation.

An analytical method was developed for acrylamide monomer to study its accumulation in fish. The fish tissue was analyzed as follows. After homogenization, the pH was adjusted to 1 with sulfuric acid. Potassium bromide and potassium bromate were added to the homogenate, which was then stored at 5 degrees C for 30 min. After bromination, the remaining bromine was removed by addition of sodium thiosulfate. The sample was then centrifuged to produce a supernatant containing dibromopropionamide. This derivative was extracted with ethyl acetate and measured by gas chromatography with electron capture detection. Fish were exposed for periods up to 40 days without feeding to 1 or 10 ppm of acrylamide monomer. At 1 ppm carp slowly accumulated the acrylamide monometer for 10 days. A maximum concentration of 0.26 ppm was reached on day 20. At the ppm level carp rapidly accumulated monomer for 10 days, slowly accumulated monomer until day 30, reaching a maximum of 7.65 ppm on day 40. Accumulation in killifish at 1 ppm monomer was similar to that of carp, reaching a maximum of 0.31 ppm on day 20. Killifish exposed to 10 ppm acrylamide monomer accumulated the chemical rapidly until day 15, then slowly until reaching a maximum of 25.3 ppm on day 20. Exposure of carp, killifish, and sea bream to 20 ppm of acrylamide polymer caused no detectable accumulation of acrylamide monomer. (Cassar-PTT)
W86-03466

ECO-KINETIC MODEL FOR THE ACCUMULATION OF PCB IN MARINE FISHES,

J. M. O'Connor, and J. C. Pizza.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 285-303, 9 fig, 4 tab, 33 ref.

Descriptors: *Fate of pollutants, *Polychlorinated biphenyls, *Fish, *Dredging, Accumulation, Bioaccumulation, New York Bight, Model studies, Sludge disposal, Ocean dumping, Food chains, Striped bass, Bass, Chlorinated hydrocarbons, Organic compounds.

Several conclusions were reached in a study of polychlorinated biphenyl (PCB) accumulation in fish. (1) The hypothesis that PCB in fishes is strongly related to diet renders the mass loading approach to ocean PCB pollution ineffective in estimating contaminant levels in fish. Both dredged material and sewage sludge must be evaluated more carefully to assess real quantities of PCBs injected into the food chain and the water column. (2) The pharmacodynamics of PCBs in fishes suggest that any isolation of contaminated materials from entry to the food chain will have the effect of lowering PCB body burdens in the large, predatory species which often form an important part of the human diet. Thus, maintaining a surficial layer of sediments with lower nonavailable PCBs will, in all likelihood, result in a trend toward lower body burdens in all trophic levels. (3) The overall outcome of the model suggests that we shall not see increased PCB levels in fishes if input rates and input sources remain similar to those of recent years. While we do not advocate use of the ocean as unrestricted dumps, we do suggest that, with time, the input of bioavailable PCB to New York marine waters has achieved a balance; it appears that any impacts which have occurred are not irreversible, although their description is unclear. Further dumping regulations should include attention to rendering such contaminants as PCB, first, unavailable to food chains, and finally, unavailable in the water column. (Author)
W86-03475

COMPARISON OF METHODS FOR ESTIMATING NUTRIENT RELEASE FROM LAKE SEDIMENTS,

M. Hosomi, M. Okada, and R. Sudo.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 238-250, 8 fig, 3 tab, 19 ref.

Descriptors: *Fate of pollutants, *Lake sediments, *Sediments, *Nutrients, Ammonium compounds, Nitrogen, Model studies, Mathematical models, Sediment cores, Interstitial water, Bottom sediments, Lake Yunoko, Japan, In situ chamber method, In situ sediment core method.

Four methods for estimating the rate of ammonium-N release from sediment are discussed. Precision of the ammonium-N release rate determination was compared by examining the variances among the laboratory sediment core method, the in situ sediment core method, the in situ chamber method, and the mathematical model method. The in situ core method reflected the least precision of the ammonium-N release rate determinations. Statistical tests showed that the ammonium-N release rates calculated from the ammonium-N gradient between the overlying water and the interstitial water of the 0- to 2-cm layer in the uppermost sediment did not significantly differ from those estimated by the laboratory core method and the in situ chamber method. The mathematical model calculating the ammonium-N gradient between the overlying water and the interstitial water in the uppermost layer of sediment could well be applied to other lake systems. (Author)
W86-03477

STOCHASTIC-CONVECTIVE ENSEMBLE METHOD FOR REPRESENTING DISPERSIVE TRANSPORT IN GROUNDWATER,

Battelle Pacific Northwest Labs., Richland, WA.
C. S. Simmons.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-021340, Price codes: A06 in paper copy, A01 in microfiche. EPRI-CS-2558, August 1982. Topical Report. 101 p, 4 fig, 18 ref, 5 append. 1406-1.

Descriptors: *Stochastic process, *Mathematical models, *Groundwater movement, *Leachates, *Solute transport, Mathematical studies, Landfills, Permeability coefficient, *Solute transport, Mathematical studies, Landfills, Permeability coefficient, Aquifers, Sand aquifers, Models, Model studies, Stochastic hydrology, Convection, Tracers, Fate of pollutants, Path of pollutants, Leaching.

A stochastic-convective transport model was developed to describe three-dimensional hydrodispersion of a non-reactive solute in groundwater. The model was based on the probability density function (Pdf) for an ensemble model of stochastic variation in flow velocity. Concepts of the method are demonstrated explicitly with a simple example tent-shaped Pdf. The method describes linear increase of effective dispersivity with solute travel distance, when velocity correlation is long-range. Previously derived results about macrodispersion in a stratified system are obtained with an ensemble viewpoint and are generalized for non-uniform velocity. A scale-relation description of hydraulic conductivity and hydraulic gradient random variations, was also developed to represent stochastic velocity. The model is based on a multiplicative rather than an additive stochastic process. It was

demonstrated that a covariance function for relative velocity variation is perhaps a better description of random variations in porous media. The model was applied to a small-scale tracer study performed near the Borden landfill, Waterloo, Ontario. An indirect evaluation of stochastic transport parameters was demonstrated for the sandy aquifer site. Results show a relatively small magnitude of velocity variation, but exhibit long-range correlations over at least a 4 m distance in both longitudinal and horizontally transverse directions. This is an example of non-Fickian dispersion, even though the solute distribution appears independently Gaussian for all principal directions. (Geiger-PTT)
W86-03498

TRANSPORT OF CONTAMINANTS FROM ENERGY PROCESS WASTE LEACHATES THROUGH SUBSURFACE SOILS AND SOIL COMPONENTS LABORATORY EXPERIMENTS,

Los Alamos National Lab., NM.
L. E. Wangen, E. A. Stallings, and R. D. Walker.
LA-9406-MS, August 1982. 39 p, 9 fig, 7 tab, 25 ref, 4 append.

Descriptors: *Leachates, *Waste disposal, *Soil types, *Adsorption, *Fate of pollutants, *Adsorbents, Clays, Clay loam, Sand, Arsenic, Boron, Selenium, Molybdenum, Cadmium, Nickel, Heavy metals, Anions, Cations, Path of pollutants, Clay minerals, Land disposal.

The subsurface transport and attenuation of inorganic contaminants common to a variety of energy process waste leachates are being studied using laboratory column methods. Anionic species currently being emphasized are As, B, Mo, and Se. Transport of the cations Cd and Ni is also being studied. The solid absorbents consist of three soil mineral components (silica sand, kaolinite, and goethite), and four subsurface soils (a dunal sand, an oxidic sandy clay loam, an acidic clay loam, and an alkaline clay loam). Breakthrough patterns of these species from packed soil columns are followed by monitoring eluent concentrations vs. time under carefully controlled laboratory conditions. The report describes the experimental methods being used, the results of preliminary batch adsorption studies, and the results of column experiments completed through calendar year 1981. Using column influent concentration of about 10 milligrams/liter, adsorption (millimoles/100 g) has been determined from the eluent volume corresponding to 50% breakthrough. On silica sand, kaolinite, dunal sand, and goethite, respectively, these are .0002, 0.020, 0.013, and 0.31 for Cd, .00044, 0.039, 0.020, and 0.98 for Ni. On kaolinite, dunal sand, and goethite, respectively, adsorption values (millimoles/100 g) are As (0.24, 0.019, and 20.5), B (0.041, 0.0019, and 1.77), Mo (0.048, 0.0010, and 5.93), and Se (0.029, 0.00048, and 1.30). Arsenic is the most highly adsorbed contaminant species and goethite has the largest adsorption capacity of the adsorbents. (Author)
W86-03500

DETERMINATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN INDUSTRIAL DISCHARGES AND OTHER AQUEOUS EFFLUENTS,

Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5A.
W86-03506

GIARDIASIS IN WASHINGTON STATE,

Washington State Dept. of Social and Health Services, Olympia. Office of Environmental Health Programs.
For primary bibliographic entry see Field 5C.
W86-03507

CHARACTERISTICS AND TREATABILITY OF URBAN RUNOFF RESIDUALS,

Rexnord, Inc., Milwaukee, WI. Environmental Research Center.
D. J. Carr, A. Geinopolos, and A. E. Zanoni.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-133561, Price codes: A05 in paper copy, A01 in microfiche. EPA-600/2-82-094, November 1982. 83 p, 16 fig, 22 tab, 22 ref, 2 append. R-806785.

Descriptors: *Urban runoff, *Storm runoff, *Wastewater treatment, *Storm wastewater, *Separation techniques, Pollutant identification, Pesticides, Suspended solids, Land disposal, Heavy metals, Polychlorinated biphenyls, Nutrients, Organic compounds, Wastewater disposal, Dewatering, Centrifugation, Lime, Urban hydrology.

The study was undertaken to determine the character of urban stormwater runoff (UR) residuals as well as handling and disposal techniques. Samples of UR residuals for the study were obtained from a field-assembled sedimentation basin in Racine, WI, swirl and helical bend solids separators in Boston, MA, and an in-line upsized storm conduit in Lansing, MI. The characterization study included analyses for nine metals, eight pesticides and PCB's, solids, nutrients and organics. The treatability study included bench scale sedimentation tests, centrifugation tests, lime stabilization tests and capillary suction time tests. The total solids concentration of the residual samples obtained from the three sites varied from 233 to 161,000 mg/1. The concentration of nutrients (TKN, NH3, NO2, and NO3) varied from 0.3 to 2250 mg/1. Fe was found in the highest concentrations observed were those for Pb and Zn, respectively. PCB's were observed in measurable concentrations (0.19 to 24.6 micrograms/1). Of the eight pesticides surveyed, only three (DDT, DDD and Dieldrin) were found in measurable concentrations. Treatability data indicated that gravity thickening is a very effective means for dewatering UR residuals. Centrifugation was also found to be effective in thickening UR residuals. Stabilization using lime was recommended. Based upon the study results, the most cost-effective UR residuals handling and disposal method is gravity thickening followed by landfilling. (Author)
W86-03508

INSTRUMENTATION AND METHODS EVALUATIONS FOR SHALLOW LAND BURIAL OF WASTE MATERIALS: WATER EROSION,

Energy Resource Management, Tucson, AZ.
For primary bibliographic entry see Field 5E.
W86-03510

REPORT OF ANALYSES FOR LIGHT HYDROCARBONS IN GROUND WATER,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Plant.
For primary bibliographic entry see Field 5A.
W86-03512

DETERMINATION OF CARBOHYDRATES AND PRIMARY AMINES IN RIVER WATER,

Minnesota Univ., Minneapolis. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W86-03524

ULTRAVIOLET MULTIWAVELENGTH ABSORBANCE MEASUREMENTS FOR MONITORING TRACE ORGANICS IN WATER,

Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 5A.
W86-03525

CHEMICAL AND MICROBIOLOGICAL MONITORING OF A SOLE-SOURCE AQUIFER INTENDED FOR ARTIFICIAL RECHARGE, NASSAU COUNTY, NEW YORK,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-03527

POLLUTION IN SWIMMING POOL WATER,

Florida International Univ., Miami.
J. A. Beech.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 525-546, 12 fig, 3 tab, 36 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Swimming pools, Organic compounds, Chlorinated hydrocarbons, Trihalomethanes, Metals, Heavy metals, Nitrates, Hydrogen ion concentrations, Chlorate.

Swimming pool water in Dade County, Florida, was analyzed for levels of various pollutants. Trihalomethanes, derived from chlorination of organic precursors such as plant and animal detritus, were present at concentrations as high as 367 micrograms per liter, chloroform predominating over bromodichloromethane, chlorodibromomethane, and bromoform. Pool sediments were leached at pH from zero to about 9. For the heavy metals (lead, copper, cadmium, iron, manganese) equilibrium leaching curves were produced. Cadmium and iron curves were similar for sediments from all six pools. However, the amount of lead, copper, and manganese varied greatly for different sediments. Estimated nitrate concentration at the end of the 14-week swimming season was 27 mg per liter, assuming a 500,000-liter pool, 2000 swimmers per week, and a 30% loss from splashout and backwashing. Most pools had chlorate concentrations of less than 20 mg per liter; the highest level was 124 mg per liter. Alkaline pool water favored formation of trihalomethanes and nitrates; acid pool water favored formation of chlorates and solubilization of heavy metals.
W86-03544

EVALUATION OF FUTURE BASE-FLOW WATER-QUALITY CONDITIONS IN THE HILLSBOROUGH RIVER, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
M. Fernandez, C. L. Goetz, and J. E. Miller.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4182, 1984. 47 p, 16 fig, 12 tab, 25 ref.

Descriptors: *Computer models, *River forecasting, *Pollution(Stream), *Watershed management, Storm runoff, *Urbanization, One-dimensional model, Steady-state model, Water quality, Urban runoff, Base flow, Coliforms, *Florida.

A one-dimensional, steady-state, water-quality model was developed for a 30.0 mile reach of the Hillsborough River to evaluate water-quality conditions to be expected from future development. The model was calibrated and verified using data collected under critical base-flow conditions in April and December 1978. Dissolved organic nitrogen, nitrate nitrogen, and total and fecal coliforms were modeled for most of the study reach. Model results were used to evaluate the impacts of two typical housing developments on water-quality conditions in Tampa Reservoir. One development is located in the Cypress Creek basin and the other near the upper end of the study reach. Model results show development in the Hillsborough River basin may cause increased total and fecal coliform conditions. Simulated total coliforms at the Tampa water treatment plant for 1-, 3-, and 5-square-mile developments located in the Cypress Creek basin were 3,000, 5,400, and 8,300 colonies per 100 milliliters. Similar developments, however, located near the upper end of the study reach were 2,000, 3,600, and 5,100 colonies per 100 milliliters. Simulated fecal coliforms were 360, 700, and 100 and 180, 350, and 510 colonies per 100 milliliters, respectively. Other constituents modeled showed only minor increases in concentrations. (USGS)
W86-03546

CHEMICAL QUALITY OF LANDFILL LEACHATE IN TREATMENT PONDS AND MIGRATION OF LEACHATE IN THE SURFICIAL AQUIFER, PINELLAS COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
M. Fernandez, and G. L. Barr.
Available from OFSS, USGS, Box 25425 Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4193, 1984. 52 p, 22 fig, 5 tab, 24 ref.

Descriptors: *Landfills, *Lagoons, Water quality, *Groundwater movement, Wastewater treatment, Path of pollutants, *Florida, *Landfill leachate, Leachate movement, Ammonia nitrogen, Potassium.

The Pinellas County leachate treatment and disposal site encompasses about 8 acres within the 220 acres of the county's Bridgeway Acres landfill. The site has a high water table and is subject to inundation due to tidal flooding and major storms. Fresh leachate is pumped from V-shaped trenches an average of about 3.8 hours per day. The pumping rate ranges from 150 to 500 gallons per minute. The leachate is aerated for about 2 days in a lined basin, then transferred by gravity to a stabilization pond where it is permitted to infiltrate into the surficial aquifer. Two chemical constituents, ammonia nitrogen and potassium, were used as indicators of migration of the leachate in the aquifer. No apparent nitrification occurred within the treatment system. Leachate has migrated from about 75 to 80 feet along the upper 5 feet of the aquifer during the period of study. Vertical migration was about 4 feet beneath the bottom of the pond into the aquifer. (USGS)
W86-03549

HYDROLOGY AND LAND USE IN VAN BUREN COUNTY, MICHIGAN,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03554

RESULTS OF A SOLUTE TRANSPORT EXPERIMENT AT UVAS CREEK, SEPTEMBER 1972,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-03556

OCCURRENCE AND DISTRIBUTION OF FLUORIDE IN GROUNDWATERS OF KENYA,

Nairobi Univ. (Kenya). Dept. of Dental Surgery.
For primary bibliographic entry see Field 2K.
W86-03569

ENVIRONMENTAL ISOTOPE HYDROLOGY IN SOUTHERN AFRICA,

University of the Witwatersrand, Johannesburg (South Africa).
For primary bibliographic entry see Field 2F.
W86-03576

PERFORMANCE OF SANITARY COMPLETION MEASURES OF WELLS AND BOREHOLES USED FOR RURAL WATER SUPPLIES IN MALAWI,

Department of Lands, Valuation and Water, Lilongwe (Malawi).
For primary bibliographic entry see Field 5G.
W86-03582

ONSHORE IMPACTS OF OFFSHORE HYDROCARBON DEVELOPMENT: ANNOTATED BIBLIOGRAPHY,

Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-03620

CANADIAN INLAND WATERS: COASTAL ENVIRONMENTS AND THE CLEANUP OF OIL SPILLS,

Woodward-Clyde Consultants, Victoria (British Columbia).
For primary bibliographic entry see Field 5G.
W86-03621

LITERATURE SURVEY OF RESERVOIR CONTAMINANT PROBLEMS,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. A. Khalid, R. P. Gambrell, B. A. Taylor, and W. H. Patrick.
Technical Report E-83-13, May 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineering Waterways Experiment Station, Vicksburg, MS. 159 p, 22 tab, 221 ref, 2 append. DACW39-80-C-0032

Descriptors: *Reservoirs, Aquatic life, Chemicals, *Fate of pollutants, Sediment transport, *Water quality, *Water quality standards, *Pollution load, Literature review, Reservoir operation, Corps of Engineers, Fish, Shellfish, Sampling, Biological magnification, Standards, Metals, Organic compounds, Inorganic compounds, Pollutant identification, Salinity, Data aquisition, Water analysis, Sedimentation, Sediment discharge, Sediment load, Bottom sediments, Monitoring, Stratification, Trace elements, Pesticides, Insecticides, Herbicides, Water pollution control, Acid mine drainage.

The literature on toxic chemical contaminants in Corps of Engineers reservoirs is reviewed for the purpose of developing interim guidelines to minimize contaminant problems. Sources of information include the published literature, the EPA STORET system, Corps of Engineers personnel, and other government reports. Although a considerable amount of information is available, procedures vary widely and certain subject areas have limited data. The need for basic project-specific research on the chemistry and fate of toxic contaminants in reservoir systems is emphasized. Data on inorganic contaminants were limited, but data on organic contaminants were even more limited. Only a few selected reservoirs were intensively monitored. Regional patterns of contamination were not established except for some patterns in acid mine discharge and high salinity. Limited information was available on sediment loss from watersheds, sediment transport in streams and rivers, sedimentation in reservoirs, sediment discharge in reservoir releases, and contaminant loadings of reservoirs and release waters. Very little information is available on which to base guidelines for managing reservoir contamination.
W86-03623

USER'S MANUAL FOR THE INSTREAM SEDIMENT-CONTAMINANT TRANSPORT MODEL SERATRA,

Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi, and S. E. Wise.
EPA 600/3-82-055, May 1982. Environmental Research Laboratory, Athens, GA. 187 p, 1 fig, 6 tab, 7 ref, append. 68-03-2613.

Descriptors: *Sediment transport, *Model studies, *Mathematical models, *Mathematical equations, *Fate of pollutants, *Pesticide kinetics, *Computer programs, *Finite element method, Models, Path of pollutants, Prediction.

This manual guides the user in applying the sediment-contaminant transport model SERATRA which is an integral part of the Chemical Migration and Risk Assessment Methodology. SERATRA is an unsteady two-dimensional code that utilizes the finite element computation method with the Galerkin weighted residual technique. It predicts overland and instream pesticide migration and fate to assess the potential short- and long-term impacts on aquatic biota in receiving streams. The model has general convection-diffusion equations containing decay and sink/source terms with appropriate boundary conditions. A sediment transport submodel, a dissolved contaminant transport submodel, and a particulate contaminant (adsorbed by sediment) transport submodel are coupled to include the effects of sediment-contaminant interaction.
W86-03630

FATE OF OIL AND DISPERSANT MIXTURES IN FRESHWATER,

Canada Centre for Inland Waters, Burlington (Ontario).
E. Nagy, B. F. Scott, and J. Hart.
Report EPA 4-EC-81-3, December 1981. Environmental Protection Service, Ottawa, Ontario. 66 p, 21 fig, 6 tab, 15 ref, 4 append.

Descriptors: *Fate of pollutants, *Path of pollutants, *Dispersants, *Oil spills, *Oil slicks, *Cleanup operations, Surfactants, Ponds, Recovery, Toxicity, Chemical analysis.

The study was initiated to observe the fate and ecological effect of an oil/dispersant mixture in a selected freshwater system over an extended period of time. Also, the effectiveness of the dispersant under the test conditions and the ability of the system to recover, if adversely affected, were investigated. Large outdoor ponds with their indigenous biota were utilized, and results from ponds treated with an oil/dispersant mixture were compared to those from oil-treated and control ponds. Oiled and controlled conditions were established, using Norman Wells crude oil and Corexit 9527 as the dispersant. The surface, water column, sediment, liner and attached biota were sampled systematically for a year. The water column contained only a small amount of the oil during most of the experimental period, as dispersed oil quickly surfaced and eventually sank to the sediment. The chemistry and composition of the slicks were examined; thinner slicks had a greater carbonyl content and more dispersant relative to thicker slicks. Final distribution analysis revealed that more oil was unaccounted for in the oil/dispersant ponds than in the oil-treated pond. There was no evidence to suggest that the dispersant altered the composition of the oil during the experiment, and the oil in all ponds underwent changes that were similarly independent of treatment.
W86-03637

DEEP-WATER BLOWOUT TRAJECTORY MODELS FOR THE LANCASTER SOUND REGION,

Arctic Sciences Ltd., Sidney (British Columbia).
J. R. Marko.
Report EPS 4-EC-82-2, March 1982. Environmental Protection Service, Ottawa, Ontario. 134 p, 19 fig, 7 tab, 24 ref, 2 append.

Descriptors: *Path of pollutants, *Blowouts, *Deep water, *Trajectory models, *Oil spills, *Turbulent flow, Model studies, Wind, Wind tides, Baffin Bay, Lancaster Sound.

Procedures were developed to simulate sea surface movements of oil released from deep-water oil blowouts. Emphasis was upon making realistic allowances for the horizontal spreading of oil by turbulence and current-features not included in the 5 nautical mile grid of residual currents utilized. The current values in this grid were established through the use of recent data from moored current-meters and drift-buoys. Simulations were carried out for four hypothetical blowout locations in Lancaster Sound and in the immediately adjoining sector of Baffin Bay. Separate scenarios were calculated at each site for steady winds from each of the four basic directions and for actual recorded wind sequences. Considerable contamination of shorelines occurred in most cases, except under westerly winds which generally tended to sweep oil out into the more open Baffin Bay region. Uncertainties regarding the appropriate magnitude of horizontal diffusion were explored through comparisons of scenarios computed for different values of a basic diffusivity parameter.
W86-03638

EVALUATION OF SELECTED ONE-DIMENSIONAL STREAM WATER-QUALITY MODELS WITH FIELD DATA,

Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
S. C. McCutcheon.
Technical Report E-83-11, May 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 183 p, 40 fig. 14 tab. 55 ref, append.

Descriptors: *Reservoirs, *Rivers, *Model studies, *Water quality, *Fate of pollutants, *Nitrogen compounds, Mathematical models, Chattahoochee River, Georgia, Willamette River, Oregon, Arkansas River, Colorado, Streeter-Phelps model, QUAL II model, U.S. Geological Survey model, U.S. Army Hydrologic Engineering Center model, Velz model, Massachusetts Institute of Technology model, Nitrification, Dissolved oxygen, Orthophosphates, Phosphates, Coliforms, Water pollution, Metals, Water temperature, Bacteria, Biochemical oxygen demand, Algae, Nitrates, Ammonia, Stream biota, Aeration, Ecology, Phytoplankton, Zooplankton, Temperature.

Evaluation of the U.S. Geological Survey One-Dimensional Steady-State Stream Water-Quality Model (a modified Streeter-Phelps model), the QUAL II model (Southeast Michigan Council of Governments version), and the U.S. Army Hydrologic Engineering Center's Water Quality for River-Reservoir Systems model indicate that these readily available models for simulating water quality downstream of reservoirs were of comparable accuracy and performance and performed according to their documentation. The evaluation was based on a wide range of accurate steady-state data collected on the Chattahoochee River in Georgia, the Willamette River in Oregon, and the Arkansas River in Colorado. A number of differences exist among these three models; however, each model has the flexibility to make these differences relatively unimportant for typical water quality studies. Each model had minor coding errors which have been corrected. Modeling capabilities are summarized in tabular form to facilitate comparison and selection. Although the modified Streeter-Phelps and QUAL II models are equally valid, different modeling options may make one preferable depending on the specific modeling application. The Water Quality for River-Reservoir Systems model is best limited to dynamic flow and water quality modeling because the data-coding it requires is tedious and involved. However, the wide range of components in the model may be needed for steady-state modeling under special conditions. (Author)
W86-03644

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA,

Battelle Pacific Northwest Labs., Richland, WA.
Y. Onishi, and S. E. Wise.
EPA 600/3-82-045, August 1982. Environmental Research Laboratory, Athens, GA. 56 p, 24 fig, 26 ref. 68-03-2613.

Descriptors: *Sediment transport, *Simulation analysis, *Pesticide kinetics, *Fate of pollutants, *Mathematical models, *Hydrolysis, *Chemical degradation, *Halogenated pesticides, Models, Model studies, Pesticides, Water pollution effects, Aquatic life, Path of pollutants, Water pollution sources, Biodegradation, Oxidation.

The sediment-contaminant transport model SERATRA was used as an integral part of the Chemical Migration and Risk Assessment Methodology, which simulates migration and fate of a contaminant over the land surface and in receiving streams, to assess potential short- and long-term impact on aquatic biota. SERATRA, an unsteady, two-dimensional finite element model, consists of three submodels coupled to include the effects of sediment-contaminant interactions--a sediment transport submodel, a dissolved contaminant transport submodel, and a particulate contaminant (contaminants adsorbed by sediment) transport submodel. The sediment transport submodel simulates transport, deposition and scouring of three sediment size fractions of cohesive and noncohesive sediments. The dissolved contaminant transport submodel includes mechanisms of contaminant adsorption/desorption and contaminant degradation resulting from hydrolysis, oxidation, photolysis, volatilization, biological activities and radionuclide decay to predict migration of dissolved contaminant. The particulate contaminant submodel simulates transport, deposition and scouring of contaminants associated with three size fractions of sediments. SERATRA also predicts changes of bed conditions for sediment and particulate contaminants. SERATRA was applied to Four Mile and Wolf Creeks in Iowa to simulate transport of sediment and the pesticide alachlor in these streams. Study results demonstrate that SERATRA is a useful tool for evaluating migration and fate of various hazardous substances and toxic chemicals in rivers by including contaminant interaction and contaminant degradation. (Author)
W86-03648

NONPOINT NITRATE POLLUTION OF MUNICIPAL WATER SUPPLY SOURCES: ISSUES OF ANALYSIS AND CONTROL,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 5G.
W86-03649

EFFECTS OF REGIONAL WATER MANAGEMENT ON N-POLLUTION IN AREAS WITH INTENSIVE AGRICULTURE,

Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 5G.
W86-03650

HYDROGEOLOGICAL ASPECTS OF GROUNDWATER NITRIFICATION,

L. Alfoldi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A02 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 43-55, 6 fig, 4 ref.

Descriptors: *Nitrates, *Nonpoint pollution sources, *Agriculture, *Water quality control, *Fate of pollutants, *Subsurface water, Fertilizers, Soil chemistry, Nitrogen compounds, Capillarity, Nitrification, Ammonia, Groundwater pollution, Confined aquifers, Surface water, Hydrologic budget, Water pollution sources, Soil horizons, Soil profiles, Soil water.

Surface and subsurface waters constitute two separate systems with respect to nitrogen budget. Interaction bewteen the two can be characterized by simple input-output relationships. The accumulation of nitrogen in subsurface waters is the result of complex and intermittent processes. Organic matter and nitrogen fertilizers enter the soil, where biochemical and chemical reactions transform the nitrogen compounds to ammonia and nitrate depending on pH and temperature. Soil systems can be classified hydrogeologically into three types: (1) self-contained water budget, as seen in gravel underlying surface soil (nitrates tend to accumulate), water budget affected by subsurface waters (nitrate permeates deep zones), and independent water budgets, e.g., impervious clay separating the surface and underlying aquifer (little vertical nitrate pollution). An understanding of the three basic soil systems shows how nitrate can accumulate irreversibly in groundwater and highlights the necessity of better control of fertilizer application.
W86-03651

IMPACT OF NITROGEN FERTILIZER APPLICATION ON THE NITRATE CONCENTRATION IN GROUNDWATER: COST-BENEFIT ANALYSIS CONSIDERATIONS,

Goettingen Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W86-03652

POSSIBILITIES OF CONTROLLING NITRATE CONCENTRATIONS IN DRINKING WATER,

For primary bibliographic entry see Field 5G.
W86-03653

NITRATE POLLUTION OF GROUNDWATER RESOURCES: MECHANISMS AND MODELLING,

Water Research Centre, Medmenham (England). Medmenham Lab.
D. B. Oakes.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A02 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria, Series No. CP-82-S4, 1982. p 207-230, 13 fig, 2 tab, 15 ref.

Descriptors: *Path of pollutants, *Nitrates, *Groundwater pollution, *Model studies, *Aquifers, *Solute transport, *Nonpoint pollution sources, Interstitial water, Aquifers, Chalk Aquifer, United Kingdom, Water pollution sources, Agriculture, Nitrogen compounds, Aeration zone, Grasslands.

In the United Kingdom field studies of the unsaturated zones of 30 sites on the Chalk and 12 on the Triassic Sandstone aquifers have shown a correlation between arable farming regimes and high nitrate concentrations in interstitial pore water. A slow downward movement of nitrate has been proved at three sites. A mathematical model of solute transport through the unsaturated zone has successfully simulated the observed nitrate profiles at a number of the investigated sites. This vertical transport model has been incorporated in a catchment model which has been used to predict changes in ground water nitrates, in some areas, to levels above 11.3 mg N per liter. (Author)
W86-03656

INTEGRATED PHYSICAL-ECONOMIC SYSTEMS ANALYSIS OF IRRIGATED AGRICULTURE,

California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W86-03658

AQUACULTURE AND DREDGED MATERIAL CONTAINMENT SITES: SIGNIFICANCE OF CONTAMINATED SEDIMENTS,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
H. E. Tatem.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 169-189, 15 tab, 1 fig, 18 ref.

Descriptors: *Fate of pollutants, *Ponds, *Aquaculture, *Aquatic habitats, *Dredging, *Sediments, *Invertebrates, Clams, Polychlorinated biphenyls, Chlorinated hydrocarbons, Metals, Lead, Prawns, Bioaccumulation, Accumulation, Polychaetes, Aquatic animals.

Invertebrates were exposed to contaminated sediments for periods of 30 to 136 days. Polychlorinated biphenyls (PCBs) were available to animals, particularly to infaunal species. Bioaccumulation was affected by the level of contamination, organic material in the sediment, and the life-style of the organism. Animals did not concentrate PCBs to levels greater than sediment levels. Shrimp and filter-feeding clams did not accumulate as much PCBs as polychaetes or deposit-feeding clams. Of the metals considered, only lead showed potential for bioaccumulation. Levels of lead in the animals were much lower than levels in the sediments. Although most dredged material contains PCB, deposition in containment areas can be planned so that sediment with higher concentrations of PCB are covered with less contaminated sediments.
W86-03714

PHYTOPLANKTON-ENVIRONMENTAL INTERACTIONS IN RESERVOIRS: VOLUME 1.

For primary bibliographic entry see Field 2H.
W86-03716

CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: PROCEEDINGS OF THE 15TH ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM.

For primary bibliographic entry see Field 6G.
W86-03737

DISTRIBUTION AND ENRICHMENT OF TRACE METALS (CD, CR, CU, NI, PB, ZN) IN BOTTOM SEDIMENTS OF NAVIGATION POOLS 4 (LAKE PEPIN), 5 AND 9 OF THE UPPER MISSISSIPPI RIVER,

Wisconsin Univ.-La Crosse. River Studies Center.
P. A. Bailey, and R. G. Rada.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 119-138, 6 fig, 5 tab, 28 ref.

Descriptors: *Fate of pollutants, *Metals, Rivers, *Sediments, Bottom sediments, Lake sediments, Heavy metals, Cadmium, Chromium, Copper, Nickel, Lead, Zinc, Adsorption, Clay, Organic matter, Mississippi River, Lake Pepin, Backwater.

Bed sediments were collected in Lake Pepin in the Upper Mississippi Valley, to determine the heavy metals contents and physical parameters. Strong positive correlations were obtained between metals and clay, between metals and organic matter, and between clay and organic matter. Lake Pepin, which contains a high proportion of clay, apparently acts as a trapping basin for metals. Mean metals concentrations (in micrograms per gram dry weight), when adjusted for grain size effects and grain size distributions, were as follows: in Lake Pepin and above Lake Pepin--Cd, 2.68-3.44; Cr, 33.1-39.9; Cu, 20.8-21.8; Ni, 22.1-21.8; Pb, 22.1-23.0; and Zn, 81.8-95.9; downstream of Lake Pepin--Cd, 1.27-1.29; Cr, 20.0-26.3; Cu, 13.4-15.3; Ni, 10.3-21.9; Pb, 12.8-16.7; and Zn, 56.9-57.5. Comparison of the data show that cadmium, copper, lead, and zinc levels were significantly higher within and upstream of Lake Pepin than in downstream stations. Chromium levels showed a slight trend in this direction. However, nickel levels were similar upstream and within Lake Pepin and at the closest downstream station.
W86-03742

LONGITUDINAL DISTRIBUTION OF TRACE ELEMENTS (AS, CD, CR, HG, PB, AND SE) IN FISHES AND SEDIMENTS IN THE UPPER MISSISSIPPI RIVER,

Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station.
J. G. Wiener, G. A. Jackson, T. W. May, and B. P. Cole.
In: Contaminants in the Upper Mississippi River; Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 139-170, 1 fig, 9 tab, 67 ref.

Descriptors: *Fate of pollutants, Fish, *Metals, Rivers, *Sediments, *Accumulation, Backwater, Bed sediments, Heavy metals, Cadmium, Mercury, Lead, Arsenic, Selenium, Chromium, Carp, Bluegills, Mississippi River, Bioaccumulation.

Concentrations of trace metals were determined in bed sediments and fish from a 500-km stretch of the Upper Mississippi River from upstream of the Twin Cities area to Guttenberg, Iowa. Levels of trace elements were generally highest in whole carp and carp liver from samples collected upstream from, at, and immediately downstream from the Twin Cities area. However, the metals levels in whole bluegills and common carp generally showed no correlation. Concentrations of Cd, Hg, and Pb in bed sediments at and downstream from the Twin Cities were higher than samples from other sites. Spearman correlation coefficients between elemental concentrations in fish and in bed sediments, paired by location, were nonsignificant for As, Cd, and Hg and only marginally significant for Pb. Mean concentrations (in micrograms per g dry weight) for whole fish were as follows: carp--As, 0.35; Cd, 0.11; Cr, 0.40; Pb, 2.9; Hg, 0.45; Se, 0.99; bluegill--As, 0.29; Cd, 0.046; Cr, 3.5; Pb, 0.38; Hg, 0.20; Se, 1.2. Concentrations of metals in sediments varied with the location; highest levels (in micrograms per g) were: Cd, 15.1; As, 6.24; Hg, 0.198; Pb, 85.8.
W86-03743

HEAVY METAL ACCUMULATION IN SELECTED SESSILE COMPONENTS OF FOUNTAIN CITY BAY, POOL 5A, OF THE UPPER MISSISSIPPI RIVER,

Saint Mary's Coll., Winona, MN. Dept. of Biology.
K. J. Buhl, and D. R. McConville.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 171-194, 3 fig, 8 tab, 43 ref.

Descriptors: *Fate of pollutants, *Aquatic plants, *Metals, Rivers, *Accumulation, *Sediments, Mississippi River, Heavy metals, Bed sediments, Fountain Clay Bay, Backwater, Roots, Bioaccumulation, Macrophytes, Cadmium, Copper, Chromium, Zinc, Coontail, Pondweed, Water lily, Arrowhead.

The trace metals Cd, Cu, Cr, and Zn were differently accumulated by different ecological life forms of aquatic macrophytes. In addition, these metals were compartmentalized within rooted species. Broadleaf arrowhead roots accumulated significantly higher levels of Cd, Cr, Cu, and Zn than shoot tissues, whereas white water lily shoots contained significantly higher levels of Cd, Cr, and Zn than rhizomes. Copper was statistically higher in the rhizomes of water lilies than in shoots. The geographic distribution and accumulation of heavy metals in sediments of backwater areas along the Upper Mississippi River appear to be regulated by the transport and deposition of suspended solids (the fraction less than 63 microns), as demonstrated by the strong correlation obtained when total sediment metal concentrations were regressed against textural composition. Fine-grained sediments, which aggregate in backwater areas, act as metal sinks in the river. In relation to these sinks, coontail and Potamogeton may accumulate metals in the water column, whereas arrowhead roots may act as biological reservoirs in the bed sediments, mobilizing the particulate-bound metals. (Author)
W86-03744

TRACE ELEMENTS IN THE WATER, SEDIMENTS, AND FISH OF THE UPPER MISSISSIPPI RIVER, TWIN CITIES METROPOLITAN AREA,

Metropolitan Waste Control Commission, St. Paul, MN.
H. A. Boyer.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 195-230, 2 fig, 16 tab, 45 ref.

Descriptors: *Fate of pollutants, Rivers, *Metals, *Aquatic life, Heavy metals, Trace metals, Sediments, Bed sediments, Fish, Water analysis, Mississippi River, Cadmium, Mercury, Lead, Arsenic, Copper, Zinc, Silver, Chromium, Nickel, Bioaccumulation, Accumulation, Public health.

Concentrations of trace elements in water, bed sediments, and fish of the Upper Mississippi River suggested potential impact on aquatic life and public health from cadmium, mercury, and lead; impact in public health only from arsenic; and impact on aquatic life only from copper and zinc. Trace element concentrations were of the same order of magnitude in the Twin Cities region as in the Lower St. Croix River, a tributary. Trends in concentrations of all trace elements were as follows: water--no discernible trends; sediment--increased from upstream to downstream, except for arsenic; fish--increased cadmium over most of the study area. Concentrations of Cd, Hg, Cu, and Zn in fish livers and bed sediments generally were within a factor of ten. As and Pb concentrations were less in carp livers than in bed sediments but more than in water. Pb and Zn levels in fish did not increase substantially with increases in bed sediment levels. Arsenic levels were higher in fish at some sites compared with levels in bed sediments. Selenium and beryllium levels were generally below detection. Silver, chromium, and nickel levels were considered of minor importance in this area of the river.
W86-03745

POLYCHLORINATED BIPHENYLS (PCBS) IN COMMON CARP (CYPRINUS CARPIO) OF THE UPPER MISSISSIPPI RIVER,

Minnesota Pollution Control Agency, Roseville.
M. E. Hora.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 231-239, 3 fig, 4 tab, 6 ref.

Descriptors: *Fate of pollutants, *Polychlorinated biphenyls, Fish, Rivers, Mississippi River, *Carp, Chlorinated hydrocarbons, Minnesota River, Bioaccumulation, Accumulation, Aquatic life.

The grand weighted mean concentrations of polychlorinated biphenyls (PCB) in common carp fillet sampled in the Upper Mississippi River (Sartell to Wabasha) decreased 49% (from 4.01 mg/kg in 1975-76 to 2.05 mg/kg in 1979-80). The grand weighted mean of the lipid-based PCB concentrations decreased 65% in the same period (129 mg/kg to 45.1 mg/kg). PCB levels in carp also decreased 85% (3.24 mg/kg to 0.5 mg/kg) in the Minnesota River, a tributary of the Mississippi. These results should be compared with caution because of interlaboratory analytical differences between the earlier and later analyses.
W86-03746

POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE INSECTICIDES IN GREAT BLUE HERON AND GREAT EGRET EGGS FROM THE UPPER MISSISSIPPI RIVER,

Saint Mary's Coll., Winona, MN.
J. A. Nosek, and R. A. Faber.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 241-259, 5 tab, 33 ref.

Descriptors: *Fate of pollutants, *Polychlorinated biphenyls, Birds, Rivers, *Wildlife, *Pesticides, *Aquatic animals, *Egrets, Herons, Eggs, Chlorinated hydrocarbons, Insecticides, DDT, DDE, Mirex, Heptachlor, Nonachlor, Hexachlorobenzene, Endrin, Dieldrin, Bioaccumulation, Accumulation, Waterfowl, Mississippi River, Fountain City Bay.

Eggs of great blue herons and great egrets collected in 1978 from a colony in the Fountain City Bay area of the Upper Mississippi River were analyzed for polychlorinated biphenyls (PCBs) and organochlorine pesticides. The highest concentrations found were those of PCBs, with geometric means of 14.1 and 13.3 ppm wet weight in great blue heron and great egret eggs, respectively. DDE concentrations were second highest, with geometric means of 1.41 and 1.76 ppm wet weight in heron and egret eggs, respectively. Ratios of (DDT+DDD)/DDE were higher than expected, because DDT was banned in 1972 (six years prior to the study), and it slowly degrades to DDE. Mirex was detected in 15 of the 22 eggs analyzed and probably was carried to the breeding area from the wintering grounds. The presence of endrin in seven of these specimens supports this contention. Dieldrin levels were higher than might be expected (geometric means of 0.400 and 0.391 ppm in herons and egrets, respectively), because it was banned in 1974. Also encountered were HCB, heptachlor epoxide, and trans-nonachlor. Reproductive success in 1978 was within the bounds of other published data, but colony size in 1978 was smaller than in 1975 (463 nests vs 586 nests). This decline was apparently due to movement of many birds to a new colony 16 km distant. (Author)
W86-03747

ESTABLISHMENT OF AN AMMONIA EFFLUENT LIMITATION FOR THE TWIN CITIES METRO PLANT,

Minnesota Pollution Control Agency, Roseville.

D. E. Maschwitz.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 261-277, 2 fig, 9 tab, 13 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Ammonia, *Wastewater treatment, *Standards, *Effluent limitations, Rivers, Mississippi River, Minnesota, Twin Cities, Low flow, Water quality standards.

Ammonia effluent limitations were determined for the Twin Cities Metro Plant using a mass balance calculation after ambient conditions below the discharger had been established. Past routine water quality data (1971-1979) from stations in the 10-mile reach of Mississippi River below the Metro Plant indicated a median pH value of 7.8 and a mean temperature of 24 degrees C for the critical period of July, August, and September. Routine data for 1980 and 1981 indicated a slight increase in downstream pH to 7.9, which generally coincided with improved BOD removal at the Metro Plant. The August through mid-September period combines relatively warm water temperatures (23 degrees C) with a greater probability of low flows. Thus, a pH of 7.9 and temperature of 23 degrees C formed the basis for the effluent limitation of 5 mg/liter for the critical period. Two provisions of Minnesota Water Quality Rules imply that compliance with the ammonia water quality standard will be achieved 50% of the time at the 7Q10 flow. A compliance analysis procedure was used to estimate compliance at flows other than the 7Q10 and over the full range of river flows. The procedure was based on the downstream variability of unionized ammonia and used the normal cumulative distribution to calculate the expected percent of time the standard will be exceeded. This technique can be a useful tool for assessing expected compliance with water quality standards under conditions of proposed limitations. (Author)
W86-03748

WATER CHEMISTRY AT SELECTED SITES ON POOLS 7 AND 8 OF THE UPPER MISSISSIPPI RIVER: A TEN-YEAR SURVEY,

National Fishery Research Lab., La Crosse, WI.
V. K. Dawson, G. A. Jackson, and C. E. Korschgen.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 279-298, 3 fig, 2 tab, 7 append, 19 ref.

Descriptors: *Fate of pollutants, *Water quality, Rivers, Mississippi River, Nutrients, *Nitrogen compounds, Nitrates, Nitrites, Ammonia, Phosphates, Biochemical oxygen demand, Hydrogen ion concentration, Conductivity, Alkalinity, Water hardness, Dissolved oxygen, Oxygen, Water temperature, Suspended load, Seasonal variation, Varied flow, Runoff, *Water chemistry.

Water samples were collected from seven stations on the Upper Mississippi River from above Dakota to LaCrosse, Wisconsin. Results of 12 water quality parameters were averaged for each month over a ten-year period. Water chemistry appeared to depend on variations in river discharge rates. In summer, total phosphate levels increased, whereas nitrate nitrogen and ammonia nitrogen levels decreased. Dissolved oxygen concentrations remained at 75%-100% of saturation at six of the seven sampling stations. Oxygen concentrations were very low at the edge of Lake Onalaska during periods of heavy ice and snow cover. Most of the nutrient load was transported during spring runoff. The average annual discharge of suspended matter in the navigation pools was about 600,000 tons per year. The water quality parameters measured did not significantly change over the study period, 1972 to 1980.
W86-03749

INVESTIGATION OF EFFECTS OF NAVIGATION TRAFFIC ACTIVITIES ON HYDROLOGIC, HYDRAULIC, AND GEOMORPHIC CHARACTERISTICS IN THE UPPER MISSISSIPPI RIVER SYSTEM,

Simons, Li and Associates, Inc., Fort Collins, CO.
Y. H. Chen, D. B. Simons, R-M. Li, and S. S. Ellis.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 299-324, 9 fig, 5 tab, 14 ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Environmental effects, *Navigation, *Channels, Rivers, *Sediments, Mississippi River, Illinois River, Suspended sediment, Model studies, Barges, Transportation, Boats, Mathematical models, Turbidity, Bank erosion, Erosion, Wave height, Towboats, Backwater.

A mathematical model was developed to determine the effects of navigation traffic on the physical environment of a channel. The following factors were considered: boat-generated wave heights and velocity changes, bed material resuspension and suspended sediment concentrations, turbidity, and sediment volume entering side channels and backwater areas. Calibration from data collected in the Upper Mississippi and Illinois Rivers showed reasonably good agreement between calculated and measured values. Suspended sediment concentrations were predicted to be 96%-144% greater in the year 2000 and 60%-167% greater in the year 2040 when compared with 1977. Tow traffic in 1977 produced increases in sediment volume entering backwater areas by 2.0%-3.4% above natural levels. Predicted values for 2000 and 2040 were 4.3%-9.3% and 3.5%-10.2%, respectively, above natural levels. Navigation effects were greatest when tow boats sailed close to the banks and when traffic was heavy.
W86-03750

CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: SUMMARY AND CONCLUSIONS,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 6G.
W86-03752

HYDROCHEMICAL BALANCES OF FRESHWATER SYSTEMS: PROCEEDINGS OF THE UPPSALA SYMPOSIUM.

Naturvetenskapliga Forskningslaboratoriet i Studsvik, Nykoeping (Sweden).
September 1984. IAHS-AISH Publication No 150, 1984. Edited by Erik Eriksson. 428 p.

Descriptors: *Chemical properties, Natural waters, Hydrologic data collections, *Data interpretation, *Geohydrology, *Groundwater, *Hydrologic models, *Sedimentology, Symposium, Conferences, Catchment areas, Hydrologic data, Chemical reactions.

This symposium which constitutes the Swedish contribution to the Third Phase of the International Hydrological Program addresses different hydrochemical processes which affect the composition of atmospheric precipitation, soil solutions, and surface water in rivers and lakes, and the hydrochemical balances attained in various freshwater systems. The interactions of freshwater forms with various biotic and abiotic environmental factors are not well understood. Man's activities affect many of the hydrochemical processes and thus complicate the designing of measurement systems and the interpretation of collected data. A select number of papers presented at the symposium were chosen for publication based on their representation of the scope of the conference and geographic representation. Symposium sessions treated the following subject areas: water interaction with soil and rock, data collection and adequate distribution in space and time, budgeting and modelling for catchment areas and other hydrological units, description and analysis of sorption-desorption phenomena in natural systems, and hydrochemical and sediment geochemical data as a tool for deciphering hydrological processes.
W86-03753

CARBON DIOXIDE IN THE SOIL ATMOSPHERE: SIMULATION MODEL PARAMETER ESTIMATION FROM FIELD MEASUREMENTS,

Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
For primary bibliographic entry see Field 2G.
W86-03755

SIMULATION OF PHYSICOCHEMICAL INTERACTIONS IN A WATER-ROCK SYSTEM IN ASSESSING GROUND-WATER QUALITY,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2K.
W86-03759

SOME IMPLICATION OF THE ROLE OF KINETICS IN ENHANCING ELEMENT TRANSPORT,

Nairobi Univ. (Kenya). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-03760

LEAD AND CADMIUM IN PRECIPITATION IN THE ESSEX REGION OF SOUTHWESTERN ONTARIO,

Windsor Univ. (Ontario). Great Lakes Inst.
M. E. Sanderson, and D. Marchand.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 215-222, 3 fig, 4 tab, 4 ref.

Descriptors: *Lead, *Cadmium, *Polychlorinated biphenyls, *Fate of pollutants, *Air pollution, *Organic compounds, *Heavy metals, *Precipitation, Seasonal variation, Path of pollutants, Rural areas, Urban areas.

This research forms part of a large multidisciplinary study of four toxic contaminants, lead, cadmium, polychlorinated biphenyls (PCB's) and octachlorostyrene, in the Essex region of Southwestern Ontario. The purpose of this part of the project is to quantify the atmospheric loading of the contaminants. A bulk precipitation sampler, wet-only precipitation sampler and recording rain gauge were installed at an urban and a rural site. One year's data indicates that atmospheric loading of lead is 35-70 times that of cadmium in both urban and rural areas. Concentrations of the metals are higher in winter than in summer but because of higher summer precipitation surface loadings are similar in both seasons. Preliminary statistical analysis indicates that concentrations of the metals are related to intensity and amount of precipitation, but not duration of precipitation or wind direction. (Author)
W86-03772

MASS-BALANCE APPROACH TO THE UNDERSTANDING OF GEOCHEMICAL PROCESSES IN AQUEOUS SYSTEMS,

Ustredni Ustav Geologicky, Prague (Czechoslovakia).
T. Paces.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 223-235, 2 tab, 39 ref.

Descriptors: *Geochemistry, *Phosphorus, *Mathematical equations, *Catchment areas, *Hydrologic budget, *Chemical reactions, *Chemical properties, *Kinetics, Mass balance, Agricultural watersheds, Forest watersheds, Rivers, Lakes.

Two types of mass-balance equations are reviewed: the local mass balance in a body of water defined by the differential equation of conservation and continuity, and the integral mass balance of aqueous systems defined by the rates of inputs, outputs, sources, sinks, and accumulation over a hydrological year. The continuous behavior of P in a polluted river, the annual mass balances of Na, Ca, Al, N, and S in forested and agricultural drainage basins of small streams, and the integral mass balances of P in a lake are presented to demonstrate the use of the equations. Although the mass balances yield data on the overall rates of geochemi-

cal processes, they are not sufficient to decipher the physicochemical and biochemical mechanisms of the processes. Elucidation of the buffering effects of geochemical reactions may best be achieved by combining results of surface-chemistry kinetic experiments with data on natural rates derived from long-term mass-balance studies in well-defined representative drainage basins.
W86-03773

HYDROCHEMICAL BUDGETS OF SOME DUTCH WOODLAND SOILS WITH HIGH INPUTS OF ATMOSPHERIC ACID DEPOSITION: MOBILIZATION OF ALUMINUM,

Agricultural Univ., Wageningen (Netherlands).
J. J. M. Van Grinsven, J. Mulder, and N. Van Breemen.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 237-247, 2 fig, 2 tab, 20 ref. EC No: ENV-650-NL.

Descriptors: *Air pollution, *Aluminum, *Hydrologic budget, *Fate of pollutants, *Acidic soils, *Nitrogen compounds, *Forest soils, *Sulfates, Water pollution sources, Nitrification, Sulfur compounds, Subsoil, *Acid rain.

Woodland soils in the Netherlands receive extremely high inputs, 4.1 to 8.6 kmol/ha/yr, of atmospheric acidic substances. Nitrification of atmospherically derived NH3, in addition to SO2 and NOx is an important source of acidity. Neutralization of these acid inputs in acidic soils is mainly accomplished by the dissolution of aluminum. To evaluate rates and mechanisms of aluminum mobilization a study was conducted on sandy and loamy acidic soils and an adjacent calcareous soil. The chemistry of rainwater, canopy throughfall and soil solutions at various depths was monitored over a 3-yr period. Chemical budgets were calculated using simulated water fluxes. In the acidic soils up to 1.5 kmol/ha/yr aluminum are mobilized from the upper 10 cm. About one third of this aluminum is immobilized in the subsoil. Ion activity products suggest that the aluminum activity in solution may be regulated by jurbanite (Al(SO4)(OH).5H2O). (Author)
W86-03774

PHYSICO-CHEMICAL CHARACTERISTICS OF SURFACE WATERS AND HYDROLOGICAL BEHAVIOR OF A SMALL GRANITIC BASIN (VOSGES MASSIF, FRANCE): ANNUAL AND DAILY VARIATIONS,

Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
B. Fritz, J. C. Massabuan, and B. Ambroise.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 249-261, 4 fig, 1 tab, 16 ref.

Descriptors: *Acid rain, *Physicochemical properties, *Seasonal variation, *Water quality, *Fate of pollutants, *Daily hydrographs, *Discharge hydrographs, *Streams, Water pollution sources, Air pollution, Small watersheds, Chemical properties, Hydrologic data collections, Diurnal distribution, Anions, Cations, Trout, Granites.

Annual, daily and (acid) rainfall-induced variations of discharge, inorganic species concentrations and respiratory characteristics (O2, CO2, pH, TA, temperature) were studied in a small mountain stream draining a 36-ha granitic basin in the Vosges massif. The extension of the water-saturated area in the basin controls the diurnal discharge oscillations by evapotranspiration, and also the flood runoff volume. All solutions are dilute like typical groundwater on granite, and are strictly dependent on water discharge and temperature on all time scales studied. Alkalinity, Ca(++), Mg(++), Na(+) and SiO2 appear as tracers of alteration intensity, Cl(-), SO4(--), and K(+) as tracers of rain acid pollution. Nitrogen is fixed in the basin. The presence of trout living in extremely poorly ionized waters is reported. (Author)
W86-03775

GEOCHEMICAL STUDIES IN THE DRAINAGE BASIN OF THE RIO VOUGA (PORTUGAL). I. GENERAL HYDROGEOCHEMISTRY FROM ITS ORIGIN TO THE RIA DE AVEIRO,

Utrecht Rijksuniversiteit (Netherlands).
For primary bibliographic entry see Field 2K.
W86-03776

STUDY OF ANTHROPOGENIC INFLUENCE ON WATER QUALITY IN SOME RIVERS OF THE BALTIC SEA BASIN,

Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
B. G Skakalsky.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 295-302, 3 tab, 4 ref.

Descriptors: *Water quality, *Rivers, *Mineralization, *Statistical methods, *Consumptive use, *Anions, *Cations, *Seasonal variation, Statistical analysis, Ions, Minerals, Chemical oxygen demand.

Extensive observational data covering the past 30-40 yr was used to study the anthropogenic influence on the water quality of the Neva, Western Dvina and Neman Rivers of the Baltic Sea Basin. Statistical analyses were made to discover trends in changes of mineralization, ionic composition, dichromate (COD) and permanganate (PO) oxidizability. Two periods were compared: prior to the 1960's, when the effect of man's activities were minimal, and after the 1960's, when water consumption in these regions greatly increased. Results showed that mean annual water mineralization in the rivers increased by 7-22% in the lower reaches. The anion content was characterized by a decrease in the dichromate ion and by an increase in chloride and sulfate ions. The cation content was characterized by a decrease in the calcium ion and by an increase in the concentration of sodium and potassium ions. The representativeness of initial data based on COD and PO enabled the study of seasonal changes of these constituents.
W86-03779

EROSION OF AGRICULTURAL LAND - A GROWING WATER QUALITY PROBLEM IN RURAL AREAS,

Swedish Environmental Research Inst., Stockholm.
S-O. Ryding.
In: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 303-311, 6 fig, 12 ref.

Descriptors: *Phosphorus, *Erosion, *Soil erosion, *Water quality, *Surface runoff, Sediment transport, Rural areas, *Agricultural runoff, Land use, *Water pollution sources, Catchment areas, Suspended solids, Fate of pollutants, *Agricultural watersheds, Sediment erosion.

A long-term study of surface runoff from ten drainage basins of different land-use patterns in the Scania region, southern Sweden, indicates a clear relationship between the content of erosion material and the degree of arable land. Losses of phosphorus bound to erosion material can make up a considerable portion of the total phosphorus export from agricultural areas - a loss that has been found to increase a lot during the two last decades. Transport of suspended matter was in the order of 300-500 kg/ha/yr, which with an average phosphorus content of 0.11%, resulted in a transport of phosphorus bound to particles of nearly 0.4 kg P/ha/yr. This corresponds to about one-third of the total phosphorus loss originating from different kinds of agricultural activities. Different outcomes concerning areal phosphorus losses from arable land due to varying investigation techniques are discussed. (Author)
W86-03780

WATER QUALITY AND WATER POLLUTION PROBLEMS ON THE INDIAN SUB-CONTINENT,

Central Chemical Lab., Lucknow (India).
B. K. Handa.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 313-322, 1 fig, 9 tab, 15 ref.

Descriptors: *Water quality, *Groundwater pollution, *Water pollution sources, *Water pollution, *Acid rain, *Fate of pollutants, *Stream pollution, *Water pollution effects, Heavy metals, Nutrients, Metals, Trace metals, Industrial wastes, *India, Chemical properties.

The quality of water on the Indian sub-continent varies both in space and time. The studies on the chemical composition of rainwater at several locations in India have revealed that except at Calcutta and Bombay, where acid rainfall has been recorded, the pH of rainwater is normally above 6.0. Studies on rainwater at Lucknow have revealed that the trace metal contents are normally low. The quality of surface waters in major part of the year is good with salinity being low to moderate, but in many cases due to discharge of untreated sewage and industrial effluents, the quality of stream water has deteriorated and at times fish mortality has been reported. Many of the freshwater lakes like the Dal, the Wular, the Naini Tal, the Kolleru etc. are in a state of decadence. Marine pollution off the coast of Bombay has been reported. The quality of groundwater also varies considerably. Apart from salinity problems in some parts of India, groundwaters with high F or high Fe content are also encountered. Pollution of groundwaters by plant nutrients, through return irrigation flows occurs widely. At places due to infiltration of industrial waste effluents, groundwaters with high Cr and/or high CN concentrations are also encountered. (Author)
W86-03781

MODEL EXPERIMENTAL STUDY OF HYDROCHEMICAL PROCESSES IN THE SATURATED ZONE,

Higher Inst. of Mining and Geology, Sofia (Bulgaria).
For primary bibliographic entry see Field 2K.
W86-03785

SEPARATION OF RUNOFF COMPONENTS BY NO3-N LOADING AND ESTIMATION OF RUNOFF LOADING BY EACH COMPONENT,

National Inst. for Environmental Studies, Tsukuba (Japan).
S. Ebise.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 393-405, 11 fig, 9 ref.

Descriptors: *Runoff, *Nitrates, *Nitrogen, *Storm runoff, *Hydrologic models, *Rainfall-runoff relationships, *Storm seepage, *Surface runoff, Flood discharge, Load distribution, Models, Nonpoint pollution sources.

Separation of runoff components is useful not only for flood analysis but also for estimation of runoff loadings. The change in relationship, during direct storm runoff, between NO3-N loading (Y-axis) and discharge (X-axis) on log-log paper counterclockwise differs from other water quality indicators. The peak of NO3-N loading appears behind that of discharge, and NO3-N concentration rises for the latter half of runoff, compared with that preceding the storm. Considering this change of NO3-N loading as a tracer of prompt-subsurface runoff, the direct runoff component could be seperated by Sugawara's Tank Model, which has second-step tanks. Runoff from the first tank corresponds to surface runoff, and that from second tank to prompt-subsurface runoff. The particulate pollutant load from nonpoint sources, accumulated upon the ground surface of the basin, is washed off mainly by surface runoff. The dissolved substance load from the surface soil layer is carried away by subsurface runoff. (Author)
W86-03788

PROCEEDINGS OF STORMWATER AND WATER QUALITY MANAGEMENT MODELING USERS GROUP MEETING.

Environmental Research Lab., Athens, GA.
March 25-26, 1982, Washington, DC. Thomas O. Barnwell, editor. EPA-600/9-82-015, August 1982. 298 p.

Descriptors: *Mathematical models, *Computer models, *Hydrologic models, Storm design, Sediment transport, Hydrology, Storm water, Aeration, Pollution load, Nonpoint pollution sources.

This report includes 16 papers on topics related to the development and application of computer-based mathematical models for water quantity and quality management presented at the semi-annual meeting of the Joint U.S.-Canadian Stormwater and Water Quality Modeling Users Group held 25-26 March 1982 in Washington, DC. Topics covered include a study of selection, calibration and verification of water quality models in Louisiana and an assessment of measurement uncertainty in the estimation of stream reaeration rates for these models. Calibration of hydrology and sediment transport on small agricultural watersheds using the Hydrological Simulation Program-FORTRAN is described. Hydrologic modeling for studies of pollutant loads and transport in large river basins and the use of continuous simulation model calibration techniques to develop nonpoint pollution loading factors were described. A verification of a continuous dissolved oxygen model for a river in Missouri was presented. State-of-the-art data acquisition techniques in hydrometeorology were discussed. Mathematical analyses of turbulence in center-feed circular sedimentation basins and for dynamic model calibration are presented. Preparing storm designs for urban drainage analysis was presented as well as studies of pollutant concentrations and loading in highway runoff. An application of the EXTRAN model to offsite drainage is described. A desk-top calculator method for nonpoint source loads evaluation is described. Modifications to the QUAL-II model for continuous simulation of fecal coliforms is presented. A literature review was done of the relationship between atmospheric pollution and stormwater quality.
W86-03822

STUDY OF THE SELECTION, CALIBRATION AND VERIFICATION OF MATHEMATICAL WATER QUALITY MODELS,

National Council of the Paper Industry for Air and Stream Improvement, Inc., Medford, MA.
R. C. Whittemore, J. S. Hovis, and J. J. McKeown.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 1-35, 13 fig, 11 tab, 14 ref.

Descriptors: *Mathematical models, *Hydrologic models, *Calibration, Dissolved oxygen, Biological oxygen demand, Watersheds, Ouachita River.

The general objective of this study was to examine the differences among various models when applied to a single watershed in order to illustrate the limitations inherent in mathematical water quality modeling. More specifically, the study objectives were (a) testing the validity of four commonly used water quality models under increasingly strict calibration and verification criteria, (b) examining the predictive capability of these models for conditions of varying complexity, and (c) elucidating the dominant issues with respect to model selection, calibration and verification which are believed to be of concern in most waste load allocation studies. Dissolved oxygen, biological oxygen demand and nitrogen species were shown to be independent variables.
W86-03823

CONTINUOUS DO RESPONSE PREDICTED USING CSPSS IS VERIFIED FOR SPRINGFIELD, MISSOURI,

CH2M Hill International Corp., Gainesville, FL.
J. E. Scholl, and R. L. Wycoff.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 90-100, 3 fig, 3 tab, 3 ref.

Descriptors: *Dissolved oxygen, *Mathematical models, *Simulation analysis, *Water pollution, *Storm wastewater, Water pollution effects, Simulation, Storm water, Storm runoff, James River-MO.

Receiving water impacts on the James River near Springfield, Missouri were evaluated using the Continuous Stormwater Pollution Simulation System (CSPSS). The simulation of James River dissolved oxygen (DO) concentrations was calibrated to match the continuous in-stream DO measurements collected by the USGS between 1974 and 1977. This calibrated CSPSS model was then used to simulate the impact of the recently completed (November 1977) AWT facility in Springfield and to quantify the impact of alternatives to control pollution from urban stormwater runoff. Since 1954, six major fishkills have occurred on the James River after storm events. At the outset of this project, the cause of those major fishkills was suspected to be urban stormwater pollution. However, the use of CSPSS has indicated that the poor quality secondary effluent of the WWTP, rather than urban stormwater pollution, was probably the major cause of these fishkills. It is the purpose of this paper to present information which verifies the conclusions reported in the paper by Scholl and Wycoff (1981). The verification was obtained by developing a cumulative duration curve for DO concentrations observed at the calibration point on the James River between 1979 and 1980 (post-AWT conditions).
W86-03826

HYDROLOGIC MODELING FOR STUDIES OF POLLUTANT LOADINGS AND TRANSPORT IN LARGE RIVER BASINS,

Northern Virginia Planning District Commission, Annandale.
For primary bibliographic entry see Field 5A.
W86-03827

USE OF CONTINUOUS SIMULATION MODEL CALIBRATION TECHNIQUES TO DEVELOP NONPOINT POLLUTION LOADING FACTORS,

Northern Virginia Planning District Commission, Annandale.
J. P. Hartigan, T. F. Quasebarth, and E. Southerland.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 101-127, 11 fig, 5 tab, 9 ref.

Descriptors: *Mathematical models, *Loading factors, *Nonpoint pollution sources, Chesapeake Bay, Nitrogen compounds, Phosphorus compounds, Pollution load, Hydrologic models.

The purpose of the River Basin modeling study of the Chesapeake Bay was to compare the delivery of point source and nonpoint pollution loadings of nitrogen and phosphorus to the Bay's estuarine system. The model was also used to evaluate alternate eutrophication management strategies for the Bay's estuarine system. To develop nonpoint pollution loading factors for rural-agricultural and urban land use categories, a version of USEPA's NPS model was calibrated to several test watersheds characterized by relatively homogeneous hydrologic characteristics and a single land use. A total of 25 test watersheds were monitored from late 1979 through mid-1981 under a $2.5 million study funded by the EPA Chesapeake Bay Program. An earlier twelve-month monitoring study (1976-1977) of 16 urban test watersheds in the Virginia suburbs of Washington, DC. produced the majority of the urban nonpoint pollution loading data. This paper focuses on the development of rural-agricultural loading factors and the verification of 1976-1977 urban loading factors described elsewhere through the calibration of the NPS model to the EPA Chesapeake Bay Program test watersheds. River Basin Model simulations which verified the nonpoint pollution loading factors are also described.
W86-03828

PREDICTIVE MODEL FOR HIGHWAY RUNOFF POLLUTANT CONCENTRATIONS AND LOADINGS,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-03834

DESK TOP METHODOLOGY FOR NONPOINT SOURCE LOAD EVALUATION,

Weston (Roy F.), Inc., West Chester, PA.
A. K. Deb.
IN: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 248-259, 5 tab, 1 ref.

Descriptors: *Mathematical analysis, *Computer models, *Runoff forecasting, *Computer program, *Nonpoint pollution sources, Land use, Runoff coefficient, Storm water, Data interpretation.

This paper outlines a simplistic methodology for nonpoint source loading evaluation, in areas where rate coefficients and loadings can be estimated. The methodology has limited application, and can be used for first level of analysis, areas with similar characteristics where rate coefficients and loadings have been developed, and for determining the need for detailed computer modeling. The step-by-step methodology developed in this paper for evaluation of nonpoint source loads incorporates the following steps: (1) historical rainfall data analysis and selection of a design storm, (2) determination of the land use pattern of the study area, (3) determination of the percent of imperviousness of the various land use types, (4) estimation of the composite run-off coefficient for the study area, (5) estimation of the stormwater run-off rates, (6) calculation of pollutant accumulation on each land use at the start of the storm, and (7) estimation of the stormwater run-off loads.
W86-03836

CONTINUOUS SIMULATION OF INSTREAM FECAL COLIFORM BACTERIA,

Proctor and Redfern Ltd., Ottawa (Ontario).
A. C. Rowney, and L. A. Roesner.
IN: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 260-273, 5 fig, 4 tab.

Descriptors: *Mathematical models, *Computer programs, *Coliforms, *Simulation analysis, Wastewater, Storm wastewater, Stream pollution, Rideau River.

The simulation of fecal coliform bacteria in an urban stream is discussed in light of a recent study of the Rideau River at Ottawa, Canada. As part of this study, it became necessary to verify the use of a one-dimensional advection/dispersion river model incorporating first order decay in the simulation of fecal coliform bacteria. An extensive time-series data base was gathered for calibration and verification of the model QUAL-II. This data base was supplemented with runoff data simulated using STORM. It was found that the selected models provided a good representation of major processes in the test reach selected, certainly adequate for planning purposes. Some preliminary statistics representing the goodness of fit of simulated to observed instream concentrations are presented. In addition, modifications made to QUAL-II to permit simulation of time series input conditions are briefly discussed. (Author)
W86-03837

ATMOSPHERIC POLLUTION IN RELATION TO STORM WATER QUALITY MODELLING: LITERATURE REVIEW FOR AN INDUSTRIAL CITY,

McMaster Univ., Hamilton (Ontario).
B. Shivalingaiah, and W. James.
IN: Proceedings of Stormwater and Water Quality

Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 274-295, 4 fig, 3 tab, 26 ref.

Descriptors: *Mathematical models, *Computer programs, *Nonpoint pollution sources, *Fallout, Air pollution, Storm water, Computer models, Water quality, Lake Ontario.

The atmosphere is one of the largest sources of pollutants in surface runoff in an industrial city. The location of the major industrial areas, wind direction and velocity, and source concentrations, are important parameters in the prediction of the atmospheric fallout are correlated with these parameters and superimposed on the discretized catchment. The total accumulated dry weather loading is input to the water quality sections of SWMM-RUNOFF. The water quality algorithms in SWMM III are reviewed and improvements suggested, eg. inclusion of atmospheric fallout and scavenging, street sweeping time series data, separation of pollutant source areas, variable time step hydrology and moving storm analysis. (Author)
W86-03838

POLLUTANT TRANSPORT IN MISSISSIPPI SOUND: INTERIM TECHNICAL REPORT III,

Gulf Coast Research Lab., Ocean Springs, MS. Analytical Chemistry Section.
T. F. Lytle, and J. S. Lytle.
MASGP-82-015, November 1982. 20 p, 5 fig, 1 tab, 2 ref.

Descriptors: *Pollutants, *Sediment concentrations, Chemical analysis, Hydrocarbons, Chemical composition, Cores, Mississippi Sound.

A pollutant transport study to address pollution issues affecting present and future development of coastal areas of Mississippi is described. The program entailed collection of sediment cores from several locations in Mississippi Sound over a three-year period from 1979 through 1981. Each core was analyzed for total phenols, total organic carbon, total Kjeldahl nitrogen, and hydrocarbons. The data were used to address those pollution issues affecting present and future development of coastal areas. The likelihood that various activities, such as boating activity, tidal impact and dredging, would disturb the sediments and release those pollutants to the water column, was considered. Bioassays were conducted on mysid shrimp, sheepshead minnows, and amphipods to determine the relative toxicities of the surface sediments from various areas within the Sound. The use of this project in several educational programs is discussed. (Halterman-PTT)
W86-03839

DISPERSION OF SEDIMENT RESUSPENSION CAUSED BY DREDGE OPERATION,

Japan Dredging and Reclamation Engineering Association, Tokyo.
H. Kobe.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 90-105, 11 fig, 9 tab, 6 ref.

Descriptors: *Dredging, *Sedimentation, Sediment load, Pollution, Sediment transport, Suspended solids, Suspension, Suspended sediments, Japan, Turbidity, Model studies.

As a working model of dispersion of sediment resuspension caused by dredge operation, a model of turbidity levels according to distance from the dredge is useful. The level of turbidity near the sea bottom is estimated to be 5 ppm at a distance of 100 m and 3 ppm at 200 m from the dredge. Also, the level of turbidity near the water surface never exceeds that at the sea bottom. Therefore, it is not believed that dredging work will make a wide area of the sea turbid. (Author)
W86-03873

NEW TECHNIQUES DEVELOPED IN JAPAN FOR OIL SPILL CLEANUP,

Japan Workvessel Association, Tokyo.
I. Ofuji, and N. Ishimatsu.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 114-131, 16 fig, 4 tab, 6 ref.

Descriptors: *Oil pollution, *Pollutants, *Oil recovery, *Toxic wastes, Oily water, Secondary oil recovery, Cleanup operations, Oil skimmers, Water pollution control.

In the last decade, the total number of reported water pollution incidents in Japan has decreased by 36 percent. Of these incidents, 80 percent are oil spills. Three oil recovery systems currently being used in Japan are discussed in this paper. The first one is an oil recovery system that uses aeration to separate the oil and the water. It is intended for recovery of low viscosity oil that spreads itself over the water surface as a thin film. The second, or rotary bucket oil recovery system, is used to clean up spills of high viscosity oil, like crude or heavy oil, which remains on the water surface in a thick layer. The third is a gelatinization recovery system that converts all types of oil into a semisolid consistency for easy mechanical recovery. (Author)
W86-03875

MEASUREMENT OF NUTRIENT CONCENTRATIONS IN SEDIMENT PORE WATER COLLECTED BY A DIALYSIS SAMPLER,

Japan Bottom Sediment Management Association, Tokyo.
For primary bibliographic entry see Field 5A.
W86-03877

5C. Effects Of Pollution

EFFECT OF SOIL ON THE MUTAGENIC PROPERTIES OF WASTE WATER,

Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
M. J. Plewa, and P. K. Hopke.
UILU-WRC-84-195, WRC Research Report No 195, December 1984, Project Completion Report. 42 p, 22 fig, 1 tab, 20 ref. S-095-ILL. 1-1-11527.

Descriptors: *Land disposal, *Wastewater disposal, *Assays, *Clay loams, *Mutagens, *Ecological effects, Waste disposal, Leaching, Soil, Soil amendments, Sludge, Solid waste disposal, Sludge disposal, Water pollution effects, Illinois.

The disposal of wastewater on agricultural lands poses known and unknown environmental risks. Mutagens may be introduced into the ecosystem and perhaps concentrated by crop plants or leached into groundwater supplies. The biological effect of a mutagenic wastewater before and after application to soil was investigated using an XAD-8 methanol extract of wastewater from the municipal sewage treatment plant at Sauget, Illinois. One and three ml of extract were brought up to 10 ml volumes with water and added to 10 g of sterile or nonsterile native clay loam. These mixtures were placed in a shaking water bath at room temperature for 0, 24, and 48 hr. After separation of solid and liquid portions by filtration, dichloromethane was added to extract the organic fractions from each component. Solvent extractions were evaporated to dryness and brought up in DMSO. Tests for mutagenic activity were conducted using strain TA98. After addition to the soil for greater periods of time, the mutagenic activity decreased. The solid component exhibited greater mutagenic activity than the liquid. The XAD-8 extract was also assayed using the yg2 assay in Zea mays and the micronucleus assay in Tradescantia. The extract did not induce mutation or chromosome aberations in these assays. The sludge from the Sauget plant was chemically fractionated and assayed with S. typhimurium strains TA98 and TA100. The neutral fraction was the most mutagenic fraction followed by the weak acid, strong acid and basic fractions. (Geiger-PTT)
W86-03502

GIARDIASIS IN WASHINGTON STATE,

Washington State Dept. of Social and Health Services, Olympia. Office of Environmental Health Programs.
F. Frost, L. Harter, B. Plan, K. Fukutaki, and B. Holman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-134882, Price codes: A05 in paper copy, A01 in microfiche. EPA-600/1-82-016, November 1982. 80 p, 1 fig, 29 tab, 13 ref, 3 append. R-805809.

Descriptors: *Protozoa, *Giardiasis, *Human diseases, *Washington, *Drinking water, *Infection, *Fate of pollutants, Public health, Water pollution effects, Diseases, Risks, Mammals, Potable water, Well water, Surface water, Spring water, Path of pollutants, Pollutant identification.

The objective was to determine the potential for transmission of giardiasis through approved drinking water supplies in Washington State. The project consisted of five studies: the first was conducted during trapping seasons (1976-1979) and resulted in examining of 656 beaver stool samples, 172 muskrat and 83 other animal stools. Positivity for beaver was 10.8%, for muskrat, 51.2%. No Giardia was found in other mammals. The second study contacted 865 Giardia-infected Washington State residents to identify likely sources or possible risk factors for infection. Clusters of cases were linked to day care centers, backpacker groups or sites for drawing water on outings and foreign travel. No excess cases were observed for users of surface drinking water supplies. The third study was a case-control study to identify risk factors for giardiasis. Factors which appeared to place a person at increased risk included consumption of untreated water, foreign travel and attendance at a day care center. The fourth study examined water filtering techniques for recovery of Giardia cysts from drinking water supplies and yielded improvements in recovery. The fifth study was a stool survey of children in Skagit and Thurston counties. Overall prevalence of infection was 7.1%. No differences in the prevalence were found by source of domestic water (surface filtered, surface unfiltered, well or spring). (Author)
W86-03507

ONSHORE IMPACTS OF OFFSHORE HYDROCARBON DEVELOPMENT: ANNOTATED BIBLIOGRAPHY,

Environmental Protection Service, Ottawa (Ontario).
F. A. Kwamena, C. Brassard, and D. Wright.
EPS 3-EC-83-4, December, 1983. 108 p.

Descriptors: *Water pollution effects, *Coastal zone management, *Oil pollution, *Offshore platforms, *Water pollution sources, *Bibliographies, *Environmental effects, *Planning, Economic impact, Social impact, Hydrocarbons, Oil wells, Natural gas, Shore protection, Continental shelf, Drilling, Alaska, Canada, Norway, United Kingdom, North America, Exploration, Arctic, Oil spills, Marine resources, Resources development, Pipelines, Environmental protection, Fate of pollutants.

The onshore impact of offshore oil and gas development is reviewed in an annotated bibliography, emphasizing issues and recommendations. This is a preliminary step in planning for future hydrocarbon exploration and production in Canada. Sections include coastal zone management, facility types and requirements, socioeconomic impacts, environmental impacts, and experiences in the United Kingdom, Norway, and North America. Papers concerning Alaska, the Gulf States, and the North Sea are numerous.
W86-03620

HEALTH AND DISEASE CONTROL FOR AQUATIC ANIMALS IN DREDGED MATERIAL CONTAINMENT SITES,

Texas A and M Univ., College Station.
S. K. Johnson.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p

131-134, 5 ref.

Descriptors: *Water pollution effects, *Ponds, *Fish farming, *Fish ponds, *Water quality, *Aquatic habitats, *Aquaculture, *Fish ponds, *Fish diseases, *Dredging, Fish parasites, Parasites, Animal diseases, Invertebrates, Algae, Crustaceans, Copepods, Isopods, Protozoans, Fungi.

Certain diseases and parasites are likely to develop in dredging containment sites because of high animal density, weather influences, and progressive enrichment of culture water. Crustacean parasites such as Ergasilus (copepods), fish lice, isopods, protozoans, helminths, and algal blooms are potential problems. Sudden temperature drops cause fishkills and fungal infections. Temperatures above 30 degrees C support bacterial diseases. Vibrio is a common cause of such disease. Weather can also affect salinity and stir up bottom sediments. Progressive water enrichment produces oxygen shortage and an abundance of fouling organisms.
W86-03709

SELECTION CRITERIA AND PROCEDURES FOR ESTABLISHING MARICULTURE FACILITIES IN EXISTING CONTAINMENT SITES,

Dow Chemical U.S.A., Freeport, TX. Texas Div.
D. Milligan.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous paper D-83-2, October 1983. p 153-162, 5 fig.

Descriptors: *Water pollution effects, *Ponds, *Dredging, *Aquaculture, *Aquatic habitats, Lakes, Brackish water, Shrimp, Aquatic life, Aquatic animals, Toxicity, Brown shrimp, Fish, Predation, Sheepshead minnow.

The feasibility of aquaculture in dredging containment sites was studied in three phases. Phase 1 was chemical analysis of dredged material and 96-hour bioassays which exposed shrimp to dredged material in seawater. The dredged material contained no significant concentrations of heavy metals, pesticides, and waste metabolites. Bioassays showed no toxicity. Phase 2 consisted of simulated containment areas studied in small ponds lined with dredged material (control ponds contained no dredge material). In the ponds containing dredged material brown shrimp grew faster and larger, less fertilizer was needed, and no extraordinary mortality was noted. Phase 3, in a 20-acre actively used contaminant site, experienced significant problems: mortality from post-larval stage to harvest was 84%, harvesting was a problem because the pond bottom was irregular, total predator control was difficult. However, shrimp were wholesome and marketable.
W86-03712

PHYTOPLANKTON-ENVIRONMENTAL INTERACTIONS IN RESERVOIRS: VOLUME 1.

For primary bibliographic entry see Field 2H.
W86-03716

USE OF BIOASSAY APPROACHES FOR ASSESSING PHYTOPLANKTON GROWTH IN LAKES AND RESERVOIRS,

Utah Water Research Lab., Logan.
D. B. Porcella, and M. L. Cleave.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 276-314, 6 fig, 4 tab, 63 ref.

Descriptors: *Water pollution effects, *Lakes, *Reservoirs, *Bioassay, *Algae, *Phytoplankton, *Water analysis, Biomass, Toxicity, Nutrients, Eutrophication, Phosphorus, Wastewater analysis, Organic compounds, Inorganic compounds, Salinity, Reservoir management, Land use, Seasonal variation, Environmental effects.

A literature review revealed that the algal assay procedure:bottle test is useful for bioassaying water samples to assess chemical constituents. The test should not be used directly to interpret ecological relationships. However, the evaluation of chemical constituents by algal growth has many advantages. It is a single, integrated, biological measurement of constituents in a sample that exerts impact as a function of chemical concentration. The algal bioassay measures the effects of biostimulatory and toxic compounds. Examples illustrating the application of the algal bioassay to management questions about effects of nutrients, toxic compounds, and salts show that the test can be used for determining the relative effects of these substances. The algal bioassay can be used in reservoir studies to assess the effects of changes in effluent discharges, tributary diversion and/or combination, evaluating water quality of potential reservoirs, changes in reservoir operation (mixing, discharge timing and location, restoration), effects of differing land uses, downstream effects, and seasonal variation in inflow/outflow. (Author)
W86-03723

ROLE OF CONTAMINANTS IN THE DECLINE OF THE ILLINOIS RIVER: IMPLICATIONS FOR THE UPPER MISSISSIPPI,

Illinois Natural History Survey, Champaign.
For primary bibliographic entry see Field 6G.
W86-03739

HYDROCHEMICAL BALANCES OF FRESHWATER SYSTEMS: PROCEEDINGS OF THE UPPSALA SYMPOSIUM.

Naturvetenskapliga Forskningslaboratoriet i Studsvik, Nykoeping (Sweden).
For primary bibliographic entry see Field 5B.
W86-03753

WATER QUALITY AND WATER POLLUTION PROBLEMS ON THE INDIAN SUB-CONTINENT,

Central Chemical Lab., Lucknow (India).
For primary bibliographic entry see Field 5B.
W86-03781

AEROBIC TRANSFORMATION OF NITROGENOUS SUBSTANCES IN A FRESHWATER ECOSYSTEM,

Slovenska Akademia Vied, Bratislava (Czechoslovakia).
D. Toth.
In: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 323-330, 3 fig, 15 ref.

Descriptors: *Stream pollution, *Water pollution effects, *Ecosystems, *Ecological effects, *Agricultural chemicals, *Nitrogen compounds, *Bacteria, Mathematical models, Fertilizers, Pesticides, Nitrogen, Ammonia, Nitrite, Nitrate, Water pollution.

In the study of the Slnava water reservoir on the river Vah and the agricultural catchment area of western Slovakia, many external influences on the complex ecosystem were identified. The study was carried out by means of laboratory experiments, field measurements and simulation analyses using the mathematical model for aerobic nitrogen transformation in a water environment. An excessive external supply of substrates in the form of ammonia and nitrate was found. An inhibitory effect of pesticides on heterotrophic and nitrifying bacteria and sharp changes in physical parameters were demonstrated. Increased input rates of ammonia and nitrate-nitrogen from the applied fertilizers are accelerating the rate of the nitrification process, resulting in the accumulation of nitrates. This process is combined with the inhibitory effect of free ammonia on bacteria. The increased input of agrochemicals to the water reservoir has disturbed some important processes of the biogeochemical cycles which may lead to the instability of the ecosystem. Pollution of streams with nitrification inhibiting agents may increase the concentration of nitrite and slow the oxidation of ammonia. Normal sedimentation processes in the Slnava reservoir create favorable conditions for the absorption of ammonia in bottom mud and for the accumulation of pesticides.
W86-03782

CONTINUOUS DO RESPONSE PREDICTED USING CSPSS IS VERIFIED FOR SPRINGFIELD, MISSOURI,

CH2M Hill International Corp., Gainesville, FL.
For primary bibliographic entry see Field 5B.
W86-03826

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES: PROCEEDINGS OF THE 9TH US/JAPAN EXPERTS MEETING.

Army Engineer Inst. for Water Resources, Fort Belvoir, VA.
For primary bibliographic entry see Field 5G.
W86-03867

AERATION EFFECTS ON MARINE EUTROPHICATION,

For primary bibliographic entry see Field 5G.
W86-03868

HYPOLIMNETIC OXYGEN DEFICIT IN A EUTROPHIC LAKE AND THE ROLE OF SEDIMENT OXYGEN DEMAND,

National Inst. for Environmental Studies, Tsukuba (Japan).
M. Okada, R. Sudo, M. Takasaki, and A. Sato.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 27-40, 8 fig, 2 tab, 17 ref.

Descriptors: *Lake sediments, *Sediments, *Lakes, *Toxic wastes, Dissolved oxygen, Sediment oxygen demand, Eutrophic lakes, Lake stages, Limnology, Lake Yunoko, Japan, Hypolimnion, Thermal stratification.

Lake surveys and in situ experiments were conducted to study the hypolimnetic oxygen deficit in a eutrophic lake, Lake Yunoko. A mathematical model was developed to estimate the dissolved oxygen budget in the lake. Production of oxygen by photosynthesis of phytoplankton, consumption by respiration of microorganisms, sediment oxygen demand, and oxygen transfer by eddy diffusion and reaeration at the surface of water were taken into consideration. It was shown from the budget that sediment oxygen demand plays an important role in the first stage of the hypolimnetic oxygen deficit in summer, i.e., the oxygen produced by photosynthesis was not transferred into the hypolimnion and the contribution of sediment oxygen demand was as large as that of the consumption in water. Restoration techniques for the oxygen deficit such as management of bottom sediment and control of phytoplankton production were discussed. The management of bottom sediment was shown to be an effective way to control the hypolimnetic oxygen deficit in Lake Yunoko. (Author)
W86-03869

DISPERSION OF SEDIMENT RESUSPENSION CAUSED BY DREDGE OPERATION,

Japan Dredging and Reclamation Engineering Association, Tokyo.
For primary bibliographic entry see Field 5B.
W86-03873

ACCUMULATION OF ACRYLAMIDE INTO FISH,

Tsukuba Univ. (Japan). School of Medicine.
J. Asada, T. Shimizu, S. Tajima, F. Sakamoto, and M. Fujiki.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 161-172, 9 fig, 2 tab, 20 ref.

Descriptors: *Acrylamide, *Fish, *Toxic wastes, Environmental effects, Carp, Chemical analysis, Chemical composition, Chromatography, Gas chromatography, Red sea bream.

The accumulation of acrylamide monomer and polymer into fish and the behavior of acrylamide monomer in the aqueous environment were investigated. Red sea bream and carp were used as experimental fish. Fishes were placed in fish-rearing tanks with freshwater and/or seawater containing acrylamide monomer and/or polymer and were reared for 25 days. The accumulation of acrylamide monomer into red sea bream from seawater containing 10 ppm acrylamide monomer reached 1.2 ppm after 20 days. Acrylamide monomer accumulated in organs of carp from water by the following factors: liver--0.5, kidney--0.5, gills--0.15, muscle--0.17, and blood 0.19. The degradability of acrylamide monomer in tap water and distilled water was slight. Approximately 90% of the acrylamide monomer in seawater and pond water was degraded after 14 days. Acrylamide monomer in fish breeding water decreased to undetectable levels in 5 days. From this experiment, it was clear that the rate of accumulation of acrylamide into fish was slight, and acrylamide monomer in environmental water was easily degradable. (Author)
W86-03878

5D. Waste Treatment Processes

WATER RECYCLING IN THE PULP AND PAPER INDUSTRY IN CALIFORNIA,

Camp, Dresser and McKee, Inc., San Francisco, CA.
For primary bibliographic entry see Field 3E.
W86-03437

INTRODUCTION TO WASTEWATER TREATMENT PROCESSES,

Laval Univ., Quebec.
R. S. Ramalho.
Second Edition. Academic Press, New York. 1983. 580 p.

Descriptors: *Activated sludge process, *Biological wastewater treatment, Reviews, Tertiary wastewater treatment, Model studies, Pilot plants, Design criteria, Chemical reactions, Chemical treatment, Advanced wastewater treatment, Wastewater treatment.

This book is an introductory presentation meant for both students and practicing engineers interested in the field of wastewater treatment. The book discusses the design of specific wastewater treatment processes followed by a summary of the theory involved in the process, a definition of the important design parameters involved in the process and the determination of such parameters using laboratory-scale or pilot-plant equipment, and the development of a systematic design procedure for the treatment plant. Numerical applications are presented which illustrate the treatment of laboratory data, and subsequent design calculations are given for the wastewater processing plant. Specific topics covered include: characterization of domestic and industrial wastewaters, pretreatment and primary treatment, theory and practice of aeration in wastewater treatment, secondary treatment (the activated sludge process), secondary treatment (other aerobic and anaerobic wastewater treatment processes), sludge treatment and disposal, and tertiary wastewater treatment. This revised edition places greater emphasis upon the principles of chemical kinetics, reactor design, and the mechanism of biological treatment processes. (Geiger-PTT)
W86-03455

CHARACTERISTICS AND TREATABILITY OF URBAN RUNOFF RESIDUALS,

Rexnord, Inc., Milwaukee, WI. Environmental Research Center.
For primary bibliographic entry see Field 5B.
W86-03508

NONLINEAR PROGRAMMING MODEL OF A WASTEWATER TREATMENT SYSTEM: SENSITIVITY ANALYSIS AND A ROBUSTNESS CONSTRAINT,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. G. Uber, E. D. Brill, and J. T. Pfeffer.
UILU-WRC-85-196, WRC Research Report No 196, June 1985. 105 p, 5 fig, 23 tab, 27 ref, 2 append. S-092-ILL.

Descriptors: *Sensitivity analysis, *Wastewater treatment, *Design criteria, *Wastewater facilities, *Mathematical models, Numerical analysis, Mathematical studies, Models, Cost analysis, Systems analysis, Optimization, Model studies, Performance evaluation.

A method for sensitivity analysis in nonlinear programming is described and then illustrated using a least-cost model of a secondary wastewater treatment system. A sensitivity equation approach is used to calculate normalized sensitivity coefficients, which approximate the percent changes in model variables and objective function due to a small parameter variation. Design changes predicted by the sensitivity coefficients are confirmed by a perturbation analysis of the optimal solution. Sensitivity concepts are used to develop a robustness measure which is incorporated into the constraint set of the nonlinear model. Robustness is narrowly defined as the ability of a model solution to maintain a level of performance that meets the system design criteria even if the actual values of model parameters are not exactly the same as the values assumed for design. A gradient optimization procedure is used to examine the tradeoff between total cost and the robustness measure. A preliminary analysis shows that the trends in robust wastewater treatment plant design are in direct conflict with the optimal decisions obtained when minimizing cost without a constraint on robustness but are in agreement with those designs observed to work in practice. The robustness constraint method presented should be applicable to other optimization models of water resources systems. (Author)
W86-03511

PILOT-SCALE EVALUATION OF THE NUTRIENT FILM TECHNIQUE FOR WASTEWATER TREATMENT,

Cold Regions Research and Engineering Lab., Hanover, NH.
J. R. Bouzoun, C. J. Diener, and P. L. Butler.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A123429. Price codes: A03 in paper copy, A01 in microfiche. Special Report 82-27, November 1982. 34 p, 17 fig, 11 tab, 12 ref.

Descriptors: *Plant growth, *Nutrient removal, *Rhizosphere, *Biofilters, *Biological wastewater treatment, Membrane processes, Nutrients, Wastewater treatment, Biological membranes, Biochemical oxygen demand, Filtration, Pilot plants, Root zone, Organic compounds.

An experiment was conducted to determine the feasibility of using several plant species in a pilot-scale nutrient film technique (NFT) installation to further treat primary-treated effluent. NFT is a modified hydroponic plant growth method in which a thin film of wastewater flows through the root mat of plants that grow on an impermeable and slightly inclined surface without soil. It was hypothesized that the root mat of the plants would filter suspended solids from the wastewater, serve as a physical structure on which microorganisms utilizing nutrients can attach, and collect nutrients for use by the plants themselves. Tracer studies showed that the hydraulic retention time of the wastewater in the NFT trays was inversely related to the wastewater application rate, and that for a given flow, plants with fine root systems (reed canarygrass) had a much longer detention time than plants with coarse tuberous rhizomes (cattails). Results showed that the NFT produced useful byproducts while treating primary effluent. NFT removal of biochemical oxygen demand (BOD) depended on filtration and sedimentation of the particulate fraction of BOD and on biological oxidation of soluble BOD. The removal of BOD by the NFT was successfully modeled using the plug-flow reactor model and first-order kinetics. The NFT was also capable of significantly reducing the levels of volatile and nonvolatile trace organic compounds in primary-treated wastewater. (Geiger-PTT)
W86-03515

CHEMISTRY IN WATER REUSE: VOLUME 1,

Ann Arbor Science, Ann Harbor, MI, 1981. Edited by William J. Cooper. 557 p.

Descriptors: *Water reuse, *Wastewater treatment, *Industrial wastewater, *Pollutant identification, Water treatment, Membrane processes, Disinfection, Water analysis, Recycling, Wastewater analysis, Fate of pollutants, Reverse osmosis, Chlorine, Metals, Organic compounds, Monitoring, Quality control.

Developments in chemistry of water reuse and recycling include a review of the published literature of this subject; most activity has been in pulp and paper, electroplating, inorganic chemicals, petroleum refining, iron and steel, and food products industries. Monitoring and control of pollutants are discussed. Ultraviolet absorbance is useful in measuring the organic pollution in wastewater. Quality assurance programs for water and wastewater analysis are described. The Industrial Environmental Research Laboratory of the EPA has a comprehensive program. Membrane processes are used to remove a variety of pollutants from industrial wastewaters: electroplating wastes, battery manufacturing rinse water, textile process water, carcinogen laboratory wastes, and municipal/industrial sewage effluents. The section on disinfection has methods for disinfecting water and wastewater to minimize trihalmethane formation and residual chlorine and the determination of chlorine compounds such as chlorine dioxide and free available chlorine. Many pollutants are found in swimming pool water; trihalomethanes, heavy metals, nitrate, and chlorate.
W86-03520

REMOVAL OF VARIOUS TOXIC HEAVY METALS AND CYANIDE FROM WATER BY MEMBRANE PROCESSES,

Trace Metal Data Inst., El Paso, TX.
L. J. Kosarek.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 261-280, 1 fig, 5 tab, 33 ref.

Descriptors: *Wastewater treatment, *Literature review, *Industrial wastewater, Metals, *Membrane processes, *Cyanide, Reverse osmosis, Ultrafiltration, Filtration, Trace metals, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Silver, Zinc, Regulations, Public health, Water pollution effects, Water pollution sources, Chelation, Water treatment, *Heavy metals.

This literature review describes the levels, frequency, and regulations associated with the metal and cyanide priority pollutants. The health effects of excess levels, natural background levels, and industrial sources are listed. Membrane processes can economically remove significant proportions of these metals and cyanide from waste streams so that the purified product is usable for recycling or human consumption. These membrane processes include chelation in combination with ultrafiltration, charged ultrafiltration, reverse osmosis, and coupled membrane transport. Reverse osmosis has been documented most frequently with respect to most of the metals. Percent ion rejection varies for the membrane processes, with reverse osmosis having the highest level of removal efficiency. Operating parameters which affect membrane performance are type of membrane, membrane preparation procedure, applied pressure, composition of the raw water, pH, and the quantity of water recovered (both overall and per pass). Membrane fouling and scaling can be minimized by pretreatment to remove suspended solids and microorganisms.
W86-03532

DEMONSTRATION OF A CROSS-FLOW MICROFILTRATION SYSTEM FROM THE REMOVAL OF TOXIC HEAVY METALS FROM

BATTERY MANUFACTURING WASTEWATER EFFLUENTS,

Hydronautics, Inc., Laurel, MD.
N. I. Shapira, H. L. Liu, J. E. Santo, D. Fruman, and C. Darvin.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 281-309, 15 fig, 7 tab, 11 ref.

Descriptors: *Wastewater treatment, *Filtration, Metals, Lead, Hydroperm system, *Heavy metals, Lime, Chemical precipitation, Ultrafiltration, Cross-flow filtration, Battery industry.

The Hydroperm cross-flow microfiltration system was evaluated in laboratory tests and field studies. The system used thickwalled, porous plastic tubes to remove suspended solids from lime-neutralized battery manufacturing wastewater. Toxic heavy metals (specifically lead) in the battery wastewater were reduced to 0.02-0.09 ppm. Fluxes of over 400 gal/sq ft/day were readily attainable. Several advantages of HydroPerm were demonstrated: (1) compactness and versatility in size, (2) ruggedness (unaffected by pH of influent and not subject to fouling and leaking, (3) ease of maintenance, (4) good performance (High flux levels, suspended solids reduction to <5 ppm, suspended toxic metals reduction to <0.1 ppm, sludges of >30% concentration), and (5) suitability of the treated effluent for recycling.
W86-03533

COUPLED TRANSPORT MEMBRANES FOR REMOVAL OF CHROMIUM FROM ELECTROPLATING RINSE SOLUTIONS,

Bend Research, Inc., OR.
K. L. Smith, W. C. Babcock, R. W. Baker, and M. G. Conrod.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 311-324, 7 fig, 1 tab, 14 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Chromium, *Metal finishing wastes, *Membrane processes, Wash water, Coupled transport membranes, Wastewater renovation.

The coupled transport membrane system was used to concentrate chromium for recovery from synthetic electroplating wastewaters. Membranes were formed by immersing a microporous polypropylene membrane in a solvent consisting of 30% by volume of Alamine 336 in an aromatic hydrocarbon diluent. In one experiment reverse osmosis of 5 g per liter of chromium at pH 1.3 produced a concentrated solution of 150 g per liter chromium in 40 g per liter NaOH in 30 hours running time. The final concentration of chromium in the feed solution was 16 ppm; in the product solution, 155,000 ppm, a concentration factor of 9700. The chromium flux was nearly independent of the concentration of chromium in the product solution. Over a 110-day period the flux declined from 54 to 12 micrograms per sq cm per min in 14 days and then increased to a steady flux of about 30 micrograms per sq cm per min in 14 days and then increased to a steady flux of about 30 micrograms per sq cm per min after 50 days.
W86-03534

HYPERFILTRATION OF TEXTILE PROCESS WATER FOR REUSE,

Clemson Univ., SC.
H. G. Spencer, C. A. Brandon, G. Goodman, J. J. Porter, and M. Samfield.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 325-340, 6 fig, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Water conservation, *Textile mill wastes, *Membrane processes, Industrial wastewater, Dye industry wastes, Wastewater renovation, Water reuse, Conservation, Filtration, Ultrafiltration, Hyperfiltration, Zirconium oxide membrane.

The pilot study of renovation of wastewater from a production dye range by high temperature hyperfiltration using dynamic zirconium oxide-polyacrylic acid membranes continues to indicate high potential for closed cycle operation by reuse of water and chemicals. The membrane stability, flux and rejection are satisfactory. Simple laboratory reuse tests indicate only a small percentage of the hyperfiltration products may be unsuitable for general reuse as wash water. Judicious planning of the sequence of dyeing processes should permit reconstitution of many hyperfiltration concentrates for reuse in the dye pad. Significant savings (50-70%) of auxiliary components and minor savings of dyes in the concentrate reuse are indicated by the laboratory tests. Reuse of the hyperfiltration products and concentrate obtained with bleach wastewater appear suitable for reuse with savings of wetting agent in the pad formulation. (Author)
W86-03535

REMOVAL OF CHEMICAL CARCINOGENS FROM WATER/WASTEWATER BY REVERSE OSMOSIS,

Abcor, Inc., Wilmington, MA. Walden Div.
W. G. Light.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 341-353, 4 fig, 4 tab, 9 ref.

Descriptors: *Wastewater treatment, *Chemical wastewater, *Carcinogens, *Organic compounds, *Membrane processes, Reverse osmosis, Ultrafiltration, Filtration.

Wastewaters from carcinogen laboratories (from cage washing, dosage, and preparation phases) were treated by reverse osmosis after ultrafiltration to remove suspended solids. The average total organic carbon level in the pilot plant ultrafiltrate from actual wastewaters was 70 mg per liter (range, 15-218 mg per liter). Average removal efficiency was 92.3-92.6%. In bench-scale reverse osmosis studies with synthetic wastewater, removal of individual representative chemicals ranged from 10% to 100%, with an average of 66-72%, depending on the membrane used. Assuming that ultrafiltration removes about 50% of total organic carbon, it was predicted that a combination of ultrafiltration and reverse osmosis would remove a total of 96% total organic carbon and 92% for individual carcinogens. If the original wastewater contained 100 mg per liter of organic compounds, the ultrafiltration-reverse osmosis treatment would remove all but 4 mg per liter of total organic carbon and all but 80 micrograms per liter of carcinogens.
W86-03536

POTENTIAL OF REVERSE OSMOSIS FOR RECYCLING AND REUSE OF SEWAGE EFFLUENTS,

Portsmouth Polytechnic (England). Dept. of Civil Engineering.
B. A. Winfield.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 355-378, 5 fig, 9 tab, 1 app, 27 ref.

Descriptors: *Wastewater treatment, *Membrane processes, *Water reuse, Reverse osmosis, Microorganisms, Organic compounds, Potable water, Agriculture, Nutrient film technique, Ammonia, Nitrates, Activated carbon, Adsorption.

Studies on reverse osmosis treatment of sewage effluents for reuse in industry, agriculture, and as a potable water supply are summarized. Costs of treating sewage effluent are about 1/3 those of treating saline or brackish water. Membrane fouling is independent of turbidity. However, pH of 6.0 produces the lowest rate of flux decline. At higher pH calcium deposits in the fouling layer; at lower pH, electrical charge effects inhibit the flow of ions across the membrane, reducing flux. Use of the concentrated residue for hydroponic growth of vegetables has been demonstrated. Heavy metals uptake in tomatoes is similar to that from plants grown in commercial soil. A model bacteriophage injected into the water was not detectable in the fruit. Some chemicals which are not as easily removed by reverse osmosis are ammonia, nitrate, and organic molecules. Since water for reuse should not contain unacceptable levels of organics such as pesticides, detergents, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, and steroids, additional treatment with activated carbon is desirable. With the combined reverse osmosis-activated carbon system, 98% removal of dissolved organic compounds can be achieved. Bacteria and virus are readily rejected by the membranes. Levels of these microorganisms are reduced by as much as 6 orders of magnitude.
W86-03537

RATIONAL APPROACHES IN THE ANALYSIS OF CHEMICAL DISINFECTION KINETICS,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
C. N. Haas.
IN: Chemistry in Water Reuse: Volume I, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 381-399, 1 fig, 3 tab, 35 ref.

Descriptors: *Wastewater treatment, *Disinfection, *Chlorine, *Kinetics, Model studies, Microorganisms, Mixing, Turbulent flow.

A conceptual model for the analysis of the disinfection process for wastewater was developed. Sample cases included (1) very low chlorine demand and high rate of mixing and (2) a chlorine demand much higher than the chlorine dose and limited mixing. Several conclusions were reached as a result of simulation studies. First, the curves have the declining rate feature often seen in the disinfection of wastewater. Second, even at a very high rate of disinfectant decomposition, substantial inactivation can occur over time intervals greater than the lifetime of measurable chlorine in solution. Third, the ratio of chlorine feed flow to wastewater flow may have a substantial influence on inactivation efficiency. An area of disagreement between model and experimental results was the effect of turbulence on disinfection efficiency.
W86-03538

DISSOLVED AIR FLOTATION FOR PRIMARY AND SECONDARY CLARIFICATION,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry, and R. Gehr.
Available from Environment Canada, Ottawa, Ontario. SCAT-9, 1981. Canada Mortgage and Housing Corporation, Ottawa, Ontario. 187 p, 27 fig, 39 tab, 11 app, 67 ref.

Descriptors: *Clarification, *Wastewater treatment, *Suspended solids, *Water treatment, *Dissolved air flotation, Flotation, Activated sludge process, Primary wastewater treatment, Secondary wastewater.

A literature survey of over 60 references on the use of dissolved air flotation (DAF) in water and wastewater treatment revealed that, except for flotation thickening, very little information was available on DAF as an alternative to sedimentation. In this study, bench-scale batch and pilot-scale continuous flow dissolved air flotation units were used to clarify raw sewage and mixed liquor from an extended aeration and a conventionally loaded activated sludge plant. Performance parameters, such as effluent and float suspended solids, air to solids ratio, and a 'thickening parameter', of the batch and continuous flow units were compared for scale-up purposes. Comparisons were also made between the performances of the DAF unit when clarifying the three types of feed. The research indicated that batch flotation tests were valuable in predicting full-scale DAF performance. The pilot studies showed that the solids in raw sewage and in the mixed liquor from extended aeration or conventional activated sludge plants could be separated by DAF with efficiencies comparable to those reported for sedimentation. Design criteria for DAF units for each of the three feeds were developed and the costs of utilizing DAF for primary and secondary clarification in municipal plants of 4,500, 45,000 and 227,000 cu m/d capacity were estimated. From an economic point of view, it was found that DAF was not competitive with sedimentation and should only be considered when space is at a premium, land costs are high or when bulking sludges necessitate its use.

W86-03611

WATER AND WASTE MANAGEMENT IN THE CANADIAN MEAT AND POULTRY PROCESSING INDUSTRY,

Dearborn Environmental Consulting Services, Mississauga (Ontario).
For primary bibliographic entry see Field 5E.
W86-03612

STATUS REPORT ON COMPLIANCE WITH THE CHLOR-ALKALI MERCURY LIQUID EFFLUENT REGULATIONS 1978-79,

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report No. EPS 3-WP-81-2, March 1981. 14 p, 3 fig, 3 app.

Descriptors: *Mercury, *Water pollution control, *Regulations, *Compliance, *Waste recovery, *Water pollution, Recycling, Water policy, Wastewater treatment, Chlor-alkali plants, Canada.

This report reviews the results of the measures taken by industry and government agencies to curtail mercury losses in liquid effluents from chlor-alkali plants in Canada. Similar status reports were issued for the years 1975 and 1976-1977. Mercury losses to liquid effluents are presently less than 200 kg/yr, a reduction of over 99.5% since 1970. Daily monitoring by companies and periodic monitoring by both federal and provincial environmental agencies have confirmed this reduction. The drastic reduction in mercury purchases and consumption since 1970 is the result of the installation of efficient treatment systems, and increased recovery of mercury from waste gases and solids; ten plants have also terminated production or converted from the mercury to the diaphragm cell process.
W86-03613

DEVELOPMENT OF ETHANOL-SELECTIVE MEMBRANES,

Southern Research Inst., Birmingham, AL.
SoRI-EAS-82-461, Annual Summary Report, June 14, 1982. 62 p, 9 fig, 20 tab, 12 ref. 4789-XIF. sub number: XB-1-9189-3.

Descriptors: *Alcohols, *Water, *Permselective membranes, Chemical properties, Membranes, Membrane filters.

In a 12-month research project, Southern Research Institute has made substantial progress in developing ethanol-selective membranes for use in separating ethanol and water. The general approach in developing such membranes is to combine high selectivity with acceptable strength and low resistance to transfer by forming thin layers of selective material on low-resistance substrates that provide strength. During the 12-month period, it has been shown that this basic approach is promising. It has also been shown that if moieties that have attractive forces for ethanol are fixed to the polymer matrix of the thin layer, the transfer of ethanol molecules is retarded. It was shown by sorption-desorption experiments that different moieties attached to the polymeric matrix have differences in their attractive forces for ethanol, and that variations in the degree of attraction result in changes of selectivity. It was shown that with some polymers, the hydrophobic ends of ethanol molecules apparently were attracted to the polymer chains, and the hydrophilic ends protruded into the spaces between polymer segments. Water molecules intruded and transferred through these spaces. It was also shown that decreasing the distances between polymer segments made it more difficult for water to intrude and thus increased the ethanol selectivity. During the course of the research, three methods of preparing acceptable dual-layer membranes by solution casting and two methods of preparing the membranes by application of monomer systems were developed.
W86-03617

EVALUATION OF BIOLOGICAL NITRIFICATION-DENITRIFICATION AT PENTICTON, BRITISH COLUMBIA,

International Environmental Consultants Ltd., Islington (Ontario).
K. L. Murphy, and R. W. Wilson.
Report SCAT-10, 1981. Canada Mortgage and Housing Corporation, Ottawa, Ontario. 72 p, 13 fig, 13 tab, 33 ref, 2 app.

Descriptors: *Denitrification, *Nitrification, *Municipal Wastewater, *Organic wastes, *Design criteria, Nitrogen removal, Wastewater, Operating costs, Sludge, Wastewater treatment, Activated sludge, Land disposal, Ion exchange.

This study was undertaken to review proven methods for biological nitrogen removal from municipal wastewater, to select suitable design parameters, and to prepare process designs plus capital and operating cost estimates for several process alternatives applicable to the City of Penticton, British Columbia. Process options that were evaluated in detail included two-sludge nitrification plus denitrification, one-sludge post-denitrification and one-sludge pre-denitrification. Process designs were based on achieving a maximum of 5 mg/L N03-N and 1 mg/L TKN in the treated effluent throughout the year, given the raw wastewater characteristics at Penticton. The pre-denitrification process was found to be the most cost effective for Penticton. The design was based on a 20-day solids residence time (SRT) for the nitrification basin and a 10-day SRT for the denitrification basin to ensure efficient nitrogen removal at a minimum operating temperature of 8 C. For Penticton the cost of combined carbon and nitrogen removal by predenitrification was estimated to be approximately 25% greater than for carbon removal by activated sludge and 10% greater than for carbon removal and nitrification alone. Land disposal, ammonia stripping and ion exchange proved to be significantly more expensive than the biological methods of nitrogen removal. The report provides some generalized cost information for nitrogen removal at wastewater treatment facilities ranging in size from 5,000 to 45,000 cu m/d.
W86-03619

STRIPPING KRAFT FOUL CONDENSATES WITH WASTE GASES,

Beak Consultants Ltd., Vancouver (British Columbia).
Report No. EPS 3-WP-82-1, March 1982. Environmental Protection Service, Ottawa, Ontario. Water Pollution Control Directorate. 156 p, 28 fig, 34 tab, 140 ref, 3 append.

Descriptors: *Pulp wastes, *Condensates, *Kraft mills, *Wastwater treatment, *Waste gases, Methanol, Sulfur compounds, Environmental effects, Cost-benefit analysis.

This report presents an assessment of the technical and economic feasibility of using waste gases to strip kraft foul condensates, and an evaluation of the potential effects of this technology on air and water quality. Kraft foul condensates are produced by the condensation of process vapors from digesters and multiple-effect evaporators in kraft pulp mills. Although foul condensates represent only about 5% of pulp mill effluent volume, they are major sources of biochemical oxygen demand, toxicity, fish-flesh tainting, and receiving water taste and odor. The proposed process for stripping kraft foul condensates involves two stages. In the first stage, the foul condesate would be stripped with a small amount of gas to remove the total reduced sulfur (TRS) compounds. In the second stage, the foul condensate would be stripped with a large quantity of waste gas to remove most of the methanol and hence most of the BOD. The off-gas from the methanol stripper, which would contain methanol, ethanol, acetone and guaiacol, would be discharged to the atmosphere. Stripped condensate would be recycled to the process. By stripping foul condensates with waste gases in the proposed process, most of the environmental problems associated with foul condensates could be eliminated, but at a much lower operating cost and a lower degree of process complexity. Capital costs for the two-stage process would be comparable to those for steam stripping.
W86-03624

EVALUATION OF OIL SKIMMERS AND PUMPS,

Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5G.
W86-03625

PILOT-SCALE ASSESSMENT OF THE BIOLOGICAL FLUDIZED BED PROCESS FOR MUNICIPAL WASTEWATER TREATMENT,

Dearborn Environmental Consulting Services, Mississauga (Ontario).
Report SCAT-11, 1981. Canada Mortgage and Housing Corporation, Ottawa, Ontario. 148 p, 73 fig, 43 tab, 69 ref.

Descriptors: *Fluidized bed process, *Municipal wastewater, *Biological wastewater treatment, *Biofiltration, Pilot plants, Oxidation process, Biologial oxidation, Nitrification, Effluents, Suspended solids.

Pilot-scale investigations of the oxygenic biological fluidized bed process demonstrated that the system is a technically feasible alternative for carbon oxidation and nitrification of municipal wastewaters. A treated effluent containing less than 15 mg/L filterable BOD5 was produced consistently at a loading rate of 10 kg BOD5/cu m.d, an order-of-magnitude higher than typical for conventional suspended growth systems. To attain less than 15 mg/L total BOD5 content, without effluent polishing, required operation at a volumetric loading similar to conventional suspended growth systems, due to the contribution of suspended solids to the final effluent BOD5. The fluidized bed responded rapidly to changes in influent conditions; the process was less susceptible to influent disturbances than the activated sludge and rotating biological contactor processes in terms of effluent filterable organic carbon concentration. There was significant deterioration in effluent quality in terms of suspended solids concentration under diurnally varying flow and concentration conditions. Separate stage nitrification studies did not demonstrate the order-of-magnitude increases in volumetric ammonia oxidation rates claimed by other investigators, primarily because of the relatively low biomass concentrations possible during the treatment of high quality secondary effluent (BOD/TKN<0.4). In addition, diffusional limitations in the reactor biofilms were identified, which significantly increased the reactor hydraulic retention time necessary for low effluent ammonia-nitrogen concentrations (<1 mg/L). The process demonstrated a potential for application in such specific areas as: (1) expanding an existing suspended growth treatment facility; (2) upgrading an existing secondary treatment system to provide nitrification through fludized bed pretreatment for organic carbon removal and/or to provide biological denitrification; and (3) pretreatment of high-strength industrial wastes.
W86-03631

STORMWATER RUNOFF TREATMENT BY IMPOUNDMENT: BARRHAVEN PILOT STUDY,

R. J. Gietz.
Report SCAT-8, 1981. Canada Mortage and Housing Corporation, Ottawa, Ontario. 72 p, 27 fig, 7 tab, 2 app, 17 ref.

Descriptors: *Storm water, *Storm runoff, *Reservoirs, *Runoff volume, Runoff rates, Basins, Suspended solids, Coliforms, Streptoccus, Bacteria, Organic compounds.

This report presents the findings of a two-year study of stormwater runoff treatment by impoundment in an open basin. The treatment system was operated as a batch process for one summer and as a continuously overflowing pond for another. Runoff from 866 ha of agricultural and residential suburban lands partly under construction entered the treatment system. Impoundment reduced pollutant loadings by over 90% for suspended solids, 75%-90% for bacteria (total and fecal coliform and fecal streptococcus) and 25%-50% for organic nitrogen and total phosphorus compounds when the

runoff could be stored for more than 12 hr. At least 5 mm of rainfall were required to produce measurable runoff. The ratio of runoff to rainfall was used to estimated the runoff volumes that would be generated by up to 25-year return frequency storms of one and two-hour durations. From this, a storage volume of 40,000 to 47,000 cu m was indicated, on the basis of containment of runoff from a ten-year storm. It was determined that the most effective method of operating the treatment system was to keep the reservoir drawn down to a shallow pond. When runoff entered the pond, the drain valve was closed and the treatment system filled. Where possible, the runoff volume would be contained until its quality was suitable for discharge. For runoff volumes exceeding the treatment system storage volume, discharge took place over the spillway with limited pollutant removal. When the effluent quality became satisfactory, the reservoir was drained to the original shallow pond, and dry weather flow allowed to pass through. Other factors that govern the choice of treatmnt system storage volume are the runoff event frequency and the allowable discharge rate. It was found that of the approximately 30 events that could be expected from May to September about half took place within four days of one another. Allowing one day to fill and one day for storage, the reservoir should require two days to empty.
W86-03632

WASTEWATER TREATMENT SYSTEM FOR A LURGI COAL GASIFICATION PLANT,

ANG Coal Gasification Co., Detroit, MI.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-015765, Price codes: A18 in paper copy, A01 in microfiche. DOE/RA/20225-T3, February 15, 1982. Department of Energy, Washington, DC. 412 p, 16 fig.

Descriptors: *Wastewater facilities, *Wastewater treatment, *Industrial wastewater, *Waste disposal, *Oily water, *Coal gasification, Phenols, Ammonia, Cooling towers, Flotation, Lurgi gasification plant, Incineration, Storm wastewater, Lignite, Sludge disposal, Water reuse, Brine disposal, Wastewater disposal, Landfills, Land disposal, Wastewater lagoons, Injection wells, Boiler water, Phenosolvan unit, Phosam unit.

A wastewater treatment plant for a Lurgi gasification plant processing 14,000 tons of North Dakota lignite per day is described. The plant has multiple wastewater sources and treatment processes. Surface runoff containing normal quantities of sediment is controlled in a drainage ditch with capacity for a 100-year storm. Clean inplant storm drainage goes to three retention ponds, which allow suspended particles to settle and oily water to be pumped to the oily water treatment system. Sanitary waste is treated in a 20,000 gal per day package unit, which includes biological oxidation, clarification, and chlorination. Wastewater, after secondary treatment, is discharged to the stormwater pond; sludge is used as a soil conditioner. Inorganic wastewater from filter backwashing and ion exchange resin regeneration is recycled to the primary water treatment system; excess good-quality wastewater, brine solutions, and blowdown are injected into a deep well. Pretreatment for injection includes filtration and pH adjustment. Oily water drainage, collected from various operating units, enters a splitter box, parallel APR separators, and flotation unit. Gasification liquor, containing tar, tar oil, coal dust, phenols, ammonia and other compounds, is the largest single wastewater stream in the plant. After cooling, the gas liquor is separated into tar-coal dust, water, and tar oil fractions. Phenols are removed by diisopropyl ether extraction. Ammonia and acid gases are treated in a Phosam Unit, which absorbs wastes in ammonium phosphate solution. Concentrated waste liquor is incinerated. Hazardous wastes are placed in an onsite landfill.
W86-03639

PROCEEDINGS OF THE 6TH SYMPOSIUM ON WASTEWATER TREATMENT,

Department of the Environment, Ottawa (Ontario).
November 16-17, 1983, Montreal (Quebec). 331 p.

Descriptors: *Symposium, *Wastewater treatment, *Sludge disposal, *Sludge utilization, *Anaerobic digestion, *Industrial wastewater, *Biological wastewater treatment, *Municipal wastewater, Biodegradation, Wastewater facilities, Settling basins, Activated sludge, Alum, Organic compounds, Tertiary wastewater treatment, Macrophytes, Slime, Water pollution control.

This symposium was organized to allow scientists, engineers, technicians, plant operators and specialists working in research, design and operation of wastewater treatment facilities to promote and share their expertise and techniques in the municipal or industrial wastewater treatment fields. Guest speakers from a variety of specialties and countries presented papers on such topics as biological oxidation, anaerobic pretreatment, sludge disposal and utilization, pulp and paper industry wastewater treatment, analysis and treatment of toxic organics, filterable solids, clarifiers and batch reactors for municipal plants. Other topics included control of alum addition, removal of particles in settling basins, anaerobic digestion systems, use of aquatic macrophytes for sludge treatment, design of activated sludge processes, pollution control, and slime growth on fine bubble diffusers. A total of 25 papers were presented, 9 in French and 16 in English.
W86-03659

POLYSAR BIOLOGICAL OXIDATION TREATMENT PLANT,

Polysar Ltd., Sarnia (Ontario).
E. R. Fioroni.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 1-25, 2 fig.

Descriptors: *Wastewater facilities, *Aeration, *Biological wastewater treatment, *Education, *Training, *Design criteria, *Pilot plants, *Wastewater treatment, Wastewater renovation, Waste recovery, Recycling, Aerators, Sludge utilization, Clarification.

The Polysar plant was designed to centrally treat industrial waste streams before discharge into the St. Clair River as part of the overall program to improve the water quality of Great Lakes. The Marshall Macklin Monaghan Limited was awarded the design of the Biox Plant in July 1980. A 'fast track' approach was adopted which called for good communications between Polysar and Marshall Macklin Monaghan. A liason office was established for the Polysar project team at the designer's Don Mills Office. The design and construction process took two and one-half years and the whole project was delivered at 10% under budget. The major process components of the Biox Plant consist of pre-treatment, pre-aeration/equalization, aeration, clarification, and sludge return. Some effluents are pre-treated to remove oil and rubber which are reclaimed for other uses. The jet aeration system, a type of deep tank system, was chosen for the Biox plant. Three blowers are housed in a separate building next to the aeration tanks. An extensive training program consisting of pre-start-up training, start-up training and post-start-up training was undertaken. The plant started up in December 1983 and after 10 days met the Ministry of the Environment requirements for phenolics and total organic carbon.
W86-03660

ANAEROBIC PRETREATMENT FACILITY ALSO PROVIDES SLUDGE DISPOSAL CAPABILITY AND SOURCE OF RENEWABLE ENERGY FOR FOOD PROCESSOR,

ADI Ltd., Fredericton (New Brunswick).
R. C. Landine, C. J. DeGarie, A. A. Cocci, A. L. Steeves, and G. J. Brown.
In: Proceedings of the 6th Symposium on Wastewater Treatment. November 16-17. 1983. Montreal (Quebec). p 26-45, 8 fig, 4 tab.

Descriptors: *Fermentation, *Wastewater facilities, *Wastewater treatment, *Food-processing wastes, *Waste recovery, *Recycling, *Sludge utilization, *Methane, Industrial wastes, Chemical oxygen demand, Biological oxygen demand, Suspended solids, Nitrogen, Operating costs, Anaerobic conditions.

A waste treatment facility for a potato processing plant in France was constructed which consists of a raw waste pumping station, vibrating screens, potato waste hoppers, ADI-BVF (anaerobic fermenter), aeration nitrification complete with clarifier and sludge return, control building and ancillaries including biogas handling equipment and automatic samplers. Phase I of the facility has been operating since August 1981. The anaerobic portion of the plant (an ADI-BVF) provides over 90% removal of BOD, COD, and SS while operating under higher loadings than assumed for design and at temperatures below 20 degrees. The ADI-BVF operates without any addition of chemicals or heat. Primary and secondary sludges are disposed in the ADI-BVF where they are anaerobically decomposed to enhance biogas production. After two years of operation, no sludge has been removed from the facility. Recovered biogas is used in the factory boilers to make process steam. Overall removals for COD, BOD, SS and total N were 98%, 99.5%, 98%, and 80%, respectively. The entire facility was economical to construct and required only two operators. The monetary value of the biogas recovered exceeds all the operating costs plus labor costs.
W86-03661

FILTRABLE SOLIDS AS A DESIGN PARAMETER FOR WASTEWATER TREATMENT PROCESSES,

California Univ., Davis. Dept. of Civil Engineering.
G. Tchobanglous, A. D. Levine, and J. R. Koltz.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983. Montreal (Quebec). p 68-87, 6 fig, 5 tab, 7 ref.

Descriptors: *Particle size, *Filtration, *Membrane filters, *Wastewater treatment, *Suspended solids, *Sedimentation, *Wastewater composition, *Trickling filters, Separation techniques, Membrane processes, Biochemical oxygen demand, Primary wastewater treatment, Case studies.

Evidence is presented to suggest that the use of the mass distribution of filtrable solids is an appropriate and practical measure to provide a more useful characterization of wastewater than suspended solids (SS) or biochemical oxygen demand (BOD) for the design of wastewater treatment processes. The performance of biological treatment processes can be enhanced through the removal of SS larger than 1 micron in particle size. Particle sizes greater than 1 micron could be removed by chemical additions to the incoming wastewater or by mechanical filtration using the pulsed-bed filter. Techniques for measuring particle sizes in water and wastewater include electronic, light scattering, microscopic, flow fractionation, sedimentation or filtration methods. The mass distribution of filterable solids was determined using Nucleopore polycarbonate membrane filters, and scanning electron microscopy of samples collected from the various size filters. Samples from four surface waters and five wastewater treatment plants were examined for solids characteristics. The distribution of filterable solids in lake and river water varies with the time of year and that of wastewater varies with the time of day. A case study was performed of the treatment of a filtered primary effluent subjected to a pulsed-bed filter and a tower trickling filter. Results suggest that a high quality effluent can be achieved by chemical treatment if larger particles are removed early in the treatment process.
W86-03662

WATERLOO CLARIFIER: PRINCIPLES AND PRACTICE,

Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
R. R. Hudgins, and P. L. Silveston.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 113-122, 8 fig, 12 ref.

Descriptors: *Wastewater treatment, *Clarifiers, *Clarification, *Suspended solids, *Internal waves, *Separation techniques, *Primary wastewater treatment, *Baffles, Waves, Wave action, Wave height, Secondary wastewater treatment.

Research has suggested that density fluctuations or internal waves in clarifiers are responsible for removal efficiencies well below those theoretically possible and that these naturally initiated fluctuations can be controlled by baffles designed to function as wave traps. Experiments conducted in 4-ft and 8-ft diameter model circular clarifiers show that baffles reduce low frequency wave amplitudes and substantially improve the solids removal. Research at the Waterloo University have concentrated on flushing internal waves out of the clarifier. In the Waterloo Clarifier, the vertical walls are replaced by sloping ones. For the circular clarifier, the walls take the form of a truncated, inverted cone. For the square clarifier, the walls become a truncated, inverted pyramid while for the rectangular clarifier, only the wall at the outlet is sloped. Performance tests indicate that the Waterloo clarifier is capable of suspended solids reductions both in primary and secondary clarification exceeding conventional clarifiers of the same surface area. Although cost savings should be appreciable with the new design, it must be tested in full-scale operation.
W86-03663

IMPLEMENTATION OF SEQUENCING BATCH REACTORS FOR MUNICIPAL WASTEWATER TREATMENT,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
E. F. Barth.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 123-143, 7 fig, 4 tab, 17 ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Phosphorus removal, *Industrial wastes, *Separation techniques, *Sequencing batch reactors, Nitrification, Denitrification, Dairy industry, Pilot plants, Cost analysis, Comparison studies.

Sequencing batch reactor (SBR) technology is being implemented at various municipal sites both in the U.S. and abroad. Total life-cycle cost savings, ease of operation and reliability favor this technology at facilities sized up to 19,000 cu m/day. SBR allows control to be exerted over substrate tension in the reactor. SBR also requires no recycle pumping and liquid solids separation occurs under near ideal quiescent conditions. A three tank SBR system is considered near optimum for flows above 3,785 cu m/day. For such a system, automated valving and a process controller which eliminates major labor times is recommended for small facilities. Current research investigations on SBR's concern controlling sludge settleability, nitrification-denitrification, and biological phosphorus removal. SBR technology is being applied to the treatment of dairy wastes at the Springfield Creamery in Oregon, the treatment of a combination of landfill leachate and chemical manufacturing wastes in Niagara, New York and the upgrading of the Culver, Indiana continuous flow activated sludge facility. SBR studies on two wastewaters have not as yet revealed the controlling parameters to insure consistent, highly reliable biological phosphorus removal.
W86-03664

APPLICATION OF BIOLOGICAL BATCH REACTOR TECHNOLOGY IN WASTEWATER TREATMENT,

Schmidtke (Norbert W.) and Associates Ltd., Kitchener (Ontario).
N. W. Schmidtke, and B. H. Topnik.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 144-158, 14 fig, 1 tab, 12 ref.

Descriptors: *Batch reactors, *Wastewater treatment, *Suspended solids, *Performance evaluation, *Biochemical oxygen demand, *Biological wastewater treatment, *Domestic wastes, *Municipal wastewater, Phosphorus removal, Canada, Aeration, Industrial wastes, Seasonal variation, Nitrogen, Cost analysis.

Until recently, biological batch reactors had been relegated to the laboratory for process design data generation. Batch reactors are now being used at full scale in a variety of operational modes, especially in the treatment of domestic wastewaters. A batch reactor in Canada was involved in the retrofitting of a 9 cu m/day extended aeration plant designed to handle the flow from 5 residences at the Glenlea Agricultural Station just outside the city of Winnipeg. Long term performance of the batch reactor produced a superior quality effluent as defined by BOD(5)=5 mg/L, SS=5.5 mg/L and NH3-N=2.5 mg/L. Reductions in total phosphorus without use of chemical precipitants exceeded 50%. These observations confirm that the proper application of biological batch reactor systems is simple, inexpensive, requires a minimum of operator skill and attention, yet produces an effluent with characteristics normally associated with more complex biological treatment systems. Batch reactors would prove an attractive treatment option in situations where seasonal, and/or high strength wastes from municipalities, resorts and industry require a quick, reliable, and cost-effective solution.
W86-03665

ALKALINITY FEED FORWARD CONTROL OF ALUM ADDITION IN WASTEWATER TREATMENT,

Norsk Inst. for Vannforskning, Oslo.
T. Damhaug, and B. Paulsrud.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 159-165, 6 fig, 5 ref.

Descriptors: *Phosphorus removal, *Automation, *Control systems, *Wastewater treatment, *Alum, *Alkalinity, *Conductivity, *Chemical precipitation, Chemical treatment, Monitoring, Phosphorus, Hydrogen ion concentration.

An alternative concept of alum addition based on feedforward control is proposed for wastewater treatment systems that practice phosphorus removal to control eutrophication of surface waters. The control method requires an alkalinity measuring device which is recorded indirectly from the conductivity parameter. Such feedforward control devices were adopted by a Norwegian primary-chemical treatment plant that had been experiencing problems with alum dosing. A follow-up study showed that effluent pH was kept nearly constant (6.4-6.6) over the flow range even though alum dosage varied between 60 and 300 g/cu m, indicating the efficiency of the control system. An overall increase of total phosphorus removal efficiency from 96 to 99% was also recorded. By changing to automatic feedforward control, the average alum consumption was reduced from 270 to 190 g/cu m. The need for manual corrections is reported to be negligible.
W86-03666

COMPUTATION OF FRACTIONAL REMOVAL OF DISCRETE AND FLOCCULANT PARTICLES IN SETTLING BASINS,

Windsor Univ. (Ontario). Dept. of Civil Engineering.
S. K. Agrawal, and J. K. Bewtra.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 182-189, 4 fig, 4 ref.

Descriptors: *Wastewater treatment, *Flocculation, *Particle size, *Suspended solids, *Settling velocity, *Mathematical studies, *Theoretical analysis, *Mathematical models, Solid wastes, Sedimentation, Settling basins, Chemical coagulation, Settling tanks, Particulate matter.

In the conventional method of calculating the fractional removal of flocculant particles, it is assumed that the average settling velocity for different particle sizes in the lower depths in settling basins is the same as in the upper depths. This assumption is not quite correct, because the particles continuously flocculate and/or shear during the entire settling depth, and hence the average settling velocity changes both with depth and time. In the modified method, a different approach for calculating the fractional removal of particles is proposed to overcome the deficiency in the conventional method. Instead of considering a vertical constant time line, a more reasonable horizontal constant depth line for that particular time is used. This approach is more reasonable because the settling velocities of different flocculating particles are all averaged over the same depth. A typical example has been worked out to illustrate the applications of both the methods. (Author)
W86-03667

COMPARISON OF STIRRED SUSPENSION AND FIXED FILM ANAEROBIC DIGESTION SYSTEMS,

Waterloo Univ. (Ontario). Dept. of Chemical Engineering.
P. W. Girard, J. M. Scharer, and M. Moo-Young.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 230-260, 10 fig, 15 tab, 32 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Comparison studies, *Cellulose acetate, *Biological wastewater treatment, *Models, *Methane, *Economic feasibility, Anaerobic conditions, Biodegradation, Model studies, Animal wastes, Industrial wastes, Pulp wastes.

The techno-economic feasibility of two-stage anaerobic digestion systems for the treatment of cellulosic wastes was investigated. In the first stage, the enzymatic hydrolysis of insoluble substrates was the rate limiting step. Optimum cellulose hydrolysis and conversion to volatile acid products was observed at C:N ratio of 24:1. Fixed film and stirred tank reactors were utilized to study methanogenesis. The kinetics of volatile fatty acid utilization was proven to be rate limiting. Acetate utilization by methanogens followed a Monod-type kinetic model; the maximum specific growth rate and the half saturation constant were found to be 0.17/day and .00846 M acetate, respectively. Propionate utilization, however, was strongly inhibited by acetate. The inhibition resembled classical competitive inhibition patterns, the inhibition constant being 2.97 times 10 to the minus 7th power M. The models derived for volatile acid substrates were applicable for acid mixtures in both stirred tank and downflow fixed film reactors. The economic feasibility of the anaerobic digestion systems has been performed concurrently with the experimental program. In the analysis, capital equipment costs were based on quotations from manufacturers. Scale-up was based on procedures generally used by the food and fermentation industry. Process economics favored fixed film biological reactors. A particularly attractive scenario was the codigestion of paper pulpmill clarifier sludges with animal wastes. Using a C:N ratio of 24:1 in the feed, a fuel gas containing 72% methane was predicted and the process would be economically feasible at moderate installation sizes. (Author)
W86-03668

USE OF AQUATIC MACROPHYTES FOR SLUDGE TREATMENT,

Foundation Trust Ltd., Salzburg (Austria).
G. A. Neurohr.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 262-279, 2 fig, 9 tab, 15 ref.

Descriptors: *Wastewater treatment, *Macrophytes, *Sludge drying, *Sludge thickening, *Dewatering, *Biodegradation, *Digested sludge, *Sludge bed, Biomass, Metabolism, Biotransformation, Composting.

Modified sand-based sludge drying beds planted with emergent reeds of Phragmites communis (reed beds) are being used to improve the dewatering capability of conventional sludge drying beds without the use of chemicals or any subsequent energy intensive handling or processing tech-

niques. Aerobic stabilized sludge is pumped directly from the aeration basins to the reed beds where it undergoes air drying. Sludge is kept on the reed beds until secondary roots and shoots are able to assist in decomposing the sludge residue by means of bacterial and plant metabolism in the rhizosphere of Phragmites communis. The bed turnover time is at least 5 yr. The oldest field scale plant at the Ustersbach plant in Germany employs 300 sq m of reed beds and has been operating intermittently for 8 yr without removing the humus build-up. In Southern Germany about 20 dryings of 8-12 cm of wet digested sludge are feasible per year on open beds. If the site is protected from rain by enclosures, the number of dryings could be increased by 30-70%. The advantages of reed beds over conventional facilities lie in the long bed turnover time and in the byproducts (biomass and low grade compost) produced.
W86-03669

FUNCTIONAL DESIGN OF ACTIVATED SLUDGE PROCESSES,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, and A. F. Rozich.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 280-297, 7 fig, 1 tab, 10 ref, 3 append.

Descriptors: *Model studies, *Mathematical models, *Design criteria, *Activated sludge process, *Mathematical equations, *Waste characteristics, *Organic matter, *Effluents, Activated sludge, Models, Computer models, Computer programs, Organic compounds.

A design and operational model for normal wastes and for waste containing toxic organic substrates is described. The model is used to predict effluent quality and sludge production which are governed by waste strength, biokinetic constants, and three selectable engineering control parameters. The interrelationship of all of these factors determines plant efficiency. The Monod relationship describes the relationship between soluble organic pollutants remaining after treatment and the specific growth rate of the biomass on noninhibitory substrates while the Haldane equation describes this same relationship for the growth of heterogeneous microbial populations on inhibitory or toxic substrates. The engineering model is most adaptable as a subroutine for economic or costing models because the parameters are easily manipulated to optimize design and operation costs for a given degree of treatment. It is easily manipulated by plant personnel to guide operation of the system. A computational example of the use of the model is given along with a sample computer program in BASIC to facilitate computations on the hand-held microcomputer.
W86-03670

POLLUTION CONTROL: THE HIDDEN PROFIT CENTRE,

Rupke and Associates Ltd., Bradford (Ontario).
J. W. Rupke.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 298-301, 1 tab.

Descriptors: *Food-processing wastes, *Case studies, *Wastewater treatment, *Cost analysis, *Activated sludge, *Sludge utilization, *Sludge thickening, *Phosphorus removal, Water pollution sources, Industrial wastes, Food processing industry, Industrial plants, Sludge disposal, Aeration lagoons, Sludge bed, Sludge drying, Water pollution control.

In many cases, the close scrutiny of pollution sources can identify raw and final product losses of such a magnitude that the savings obtained in the production facility more than offset the costs of pollution control. To illustrate this point a case history of a food processor operating a 200 cu m/day activated sludge system followed by an aerated lagoon and two stabilization ponds is examined. The regulatory agency was concerned about odors from the industry's aerated lagoon being used for waste activated sludge stabilization and storage. In the first year, minor piping and operational changes allowed more sludge solids to be generated from the thickener, resulting in a more acceptable cattle feed product. The aeration system was found to be of sufficient capacity that only one aeration tank was needed during periods of lower production. The food processing industry has also been able to treat the waste stream of an adjacent company at a profit. Phosphorus discharge was reduced by careful monitoring of a phosphate spray step and capture of the overspray. The use of professional operators helped to maximize the use of existing equipment and delay or remove the need for further capital expenditures.
W86-03671

SLIME GROWTH ON FINE BUBBLE DIFFUSERS,

Gore and Storrie Ltd., Toronto (Ontario).
G. Addison.
In: Proceedings of the 6th Symposium on Wastewater Treatment, November 16-17, 1983, Montreal (Quebec). p 302-322, 14 tab, 9 photos.

Descriptors: *Bubbles, *Aerators, *Slime, *Hydraulic equipment, *Biochemical oxygen demand, *Fouling, *Wastewater treatment, *Performance evaluation, Water pollution control, Aeration, Hydraulic machinery, Biological oxygen demand, Dissolved oxygen, Pilot plants, Aeration lagoons, Model studies.

Pilot studies were conducted at the Lakeview Water Pollution Control Plant (WPCP) in Ontario to determine whether fine bubble diffusers would slime when used to treat sewage. As a result of the testing at Lakeview it was concluded that sliming can be expected on fine bubble diffusers when they are installed at the inlet zone of the plug flow aeration tank. Sliming is not expected at the end of a plug flow aeration tank as long as soluble BOD5 remains below approximately 15 mg/L. Sliming can be expected to about the halfway point of an aeration tank at the Lakeview WPCP. Headloss increases that occur appear to be from air side fouling or inorganic compound build-up rather than slime growth. Formic acid cleaning lessens but does not eliminate sliming of diffusers. It is recommended that the limits of soluble BOD under which diffusers can be operated without problems be identified and that satisfactory operation of bubble diffusers on a pilot scale be demonstrated to confirm that factors other than soluble BOD concentrations have no significant effects with respect to sliming.
W86-03672

AQUACULTURE IN DREDGED MATERIAL CONTAINMENT AREAS: PROCEEDINGS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W86-03704

PROCEDURES AND PRACTICES IN ACTIVATED SLUDGE PROCESS CONTROL.

Activated Sludge Process Control Series, Butterworth, Boston. 1983. Edited by Robert M. Arthur. 226 p.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control, *Design criteria, *Computers, Biological wastewater treatment, Sludge, Training.

Several aspects of process control in activated sludge systems were discussed in a conference by invited speakers. Correlation of process control with effluent BOD and suspended solids is possible if growth of floc-forming bacteria is maintained. Only three basic processes can be controlled. These are aeration, return sludge rate, and sludge wasting. The use of analytical data in process control is explained with sample reporting forms. Two papers concern computerization of process control. On-line oxygen uptake rate determined by respirometers allows rapid implementation of process changes. Activated sludge plants can be designed for ease of operation; practical suggestions, emphasizing flexibility, are presented. Employee training is an important part of process startup.
W86-03727

CORRELATION OF PROCESS CONTROL STRATEGUES WITH EFFLUENT BOD AND SUSPENDED SOLIDS,

California Univ., Davis. Dept. of Civil Engineering.
D. E. Schroeder.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 1-23, 6 fig, 4 tab, 3 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control, Biological wastewater treatment, Design criteria, Sludge, Organic loading, Equalizing, Dissolved oxygen, Oxygenation, Chemical coagulation, Flocculation, Baffles, Suspended solids, Model studies, Statistical analysis.

The steady state is an unachievable goal in biological wastewater treatment, which should be viewed as an inherently unstable process. Three factors are responsible for this--variation in input, sequencing in microbial population dominance, and sensitivity to temperature. The objectives of process control in the activated sludge process are (1) damping out of input variations, (2) minimization of effluent variation, and (3) prevention and recovery from process upsets. The following control strategies are in common use in activated sludge plants (with the exception of trickling filters): sludge age/wasting, loading rate, flow equalization, change in process configuration, recycle, dissolved oxygen, and chemical addition. Although mathematical models can be used to determine design values for oxygen uptake rates, sludge production, and filtered effluent BOD, they are not helpful in estimating actual effluent quality because that value is dominated by suspended solids. Two preventive and long-term strategies are available for controlling effluent BOD and suspended solids: matching process configuration with wastewater characteristics and use of statistical tools for determination of inherent problems. Factors to be considered in process control are pinpoint floc, dispersed growth, filamentous bulking, and hydraulic instabilities. The best control operates in the conventional solids retention time range and incorporates a non-carbon-limited region into the system. Baffling can accomplish this.
W86-03728

PROCESS CONTROL STRATEGIES,

Arthur Technology, Inc., Fond du Lac, WI.
R. M. Arthur.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 25-45, 10 fig, 6 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control, Biological wastewater treatment, Sludge, Aeration.

In a conventional activated sludge plant only three variables can be controlled: rate of aeration, rate of return sludge, and rate of wasting. The best way to vary aeration is to use several blowers of different sizes so that the optimum combination may be used at given conditions. Close control may be achieved by (1) a feedback system in which dissolved oxygen changes are used to indicate changes in oxygen requirements or (2) use of respiration rates to indicate the actual oxygen demand. Although the rate of sludge return should be controlled, it is difficult. However, respiration rates can be used to indicate the food: microorganism ratio. Return pumps can also be set to work at a given sludge blanket level height. To prevent anoxic conditions the detention time of the sludge can be matched with the time it takes for the dissolved oxygen to equal zero or to monitor the oxidation reduction potential. Sludge wasting can be controlled by determining the ratio of endogenous rate of respiration of the sludge to the concentration of mixed liquor volatile suspended solids. In some plants raw wastewater storage or microorganism storage can be effectively used in process control.

W86-03729

UNDERSTANDING THE APPLICATION OF ANALYTICAL DATA TO PROCESS CONTROL,

Operating Consultant Services, Cincinnati, OH.
T. J. Lutcher, and G. E. Ettel.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 53-64, 3 fig, 7 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control, Biological wastewater treatment, Performance evaluation, Monitoring, Chemical analysis, Microorganisms.

Analytical data can be used in activated sludge process control. Typical tests providing performance data are temperature, pH, dissolved oxygen, mixed liquor suspended solids, mixed liquor volatile suspended solids, solids settling rate, alkalinity, nutrients, oxygen uptake rate, and viability of microorganisms. Before choosing tests for a monitoring program several factors must be considered: limitations of the procedure, similarity between test conditions and process conditions, test interferences, sample degradation, meaning of the end result, and type of sample (grab, composite, online). Sample forms for recording test results are illustrated. If test results indicate that a process parameter is out of control, the required adjustment must be communicated accurately to others involved. The necessary process change is then implemented, allowing sufficient time for the biological processes to respond.
W86-03730

COMPUTERIZATION: CAN IT WORK FOR YOU,

Thorn Creek Basin Sanitary District, Chicago Heights, IL.
R. A. Davis.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 77-85.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control. *Computers, Biological wastewater treatment, Performance evaluation, Monitoring, Thorn Creek Basin, Automation, Data processing.

Computerization is useful in wastewater treatment plant process control. Cost savings result from increased efficiency in using equipment and personnel. Reports are available within minutes instead of days, improving the quality and consistency of effluent quality. However, all personnel should understand how to perform all procedures and calculations manually in case of system failure. Programming should allow flexibility to account for changes in technology and requirements. Experience in computer installation and operation in the Thorn Creek Basin Sanitary District (Chicago, Illinois) advanced wastewater treatment plant are related. Here direct control has been used successfully for flow equalization, pump related. Here direct control has been used successfully for flow equalization, pump operation, and blower control. In addition, flow control, digester performance, and utility consumption efficiency have been improved. Computerization has not yet proved usable in chlorination control and raw sludge pumping. Maintenance of the computer system is protected from the ever-present high moisture and hydrogen sulfide, which can attack electronic circuitry. Power fluctuations have wiped out the entire disk and have caused all processes to switch to manual control. This problem has been partially alleviated by installation of an uninterruptible power supply. Sensors, the weakest link in the control loop, must be constructed to work reliably and must be maintained and calibrated regularly.
W86-03731

COMPUTER AS A TOOL FOR ACTIVATED SLUDGE.

EMA, Inc., St. Paul, MN.
R. G. Skrentner.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 87-111, 12 fig, 11 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control, *Computers, Biological wastewater treatment, Performance evaluation, Monitoring, Flow control, Flow measurement, Automation, Data processing, Sludge, Aeration, Dissolved oxygen, Oxygenation.

Computers can provide not only basic control, but optimized control, in an activated sludge plant. Converting from basic to optimized control involves developing a way of measuring the characteristics of the process, improving efficiency and stability with less operator involvement, and formulating predictive models to correct possible problems. Detailed information is provided to computerize flow measurement/control, sludge handling/distribution, and dissolved oxygen or air systems. Practical suggestions include borrowing or leasing instruments for testing and evaluation and becoming knowledgeable about the capabilities of a computer control system.
W86-03732

RELATING BOD5 WITH ON-LINE OXYGEN UPTAKE RATE MEASUREMENTS USING AUTOMATIC RESPIROMETERS IN VIEW OF PROCESS MONITORING AND CONTROL,

Sherbrooke Univ. (Quebec).
N. Therien, and F. Ilhan.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 113-129, 10 fig, 4 tab, 9 ref.

Descriptors: *Wastewater analysis, *Activated sludge process, *Process control, *Respirometers, *Biochemical oxygen demand, Biological wastewater treatment, Monitoring, Automation, Oxygen uptake.

Automatic respirometers were used to relate specific oxygen uptake rate to the BOD5 of domestic and industrial wastewater. A linear relationship was observed when biomass is not limiting the substrate assimilation process. A Michaelis-Menten formulation fit the data well and produced reliable BOD5 estimates even when biomass influenced the substrate assimilation process. Typically the predicted BOD5 value of influent was obtained within 30 min. This information was then put into a system which controlled the activated sludge process.
W86-03733

DESIGN OF ACTIVATED SLUDGE FACILITIES FOR OPERATING AND MAINTAINABILITY,

Smokey Stack, Inc., Cedars, PA.
V. T. Stack.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 131-152, 3 fig.

Descriptors: *Wastewater treatment, *Activated sludge process, *Process control, *Design criteria, Flexibility, Biological wastewater treatment, Maintenance, Equalizing, Pretreatment of wastewater, Screens, Clarification, Aeration basins, Sludge, Chlorination, Chemical treatment, Pipes, Sampling, Measuring instruments.

The operator of an activated sludge plant generally recognizes the need for process flexibility more than the other parties involved in plant design: owner, engineer, and regulatory agencies. Flexibility generally adds 25%-40% to capital costs. For adequate flexibility the processes should be designed for the proper number and capacity of parallel units and for several modes of operation including plug flow, complete-mix, step feed, and contact stabilization. In pretreatment, operations and maintenance are easier with equalization, three parallel grit removal units, and three parallel rag screening units. Primary clarification, which is an economical BOD removal process, should have at least 4 units. Three or four aeration basins provide adequate flexibility if the startup load to the process is 50% or less of capacity. Installing four or more secondary clarifiers will prevent suspended solids overflow if one unit is out of service. The return sludge rate should be at least 100%. Optimum chlorination unit performance is attained with short feed lines and frequent removal of sludge from the chlorination basin. The effect of side streams entering the main process can be controlled by aerobic stabilization before return or by sludge thickening before digestion. Piping, storage space, and inlets should be provided for chemical addition even though it may not be part of the original process. Piping should be as short as possible, above ground, and include bypass lines and drain systems. Sampling lines should be provided as well as adequate monitoring instrumentation. In sludge management, liquid and solid sludges should be kept separate.
W86-03734

GOOD PROCESS CONTROL: PLANNING AND IMPLEMENTATION,

Polysar Ltd., Sarnia (Ontario).
R. Fioroni, and W. D. Frais.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 153-171, 4 fig, 1 tab.

Descriptors: *Wastewater treatment, *Activated sludge process, *Design criteria, *Operations, *Training, Biological wastewater treatment, Biox plant, Measuring instruments, Polysar, Ltd.

When the Polysar activated sludge plant at Sarnia, Ontario, was modified, three problems were considered: proper design, instrumentation, and training of personnel. Although the importance of process flexibility and controllability was recognized, the process operator was considered the key factor in a successful operation. The plant was designed to handle more than 200% of the average daily hydraulic flow and organic loading. Parallel and series configurations were designed for maximum flexibility. Instrumentation was designed to provide current information rapidly as well as historical data. Training was divided into pre-startup, and post-startup sections. Some personnel were onsite as much as 2 years before startup. The training courses are described in detail.
W86-03735

STARTUP CRITIQUE OF SARTELL 3,

Saint Regis Paper Co., Sartell, MN.
D. L. Keller.
In: Procedures and Practices in Activated Sludge Process Control, Butterworth, Boston. 1983. p 173-180, 2 fig, 1 tab.

Descriptors: *Wastewater treatment, *Activated sludge system, *Process control, *Pulp and paper industry, Biological wastewater treatment, Design criteria, St. Regis Paper Company, Sartell plant, Training, Dewatering, Clarifiers.

Practical suggestions are offered in a description of the startup of the fully automated waste treatment plant at the St. Regis Paper Company mill at Sartell, Minnesota. A successful startup begins with proper design and construction. Visits to similar plants during design can provide information which may be incorporated into the final design. Equipment should be on the market long enough for performance data to be available. Problems encountered in the plant startup included bent shafts on the pumping turbines, tripping of the clarifier drive (solved by increasing the clearance between floor and rake to 3 inches), and roll failures and belt mistracking in the sludge dewatering system.
W86-03736

SEPARATION OF BOUNDARY LAYER AND FLOW TURBULENCE OF CENTER-FEED CIRCULAR SEDIMENTATION BASINS,

Maryland-National Capital Park and Planning Commission, Upper Marlboro.
T-L. Yin.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 152-161, 8 ref.

Descriptors: *Boundary layers, *Sedimentation basins, *Turbulent flow, Center-feed basins, Sedimentation, Basins, Circular basins.

This research analyses boundary layer flow separation in center-feed circular basins by adopting some classical treatments of the problem. Analysis yielded the following conclusions: (1) In center-feed circular settling basins, the boundary layer flow separation does occur and also the subsequent reverse flow and vertical eddies at bottom of the settling basins, due to the continuous increase of pressure. Location of flow separation is analytically obtained. (2) The flow separation, reversed flow and eddies which cause turbulence of flow at basin bottom are believed to be the fundamental reason for less settling efficiency of center-feed settling basins compared with rectangular ones. (3) For practical purposes, it needs further study to quantify the impact of boundary layer flow separation on the turbulence of bottom flow and on the settling efficiency. (4) The reduction of settling efficiency due to boundary layer flow separation in center-feed circular basins may be considered not as important as some other factors in practical wastewater treatment operations and design. However, the analysis of the insight of the phenomenon and the location of the separation point of bottom flow might lead to improvement of design in circular settling basins or other related hydraulic structures.
W86-03830

PUBLICATIONS OF THE WATER RESEARCH INSTITUTE, 58.

National Board of Waters, Helsinki (Finland). Water Research Inst.
1985. 82 p.

Descriptors: *Filtration, *Wastewater treatment, *Domestic wastes, *Chemical precipitation, *Nutrient removal, Phosphorus removal, Nitrogen removal, Denitrification, Aeration, Pilot plants, Flocculation, Separation techniques, Organic compounds, Nitrification.

The series 'Publications of the Water Research Institute' contains scientific papers and processed data from the research fields of the Water Research Institute, National Board of Waters, Finland. The series is a sequel to the publications 'Communications of the Hydrological Office' and 'Soil and Hydrotechnical Investigations.' This publication contains papers on the topics of rapid filtration as a supplementary treatment of domestic sewage, combined nitrogen and phosphorus removal from wastewaters, and post-precipitation in wastewater treatment. In the first report, the applications of rapid filtration to sewage treatment in Central and Northern Europe are briefly examined. The second report examines efforts to find a reliable and simple method for the simultaneous removal of organic compounds, phosphorus and nitrogen from domestic sewage through activated sludge pilot-plant experiments on nitrification, post and predenitrification and intermittent aeration with and without ferrous sulfate addition. In the third report, the effects of chemical unit flocculation time and intensity on removal efficiency in post-precipitation plant (precipitant aluminum sulfate) were studied. (Geiger-PTT)
W86-03842

RAPID FILTRATION AS A SUPPLEMENTARY TREATMENT OF DOMESTIC SEWAGE,

A. Latvala.
IN: Publications of the Water Research Institute, 58, 1985. p 3-27, 21 fig, 8 tab, 30 ref, 1 append.

Descriptors: *Filtration, *Sand filters, *Domestic wastes, *Chemical precipitation, *Filter rates, *Wastewater treatment, Suspended solids, Biological oxygen demand, Phosphorus, Filters, Performance evaluations, Filtered wastewater, Sulfates, Separation techniques.

This study briefly examines rapid filtration applications of sewage treatment in Central and Northern Europe. Tests were made of the ability of low upflow filters to supplement simultaneous precipitation with ferrosulfate at two low-load plants. No chemicals were used in the filtration, and contact material was sand of finest grain size. Fluidizing water backwashing of the filter was supplemented with air. The ferrosulfate dose of simultaneous precipitation and filter rate were varied in the tests. Results for suspended solids, biological oxygen demand and total phosphorus were examined in detail. At one of the plants a total phosphorus level below 0.2 milligrams/liter was obtained using 100 g/cu m of ferrosulfate to simultaneous precipitation. The best results were obtained at low filter rates. Biological oxygen demand and suspended solids reductions in rapid filtration were generally 40-100%. A two-layer or upflow filter is preferred over a single-layer one for better filter efficiency and multiple storage capacity. (Geiger-PTT)
W86-03843

COMBINED NITROGEN AND PHOSPHORUS REMOVAL FROM WASTEWATERS,

M. Valve.
IN: Publications of the Water Research Institute, 58, 1985. p 28-54, 14 fig, 18 tab, 224 ref, 7 append.

Descriptors: *Activated sludge process, *Nitrification, *Denitrification, *Nutrient removal, *Wastewater treatment, Suspended solids, Biological oxygen demand, Phosphorus removal, Chemical oxygen demand, Phosphorus, Nitrogen removal, Activated suldge, Pilot plants, Aeration, Separation techniques, Sulfates, Organic compounds.

Activated sludge pilot-plant experiments on nitrification, post and pre-dentrification and intermittent aeration with and without ferrous sulfate addition were conducted to find a reliable and simple method for the simultaneous removal of organic compounds, phosphorus, and nitrogen from domestic sewage. Results showed that nitrification was inhibited at dosages of Fe(II) exceeding 30 g/cu m. Ferrous sulfate also had an inhibitory effect on the denitrification process. The post-denitrification process gave improper results. In the re-denitrification process, the nitrification rate was >80%, total nitrogen reduction 70%, and effluent phosphorous <1.5 milligram/liter. Similar results were observed for the intermittent aeration process. The SVI value, suspended solids, biological oxygen demand, and chemical oxygen demand were basically the same for both pilot plant units. (Geiger-PTT)
W86-03844

POST-PRECIPITATION IN WASTEWATER TREATMENT,

S. Valimaa, and M. Pietarila.
IN: Publications of the Water Research Institute, 58, 1985. p 55-82, 28 fig, 16 tab, 20 ref.

Descriptors: *Activated sludge process, *Sulfates, *Precipitation, *Flocculation, Biological wastewater treatment, Phosphorus, Nitrification, Phosphorus removal, Chemical oxygen demand, Activated sludge, Wastewater treatment, Separation techniques, Hydrogen ion concentration, Alkalinity, Cost analysis, Chemical treatment.

The effects of chemical unit flocculation time and intensity on removal efficiency in post-precipitation plant (precipitant aluminum sulfate) were studied. Also, the effect of the flow rate, precipitation dosage and nitrification were measured. A test was performed to operate the post-precipitation plant biological unit as a simultaneous-precipitation one (ferrosulfate), and results were collected from post-precipitation plants operating in Finland. The effect of flocculation factors on removal results in the parameter regulation range studied turned out to be small. Good results were achieved with first stirrer rotation speed 20-28 revolutions/min (G value 15-21/sec) and total residence time 10-30 min. Due to nitrification in biological unit and the precipitant, pH of wastewater occasionally altogether stopped. Simultaneous precipitation enabled a reduction in post-precipitation plant precitant costs. (Author)
W86-03845

THEORETICAL CONSIDERATIONS OF GRAVITY DEWATERING OF DREDGED MATERIAL THROUGH THE BOTTOM OF A CONTAINMENT AREA,

Japan Bottom Sediment Management Association, Tokyo.
T. Yoshida.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 41-62, 12 fig.

Descriptors: *Dredging, *Dewatering, Sludge drying, Soil mechanics, Soil water, Settling ponds.

The theoretical considerations of a pilot study utilizing short-term dewatering basins for dredged material, performed adjacent to a dredging site, are presented. The study, based on the principle of dewatering dredged material by gravity drainage, was conducted at Lake Suwa, Japan. It was concluded that in the management of dredged material the most important matter is to dewater the material as quickly as possible. Dewatering dredged material by gravity drainage is very effective in lowering the water content within a short time period. The drainage behavior of dredged material from the soil mechanics point of view is discussed. (Halterman-PTT)
W86-03870

RAPID DEWATERING TEST OF DREDGED MATERIAL IN SITU,

Japan Bottom Sediment Management Association. Tokyo.
M. Nakamura.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 63-73, 15 fig, 4 tab.

Descriptors: *Dredging, *Dewatering, Sludge drying, Soil mechanics, Soil water, Settline ponds.

The most popular method of reducing the volume of dredged material is natural evaporative dewatering. This method necessitates a long desiccation period of about 10 months and a large space. Conditions like these are difficult to overcome in the solution of water pollution problems, especially in lake restoration. To implement pollution control projects it is necessary to dewater dredged material as rapidly as possible and to overcome the unfavorable conditions mentioned above. A rapid dewatering test, conducted in Lake Suwa, Japan, is discussed. The efficiency of sun-dried and bottom drainage ponds was compared. The bottom drainage ponds produced superior results, and the concept that water in dredged material should be drawn out by gravity was verified by the test. (Halterman-PTT)
W86-03871

MECHANICAL DEWATERING OF DREDGED SLURRIES,

Rexnord, Inc., Milwaukee, WI.
P. R. Erickson, and J. Hurst.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 74-89, 12 fig, 1 tab, 9 ref.

Descriptors: *Dredging, *Dewatering, *Sludge drying, Spoil banks, Model studies, Pollution.

A 2.5-m-wide heavy duty belt press can dewater high density sludge at a rate of 20 to 30 tons/hr (dry basis). The unit is the largest factory preassembled module, and thus is transportable from site to site. It can be mounted on a concrete slab, truck-mounted, or mounted on a barge to eliminate dredge-to-shore pumping and piping problems. Energy required for dewatering is equal or less than current energy levels expedient when pumping from dredge to shore. It is anticipated that an 83% volume reduction would occur when converting a 15% solids dredged slurry to a 70% solids cake. Near term, belt press dewatering may especially fit into dredging operations where confinement is necessary or where chemical contamination is present in the dredgings and total solids capture is necessary. Final cake may be placed

directly into berm or dike construction, or, where chemical contaminants build up significantly, chemical fixation is feasible. (Author)
W86-03872

PROCEEDINGS OF THE CONFERENCE ON COMBINED MUNICIPAL/INDUSTRIAL WASTEWATER TREATMENT.

Robert S. Kerr Environmental Research Lab., Ada, OK.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142133, Price codes: A23 in paper copy, A01 in microfiche. University of Texas at Dallas, March 25-27, 1980. EPA-600/9-81-021, Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. Edited by Aharon Netzer. 550 p.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Municipal wastewater, Pollutants, Toxicity, Organic compounds, Sludge, Heavy metals, Water treatment facilities, Land disposal.

Papers discussing a wide variety of topics related to combined municipal/industrial wastewater treatment are presented. Specific areas of focus include: combined biological treatment, treatment of hazardous industrial compounds, textile wastes, wastewater reuse, land application of sludge, activated carbon use, case histories, textile wastes, treatment of priority pollutants, and heavy metal removal. (Halterman-PTT)
W86-03883

INNOVATION IN WASTEWATER TREATMENT,

Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
J. G. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142158, Price codes: A02 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 7-15.

Descriptors: *Wastewater treatment, *Wastewater, Industrial wastewater, Municipal wastewater, Water treatment facilities, Wastewater purification, Sludge, Chemical sludge, Sludge disposal.

Difficulties encountered in attempting to advance technology in the area of wastewater treatment are discussed, with specific examples provided which focus on combined industrial and municipal wastewater treatment. The problems with the concept of industrial cost recovery, the pre-treatment requirement, the concept of pollutants being resources 'out of place', and the problems of the disposal of the final residual, are outlined. Various aspects of sludge disposal are discussed, with the Detroit, Michigan municipal treatment facility presented as a case study. The opportunities for innovative wastewater treatment are predicted to be in the areas of pre-treatment of industrial wastewater, and in the production processes. (Halterman-PTT)
W86-03884

INDUSTRIAL CATEGORICAL PRETREATMENT STANDARDS,

Environmental Protection Agency, Washington, DC.
R. M. Southworth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142166, Price codes: A02 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 16-23, 2 tab.

Descriptors: *Wastewater treatment, *Wastewater, Waste treatment, Industrial wastewater, Municipal wastewater, Wastewater purification, Legal aspects, Legislation, Pretreatment of water.

The categorical pretreatment standards currently being developed by the Effluent Guidelines Division of the Office of Water Regulations and Standards, are outlined. Included are discussions of the pretreatment requirements in the Clean Water Act of 1977, EPA's general pretreatment regulations, and the procedure used to establish categorical pretreatment standards. Significant problems (addressed by the Clean Water Act of 1977) caused by discharges to publicly owned treatment works (POTW) include interference with POTW operations (fires, corrosion, explosions, hazardous fumes, system upsets); incompatibility, such as interfering with sludge disposal; and the passage of discharges through POTW. Categorical pretreatment standards are based on the degree of treatment that can be obtained by different technologies, considering the economic impact of those technologies. The philosophy behind establishing uniform categorical pretreatment standards is that all industries in a category, or subcategory, should have to treat their wastewater to the same degree of treatment. (Halerman-PTT)
W86-03885

COMPATIBILITY ASSESSMENT OF MUNICIPAL/INDUSTRIAL WASTEWATERS FOR COMBINED BIOLOGICAL TREATMENT,

A. W. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142182. Price codes: A03 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 31-44, 9 fig, 3 ref.

Descriptors: *Wastewater treatment, *Wastewater, Industrial wastewater, Municipal wastewater, Water treatment facilities, Biological treatment, Sludge, Wastewater purification.

There are numerous chemical and hydraulic aspects of biological treatment of combined municipal and industrial wastewaters. Compatibility is effected by qualitative and quantitative characteristics of the wastes involved. Assessment should include reaction rates, phase distribution of organics, concentration effects, hydrographs and relative volumes, transport time effects and nature of sludges produced. When compatibility assessment is properly done during process design, combined treatment is frequently not the best alternative. Because of legislation and regulations developed since 1970, combined biological treatment is less attractive now than ever. Separate treatment is increasingly the obvious method of choice where a choice can be made. (Author)
W86-03887

BIOLOGICAL INHIBITION SCREENING OF INDUSTRIAL WASTEWATERS,

Metcalf and Eddy, Inc., Wakefield, MA.
R. L. Stover.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142190, Price codes: A04 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 45-59, 3 fig, 4 tab, 9 ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, Inhibition, Inhibitors, Biological inhibitors, Bioassay, Nitrification, Microbiological studies.

A simple and inexpensive microbiological inhibition screening test procedure is discussed. The test can be conducted by treatment plant personnel at municipal plants receiving industrial wastewater discharges to provide estimates of the threshold inhibition levels to both the carbonaceous and nitrification reactions. This procedure consists of adding different dilutions of wastewater to a series of BOD bottles containing the appropriate seed source (carbonaceous or nitrifying) and monitoring the respective respiration rates. The factors affecting this inhibition screening procedure and important experimental design considerations are presented along with results from inhibition testing of various industrial wastewaters for both carbonaceous removal and nitrification. This test procedure can be employed to provide valuable screening information relative to biological treatment, as well as providing monitoring for problem assessment and changes in the daily operations of treatment facilities. (Halterman-PTT)
W86-03888

TREATMENT OF MUNICIPAL WASTEWATERS CONTAINING BIOLOGICALLY HAZARDOUS INDUSTRIAL COMPOUNDS BY CONVENTIONAL ACTIVATED SLUDGE AND EXTENDED AERATION,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
D. F. Kincannon, A. F Gaudy, and T. S. Manickam.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142208, Price codes: A04 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 60-78, 8 fig, 2 tab, 4 ref. R-805242.

Descriptors: *Wastewater treatment, *Wastewater, *Industrial wastewater, Sludge, Activated sludge, Chemical sludge, Aeration.

Internal recycle bench scale reactors were used to study the effects of phenol, 2-chlorophenol, methylene chloride, and 4-chloro,3-methyl phenol on activated sludge and extended aeration processes treating a municipal wastewater. The activated sludge process was operated at a mean cell residence time of five days. The only solids wasted in the extended aeration units were those used for analyses and whatever solids were in the effluent from the final clarifier. The results of this study showed that the effluents of the extended aeration pilot plants were lower in soluble COD and particularly in suspended solids concentration than effluents from the 5-day systems. Increased suspended solids due to the presence of priority pollutants led to operational problems in maintaining a steady mean cell residence time except in the case of 4-chloro,3-methyl phenol. Presence of 4-chloro,3-methyl phenol did not upset the steady mean cell residence time. There was no evidence for massive pass through of any of the compounds for which specific analytical determination was made even at the high dosage level of 50 mg/l. (Author)
W86-03889

TREATMENT OF COMBINED INDUSTRIAL AND DOMESTIC WASTEWATER FOR REUSE IN SOUTH AFRICA,

National Inst. for Water Research, Pretoria (South Africa).
J. Van Leeuwen, L. R. J. Van Vuuren, J. F. J. Van Rensburg, and A. J. R. Du Plessis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142216, Price codes: A05 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 79-92, 6 fig, 24 ref.

Descriptors: *Water reuse, *Wastewater renovation, Wastewater facilities, Pulp and paper industry, Bleach plants, Sludge, Activated sludge, Biofiltration, Biological wastewater treatment, Wastewater treatment.

The experience gained on various South African water reclamation plants is described. The types of water reuse discussed include: production of water for bleached pulp processing from domestic-industrial wastewater treated in a biofilter plant; production of water for fine paper production from domestic-industrial wastewater from an activated sludge plant; potable water production from biofilter and activated sludge effluents; high-quality water production from biofilter effluent of mainly industrial origin using an integrated physical-chem-

ical-biological process; and, potable water production from settled wastewater of mainly domestic origin using an integrated physical-chemical-biological process. The advantages of partial dependence of consumers on reclaimed water are discussed. A primary advantage is that disruption in supply from one of the sources will be less damaging than disruption of a single supply. (Halterman-PTT)
W86-03890

USE OF GRANULAR ACTIVATED CARBON TO TREAT MUNICIPAL WASTEWATER RECEIVING INDUSTRIAL FLOW,

ICI Americas, Inc., Wilmington, DE.
P. B. DeJohn, J. P. Black, and R. W. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142224, Price codes: A06 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 93-112, 3 fig, 7 tab, 20 ref.

Descriptors: *Wastewater treatment, *Water reuse, Sludge, Activated sludge, Municipal wastewater, Sanitary wastewater, Wastewater analysis, Wastewater composition, Wastewater renovation.

The necessity of removing a high degree of such pollutants as BOD, COD, and color from wastewater if it is to be reused, is discussed. Recommendations include: use of isotherms to determine if carbon can reduce impurities to the desired level; determination of relative size of pollutant molecules in a given waste by running comparative isotherms between lignite and bituminous coal carbons; design of granular carbon systems should be based on column studies, not isotherms; predominantly large molecules can best be removed by lignite carbons; small molecules can best be removed by unused bituminous coal, however once the carbon is regenerated the small pore range is lost; lignite carbon properties do not change as much as bituminous coal carbon properties upon regeneration. (Halterman-PTT)
W86-03891

FULL SCALE EXPERIENCE WITH ACTIVATED CARBON TREATMENT OF JOINT MUNICIPAL - INDUSTRIAL WASTEWATER,

Fitchburg Wastewater Treatment Facilities, MA.
J. L. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142232, Price codes: A06 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 113-121, 2 fig, 7 ref.

Descriptors: *Wastewater treatment, *Activated carbon, Adsorbents, Sludge, Municipal wastewater, Sanitary wastewater, Industrial wastewater, Activated sludge, Pulp and paper industry, Wastewater facilities.

A case study is presented in which numerous mechanical and process difficulties have occurred in an advanced wastewater treatment facility. The facility used carbon for removing wastes because of extreme fluctuations in wastewater characteristics discharged by local industries, which made the maintenance of high quality effluent from a biological system extremely difficult. Also, the color removal capabilities of activated sludge was not known. Over time, various breakdowns occurred, involving the primary sludge pumping system, excess H_2S generation within the carbon columns, surface wash shower system failure, failure of the automatic flow control system, and corrosion of filter vessels. The need for major changes in the evaluation of processes and facility designs, before carbon adsorption can be considered for a major role in wastewater treatment facilities, is discussed. (Halterman-PTT)
W86-03892

TEXTILE WASTE TREATMENT AT A MUNICIPAL PACT FACILITY,

Zimpro, Inc., Rothschild, WI.
C. L. Berndt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142240, Price codes: A07 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 122-140, 7 fig, 8 tab, 2 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Aeration, *Activated carbon, Municipal wastewater, Industrial wastewater, Wastewater purification, Water treatment facilities, Sludge, Activated sludge.

The initial year of the operation of a powdered activated carbon treatment (PACT) facility is described. The municipal treatment facility performs well treating a highly colored wastewater. Both a low effluent 5-day BOD concentration (less than 5 mg/l), and efficient color removal have been maintained. The facility serves a residential population of approximately 30,000 people and an industrial fraction that consists of textile dye house operations, metal plating, and manufacturing industries. A flow chart of the treatment facility is presented, which includes coarse screen, grit removal chambers, clariflocculators, scrubbing channel (where generated carbon is added), coarse bubble diffusers, aeration tanks, carbon gravity thickeners, heat exchangers, filtration units and chlorinators. (Halterman-PTT)
W86-03893

REVIEW OF THE USE OF OZONE FOR IMPROVING COMBINED MUNICIPAL/INDUSTRIAL WASTEWATER TREATMENT,

Jacobs Engineering Group, Inc., Washington, DC.
R. G. Rice.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142257, Price codes: A08 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 141-166, 3 fig, 10 tab, 25 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Ozonation, Ozone, Municipal wastewater, Industrial wastewater, Wastewater purification, Water treatment facilities.

Ozone has been developed for the treatment of sewage since the early 1970's and primarily in the United States. Full scale plant operational data, and data from pilot plant testing upon which full scale plant designs have been developed are discussed. In plants providing tertiary treated wastewaters, including filtration of secondary effluents, when the wastewater does not contain significant levels of industrial wastes, the average absorbed ozone dosage required to achieve a disinfection level of 200 fecal coliform/100mL is 4 to 8 mg/L. However, when significant amounts of industrial wastes are present in the initial sewage, then absorbed ozone dosages can run as high as 10 to 15 mg/L. To attain the more rigid disinfection level of 2.2 total coliforms/100 mL using municipal wastewaters not containing industrial components requires 15 to 20 mg/L absorbed ozone dosage with filtered nitrified secondary effluent and 35 to 40 mg/L of filtered secondary effluent. Other uses of ozone in treating combined municipal/industrial wastewaters include oxidation of organic materials prior to passage through granular activated carbon. This technique appears to provide significant savings in costs associated with operation of granular activated carbon adsorbers. (Author)
W86-03894

USE OF SOLAR ENERGY FOR COMBINED MUNICIPAL-INDUSTRIAL WASTEWATER TREATMENT,

Utah Water Research Lab., Logan.
A. J. Acher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142265, Price codes: A08 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 167-179, 9 fig, 5 tab, 17 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Solar radiation, Municipal wastewater, Industrial wastewater, Wastewater purification, Water treatment facilities, Radiation.

Three years of ongoing research on a new method for using solar energy for municipal and industrial wastewater treatment is discussed. Aerated municipal or industrial wastewaters containing dye-sensitizers were exposed to solar irradiation for various periods of time. The influence of the solar energy, absorbed by these sensitizers in the visible range, on the organic matter and anionic surfactants in secondary effluents was checked by determining the COD and MBAS values of treated wastewater. The disinfection potential of this method was followed by bacteriological analyses of running water or secondary effluents, previously contaminated or enriched, respectively, with laboratory cultures of E. coli, bacteriophages and polio virus. The influence of this photooxidative method was also studied on eutrophic algae present in the Lake of Galilee. It was found that the conditions under which disinfection proceeds also support algicidal processes, causing lethal damage to algal cultures. (Author)
W86-03895

LAND TREATMENT OF COMBINED MUNICIPAL/INDUSTRIAL WASTEWATERS,

Metcalf and Eddy, Inc., San Bernardino, CA.
C. E. Pound, and R. W. Crites.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142273, Price codes: A09 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 180-187, 5 tab.

Descriptors: *Wastewater, *Wastewater treatment, *Land disposal, Waste disposal, Municipal wastewater, Industrial wastewater, Wastewater purification, Water treatment facilities.

The most direct measure of benefits from land treatment of municipal/industrial wastewaters is a cost comparison. Two cost studies are presented which illustrate several ways that land treatment can be used to provide cost effective solutions to municipal/industrial wastewater management. Selection by one city of a separate but publicly owned land treatment system for industrial wastes resulted in reductions in cost from $1.10/1,000 gal to $0.35/1,000 gal for the industrial waste contributions. Selection by another city of a combined municipal/industrial land treatment resulted in reducing costs for one example industry from $1.70/1,000 to $1.12/1,000 gal as compared to an activated sludge system. In the first case, both industrial and municipal systems were eligible for federal grant funding because the parallel approach was most effective. The municipal wastewater was treated to 40 mg/l BOD and the industrial wastewater was applied raw except for screening. In the second case, a single land treatment system was constructed as the most cost effective because the industrial waste flow was small compared to the total combined flow. (Author)
W86-03896

UTILIZATION OF SEWAGE SLUDGES ON CROPLAND,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W86-03897

CITY OF CHATTANOOGA INDUSTRIAL-MUNICIPAL PRETREATMENT PROGRAM,

Chattanooga Interceptor Sewer System, TN. Moccasin Bend Treatment Plant.
E. G. Wright, G. E. Kurz, and D. A. Summers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142315, Price codes: A11 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 230-258, 6 fig, 11 tab, 7 ref.

Descriptors: *Wastewater treatment, *Wastewater, *Pretreatment of water, Municipal wastewater, Industrial wastewater, Wastewater purification, Regulations, Legal aspects.

Faced with stringent 201 grant requirements to accomplish industrial waste control for protection of its 50 million dollar wastewater plant expansion, the City of Chattanooga has developed an innovative and comprehensive industrial pretreatment program to satisfy the conditions in its grant agreement. The goal of the strict compliance schedule in the grant agreement was to achieve control of industrial wastes by 1983 so that the plant expansion scheduled for completion then will be able to meet its NPDES permit conditions. The pretreatment program that evolved from the grant conditions is unique since it was developed simultaneously with the promulgation of EPA's General Pretreatment Regulations, and has been tailored to meet the requirements of EPA's National Pretreatment Strategy. The program developed by Chattanooga is additionally incorporating the National Categorical Standards now being issued by EPA and is one of the few cities to have sufficient data on 'Consistent Removal' of toxic pollutants to apply to EPA for Local Removal Credits. The mass balance technique used by the City for developing local standards (as required by EPA regulations) has been adopted by the State of Tennessee and was recommended to the 41 cities in the State required to develop local programs. (Author)
W86-03899

INVESTIGATION ON THE SUITABILITY OF VARIOUS PESTICIDE MANUFACTURING WASTEWATER FOR DISCHARGE TO MUNICIPAL WASTE TREATMENT FACILITIES,

TRW Environmental Engineering Div., Research Triangle Park, NC.
E. C. Monning, L. W. Little, and R. Zweidinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142323, Price codes: A12 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 259-271, 4 fig, 3 tab, 9 ref. 68-02-2612.

Descriptors: *Wastewater treatment, *Wastewater, *Pesticides, *Municipal wastewater, Wastewater purification, Atrazine, Carbaryl, Dazomet, Dinoseb, Glyphosate, Maneb, Mancozeb, Oryzalin.

The biological treatment of wastewaters from the production of atrazine, carbaryl, dazomet, dinoseb, glyphosate, maneb, mancozeb, and oryzalin is discussed. Data are presented indicating that the mechanism of removal during biological treatment of volatile organics such as toluene probably involves significant volatilization. Data are presented on the use of activated carbon as a pretreatment to biological treatment. A final example is noted regarding the difference between ozonating a pesticide in a pure solution and a pesticide in a mixed wastewater. (Author)
W86-03900

5E. Ultimate Disposal Of Wastes

TRANSPORT OF CONTAMINANTS FROM ENERGY PROCESS WASTE LEACHATES THROUGH SUBSURFACE SOILS AND SOIL COMPONENTS LABORATORY EXPERIMENTS,

Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.
W86-03500

EFFECT OF SOIL ON THE MUTAGENIC PROPERTIES OF WASTE WATER,

Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W86-03502

INSTRUMENTATION AND METHODS EVALUATIONS FOR SHALLOW LAND BURIAL OF WASTE MATERIALS: WATER EROSION,

Energy Resource Management, Tucson, AZ.
D. D. Hostetler, E. M. Murphy, and S. W. Childs.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-017582, Price codes: A05 in paper copy, A01 in microfiche. RHO-C-56, August 1981. 80 P, 2 fig, 5 tab, 94 ref. DE-AC06-77RL01030.

Descriptors: *Waste disposal, *Hazardous materials, *Land disposal, *Erosion control, *Soil erosion, Erosion, Fate of pollutants, Models, Erosion rates, Erosion analysis, Sediment erosion, Monitoring, Waste management, Underground.

This report summarizes current literature regarding water erosion predictions and control and provides a basis for guiding the development of future erosion monitoring programs at the United States Department of Energy (DOE) hazardous waste disposal sites. The report includes a survey of existing erosion models and their parameters, a survey of current methods of instrumentation, an evaluation of important erosion considerations relative to shallow-land waste disposal sites, and recommendations for future courses of action. Many complex natural mechanisms interact in the erosion process. These interactions involve factors such as site meteorology, plant ecology, geology, topography, and hydrology. The basic principles of erosion control are: minimize raindrop impact on the soil surface, minimize runoff quantity, minimize runoff velocity, and maximize the soil's resistance to erosion. Some of these erosion control practices may jeopardize waste containment. Typical erosion control practices may enhance waste transport by increasing subsurface moisture movement and biologic uptake of hazardous wastes. An understanding of local site hydrology is needed for evaluating water erosion and waste transport. Baseline environmental parameters should be measured to some degree at each site. A two part monitoring program recommended for DOE hazardous waste disposal sites consists of reconnaissance and tracking and site instrumentation. (Geiger-PTT)
W86-03510

SLUDGE AND THE LAND: THE ROLE OF SOIL AND WATER CONSERVATION DISTRICTS IN LAND APPLICATION OF SEWAGE SLUDGE.

National Association of Conservation Districts, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-156307, Price codes: A02 in paper copy, A01 in microfiche. 430/9-82-007, September 1982. Final Report. 17 p, 2 append.

Descriptors: *Sludge disposal, *Sludge utilization, Waste disposal, Land disposal, Land spreading, Land reclamation, Land disposal, Heavy metals, Toxins.

As a consequence of increased quantities of sewage sludge and the growing unacceptiblity of traditional disposal methods, there is an upsurge of interest in the land application of sludge. Examples of land application opportunities include: spreading sludge on cropland, pasture or grassland; using sludge to help reclaim surface mined land, mine spoils, and other drastically disturbed lands; applying sludge products to gardens, nurseries and golfcourses; and applying sludge to forestland, park land or highway median strips. This booklet is aimed at facilitating communication between rural and urban areas in assessing sewage sludge management options involving land application. Alternative beneficial uses for sludge, alternative roles for soil and water conservation districts in land application; the difference between good and bad sludge for land application, and factors involved in designing a sludge application program for agricultural lands are briefly described. Finally, case histories of involvement of agricultural agencies in land application are presented. (Halterman-PTT)
W86-03514

WATER AND WASTE MANAGEMENT IN THE CANADIAN MEAT AND POULTRY PROCESSING INDUSTRY,

Dearborn Environmental Consulting Services, Mississauga (Ontario).
Report No. EPS-WP-81-3, June 1981. Environmental Protection Service, Ottawa, Ontario. Water Pollution Control Directorate. 297 p, 44 fig, 58 tab, 4 app, 8 ref.

Descriptors: *Water management, *Waste management, *Meat processing industry, *Water use efficiency, Poultry, Water use, Waste load, Cost-benefit analysis, Water pollution control.

Subsequent to visits to Canadian and American meat and poultry processing plants to evaluate existing water and waste management practices, demonstration studies were conducted at two Canadian red meat processing facilities to document the feasibility of in-plant control fo water use and process effluent waste loadings. These studies confirmed that water use and waste load reductions could be accomplished at minimal cost. In the red meat processing plants, the major areas of water use reduction involved shroud washing processes, employee handwashers, carcass washers and viscera table washing systems. In the poultry processing plants, major reductions were accomplished in the water use associated with coop washing, feather transport, gooseneck handwashers and rotary screen backwashing. Considerable reductions in process effluent waste loadings were demonstrated at both red meat packing plants, primarily by improving the blood recovery systems. The process effluent BOD5 was reduced from 48% to 56% in these instances. There was no significant decrease in the waste loads at either of the two poultry processing plants. All process modifications were reviewed by Agriculture Canada and plant inspection staff prior to installation and evaluated during the studies to ensure that no detrimental effect on product quality resulted. The maximum cost of any single modification installed as a result of the demonstration studies was $7,700 for a blood recovery system at one of the red meat packing plants. The average cost of all other modifications was approximately $500. Several changes were implemented at no cost. At all four plants, the costs of the modifications could be recovered in less than one year. The site-specific nature of water use patterns and facilities at a particular plant was determined to be an important factor in identifying the modifications that can be successfully implemented. A number of reuse/recycle schemes which require further study were also identified.
W86-03612

STATUS REPORT ON COMPLIANCE WITH THE CHLOR-ALKALI MERCURY LIQUID EFFLUENT REGULATIONS 1980-81,

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report No. EPS 3-WP-83-2, February 1983. 16 p, 3 fig, 1 tab, 3 append.

Descriptors: *Mercury, *Effluents, *Regulations, Wastes, Wastewater treatment, Chlor-alkali plants.

This report reviews the results of the measures taken by industry and government agencies to curtail mercury losses in liquid effluents from chlor-alkali plants in Canada. Similar status reports were issued for the years 1975, 1976-1977 and 1978-1979. Mercury losses to liquid effluents are presently less than 110 kg/y, a reduction of over 99.8% since 1970. Daily monitoring by companies and periodic monitoring by both federal and provincial environmental agencies have confirmed this reduction. The drastic reduction in mercury purchases and consumtion since 1970 is the result of

the installation of efficient treatment systems, and increased recovery of mercury from waste gases and solids, as well as the closure or conversion of ten plants. Only minor reductions will likely occur in the future, as all companies are practicing best operating and treatment technology for mercury cell plants.
W86-03633

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR SLUDGE DISPOSAL FOR THE DES MOINES INTEGRATED COMMUNITY AREA,

TenEch Environmental Engineers, Inc., Louisville, KY.
G. T. Boblitt, J. W. Braswell, S. H. Fralish, G. M. Gibbons, and L. W. Greavengel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-120253, Price codes: A09 in paper copy, A01 in microfiche. EPA 907/9-82-002, July 1982. Environmental Protection Agency, Kansas City, MO. 190 p, 13 fig, 35 tab, 62 ref, 3 append.

Descriptors: *Sludge disposal, *Wastewater treatment, *Digestion, *Land disposal, *Environmental impact statement, *Land use, *Composting, *Fate of pollutants, Sludge digestion, Dewatering, Des Moines, Iowa, Environmental effects, Water quality, Wildlife, Odors, Vegetation, Aquatic life, Social impact, Economic impact, Employment, Fertilizers, Aesthetics, Public health, Water supply, Alternative planning, Flotation, Sludge thickening, Thickening, Anaerobic digestion, Land reclamation, Soil management, Heavy metals, Metals, Landfills, Pathogens, Wetlands.

Eleven alternatives for sewage sludge disposal were evaluated for the Des Moines Integrated Community Area. Problems with the present sludge treatment operation and the proposed construction of a regional wastewater treatment plant necessitated the study. The proposed action includes dissolved air flotation for dewatering, truck transportation, and ultimate disposal via land application at agronomic rates. Methane gas produced during the digestion will be used to heat digesters and generate electricity. Probable environmental impacts include the following: accumulation of heavy metals and organic material in the soil and adverse effects on water quality, air quality, noise aquatic and terrestrial life. Proper selection of sludge haul routes and proper management of the sludge application program can minimize these problems. Significant quantities of heavy metals may be removed by a pretreatment program. Sludge application would benefit plant growth and the energy-balance. Socioeconomic effects are minimal but beneficial, providing low-cost fertilizer and improvement in waste collection and treatment for the community. Transportation, aesthetics, and public health may be adversely affected by increased truck traffic, accelerated road deterioration, odor nuisance, and possible contact between the sludge and the public.
W86-03635

WASTEWATER TREATMENT SYSTEM FOR A LURGI COAL GASIFICATION PLANT,

ANG Coal Gasification Co., Detroit, MI.
For primary bibliographic entry see Field 5D.
W86-03639

POLLUTION CONTROL: THE HIDDEN PROFIT CENTRE,

Rupke and Associates Ltd., Bradford (Ontario).
For primary bibliographic entry see Field 5D.
W86-03671

ANTI-TURBIDITY OVERFLOW SYSTEM (ATOS) USED FOR REDUCING THE DISPERSION OF FINE SEDIMENTS FROM A DREDGE PLANE,

Minerals Management Service, Reston, VA.
M. J. Cruickshank.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 106-113, 5 fig, 2 tab.

Descriptors: *Dredging, *Turbidity, *Sediment control, Suspended load, Suspended solids, Bottom sediments, Sand, Silt.

The 'Anti-Turbidity Overflow System for Hopper Dredger' (ATOS) developed in Japan is described and its use in the United States is discussed. By the removal of air trapped in the overflow slurry from a hopper dredge, and the placement of the overflow below the water line, reductions in visible surface plume effects were achieved by a factor of 40 in silty sands. The effects were not so noticeable in coarse sands. The U.S. Department of the Interior, Minerals Management Service (MMS) is responsible for managing the production of minerals from the Outer Continental Shelf. In an effort to further quantify the effects of installations of an ATOS on a dredge used for mining offshore, the MMS and the United States/Japan Cooperative Program in Natural Resources are preparing a test to take place in Shimonoseki Port in Northern Kyushu. The purpose of the test is to characterize the magnitude and behavior of turbidity plumes associated with a dredging operation with and without ATOS. Plume characteristics, including magnitudes in three dimensions--trajectory, density, and density gradients and suspended sediments--will be measured as a function of time. The test is planned for the spring of 1984. (Halterman-PTT)
W86-03874

NEW TECHNIQUES DEVELOPED IN JAPAN FOR OIL SPILL CLEANUP,

Japan Workvessel Association, Tokyo.
For primary bibliographic entry see Field 5B.
W86-03875

THEORETICAL CONSIDERATION OF POND AND SPILLWATER TREATMENT DESIGN,

Japan Bottom Sediment Management Association, Tokyo.
For primary bibliographic entry see Field 5G.
W86-03876

ALTERNATIVES TO OPEN WATER DISPOSAL OF CONTAMINATED DREDGED MATERIAL,

Army Engineer District, New York.
C. A. Coch, J. F. Tavolaro, R. F. Krauser, and P. Tischbein.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 176-197, 6 fig, 4 tab, 32 ref.

Descriptors: *Dredging, *Hazardous materials, *Toxic wastes, Ocean dumping, Toxicity, Contamination, Pollutants, Economic aspects, Public health aspects, Legal aspects, Landfills.

Of the 6 to 7.5 million cubic meters of dredged material generated each year from the New York Harbor Area, 2 to 5% has been determined to be unacceptable for unrestricted ocean disposal. Three disposal options are being studied which could accommodate this material: use of dredged material as sanitary landfill cover, upland disposal, and containment areas and islands. In a dewatered state, dredged material could be used as a substitute for traditional cover material at sanitary landfills. Chemical and engineering tests were performed on representative dredged material from New York Harbor, and it was determined that all material is environmentally acceptable and may be economically feasible for this use. Potential upland disposal areas (barren areas) were evaluated using environmental and socioeconomic criteria to eliminate unacceptable sites. Containment area and island siting criteria were developed to eliminate highly biological productive areas in New York Harbor from consideration. Further efforts for all three disposal options are being directed at site availability, social acceptability, and detailed environmental and economic studies. All three options appear to be technically feasible. Sanitary landfill cover may prove to be a use of dredged material as a resource. However, the most problematic aspects of these disposal options involve their social acceptability rather than technical aspects. (Author)
W86-03879

BENEFICIAL USES OF DREDGED MATERIAL: AQUACULTURE IN DREDGED MATERIAL CONTAINMENT AREAS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. D. Lunz.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 226-244, 7 fig, 2 tab, 13 ref.

Descriptors: *Dredging, *Aquaculture, Sediments, Pollutants, Economic aspects, Ponds, Sedimentation basins, Settling basins, Containment areas.

A Corp of Engineers two-day workshop on aquaculture in dredged material containment areas was conducted in 1982. The proceedings of the workshop are briefly summarized and include discussions about: site characteristics; site acquisition and permitting; contaminated dredged material; economics; pond design and construction; pond operation and management considering water quality, production, and disease control techniques; operational compatibility between dredged material disposal and aquaculture; and prospects for success. At a time when commercial aquaculturists are saying that the lack of available coastal sites has been the principal restraint on the application of commercially practical culture technologies, coastal lowland availability could be increased for culturists willing to operate in a containment area. The necessary, preliminary desk-top analyses have taken the idea as far as possible. Before the concept is likely to be tried by an American aquaculturist working together with coordinated Corps of Engineers dredged material containment operations, a successful, full-scale field demonstration will need to be conducted. Such a demonstration will probably require Federal subsidy. (Author)
W86-03882

UTILIZATION OF SEWAGE SLUDGES ON CROPLAND,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
L. E. Sommers, and D. W. Nelson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142281, Price codes: A09 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 188-208, 8 tab, 55 ref. W-124.

Descriptors: *Wastewater, *Sludge, *Wastewater treatment, *Land disposal, Waste disposal, Municipal wastewater, Industrial wastewater, Wastewater purification, Water treatment facilities.

The application of sewage sludges on cropland is receiving increased emphasis because of environmental and economic constraints being placed on alternative disposal methods. Sewage sludges contain macronutrients (N,P, and K) and trace elements (e.g. Zn, Cu, Mn, and Mo) required for plant growth and thus, sewage sludges can be used as a low analysis fertilizer material. Numerous studies have indicated that comparable crop yields can be obtained by fertilizing soils with either sewage sludges or conventional inorganic fertilizer materials. However, sewage sludges also contain other constituents, primarily of industrial origin, which may limit their application rate on cropland. The sludge components of greatest concern include pathogens, slowly-degraded organics (e.g., PCB') and non-essential heavy metals (Ni, Cd, and Pb). Approaches being developed for land application of sewage sludges are based on maintaining the productivity of agricultural cropland and the quality of the environment. Developing a land application system involves the following considerations: (1) pathogens; (2) nitrate and heavy metal leaching into groundwaters; (3) effects on human health resulting from Cd accumulation in crops; (4) phytotoxicity due to increased soil levels of Cu, Zn, and Ni and; (5) contamination of crops with persistent organics such as PCB's. (Author)

W86-03897

5F. Water Treatment and Quality Alteration

WATER 2000, VOLUME V: WATER SUPPLY FACILITY OPTIMIZATION IN NORTHERN NEW CASTLE COUNTY.
New Castle County Water Resources Agency, DE.
Volume V, A Water Plan for New Castle County, DE. February 1983. 40 p, 8 fig, 11 tab, 20 ref.

Descriptors: *Water supply, *Potential water supply, *Water demand, *Water resources development, *Pumpage, Forecasting, Water policy, Water conveyance, Peak demand, Population dynamics, Effective capacity, Planning.

WATER 2000 is a multi-volume future water resources plan with the goal of achieving and maintaining a balance between water resources and water use while minimizing costs to the public and conflicts with other community goals. Volume V presents a view of existing public water systems in the county and analyzes them relative to anticipated future demands. The work is limited to the contiguous public water systems north of the Chesapeake and Delaware Canal. The area's existing water supply is drawn from surface water and ground water. Previous population projections forecasted a high growth rate based on increases from the 1940s through the 1960s; however, in the 1970-80 period there was only a 3% increase. Total water demand has increased in the last 30 years but the overall rate has been declining more recently. By taking current pumpage levels for residential, commercial, light industrial and industrial uses and adding usages based on the population growth, projected demands for these categories were developed through the year 2010. The average daily mgd in 1980 is 72.9 and increases to 81.2 mgd in 2010, which includes future water projects such as withdrawal, treatment, transmission and storage facilities. The collective capacity of the water users will exceed average demand by 40 mgd in 1990, 39 mgd in 1000 and 37 mgd in 2010. However, if the capacity of the existing facilities is utilized on a regional basis, it would not be necessary to construct any major new supply or treatment projects to meet anticipated demands over the next thirty years. (Atkins-Omniplan)
W86-03443

CHLORINE DIOXIDE CHEMISTRY: GENERATION AND RESIDUAL ANALYSIS,
Stanford Univ., CA. Dept. of Civil Engineering.
E. M. Aieta, and P. V. Roberts.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 429-452, 3 fig, 12 tab, 7 ref. R-805426.

Descriptors: *Water treatment, *Pollutant identification, *Wastewater treatment, *Chlorine dioxide, *Disinfection, Residual chlorine, Chlorine, Chlorite, Chloride, Chlorate.

A method for measuring the concentrations of chlorine dioxide and related species was based on amperometric and iodometric techniques. The procedure consists of the following steps: (1) measurement of chlorine dioxide by ultraviolet absorption spectrophotometry at 360 nm, (2) measurement of the sum of chlorine dioxide and chlorine by amperometric titration at pH 7, (3) measurement of the sum of chlorine dioxide, chlorine, and chlorite by iodometric titration at pH 7, (4) measurement of the sum of chlorine dioxide, chlorine, chlorite, and chlorate by step 3, after allowing prior reaction with concentrated HCL, and (5) measurement of chloride by an adaptation of the mercuric nitrate method. The molar yield of chlorine dioxide by acid activation was about 50% when sulfuric was used; 75-80% when hydrochloric acid was used. When chlorine dioxide was generated by the reaction of sodium chlorite with chlorine (4% excess), the yield of chlorine dioxide based on chlorite reactant was 93-98% based on chlorite feed. Use of excess chlorine appeared not to increase chlorine dioxide yield but to retard subsequent reactions that consume the chlorine dioxide product.
W86-03540

REDUCTION OF TRIHALOMETHANE PRODUCTION WITH OPTIMAL DISINFECTION THROUGH ALTERNATIVE DISINFECTION SYSTEMS,
Texas Univ. at San Antonio. Center for Applied Research and Technology.
R. F. Williams, B. E. Moore, K. E. Longley, and C. A. Sorber.
IN: Chemistry in Water Reuse: Volume I, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 477-500, 3 fig, 10 tab, 20 ref.

Descriptors: *Water treatment, *Disinfection, *Chlorine, *Chlorinated hydrocarbons, Trihalomethanes, Ammonia, Chloramine, Chlorine dioxide.

Rapid hydraulic mixing increased the speed of bacterial inactivation with chlorine, chlorine dioxide, and chlorine-ammonia. At a dose of 1.5 mg per liter, chlorine achieved total inactivation in 16 sec. For chlorine followed by ammonia, inactivation occurred within 15 min for a 1.5 mg per liter dose and within 1 min for a 5 mg per liter dose. A dose of 0.5 mg per liter chloramine required 60 min for inactivation. Lower disinfectant doses produced lower levels of trihalomethanes. The total trihalomethane concentrations (in micrograms per liter) observed with doses of 0.2-5.0 mg per liter disinfectant were (1) chlorine, 4.29-179.3; chlorine followed by ammonia, 2.47-10-10.24; and ammonia followed by chlorine, 0.13-4.31. The best choice for optimal disinfection and lowest trihalomethane formation was 1.5 mg per liter ammonia followed by 1.5 mg per liter chlorine. Total disinfection was achieved with 15 min contact and the trihalomethane level was reduced 275-fold compared with a 1.5 mg per liter chlorine dose.
W86-03542

INSOLUBLE POLYMERIC CONTACT DISINFECTANTS: AN ALTERNATIVE APPROACH TO WATER DISINFECTION,
State Univ. of New York at Binghamton.
G. E. Janauer, C. P. Gerba, W. C. Chiorse, M. Costello, and E-M. Heurich.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 501-522, 6 fig, 3 tab, 52 ref.

Descriptors: *Water treatment, *Disinfection, *Polymers, Quaternary ammonium compounds, Resins, Resin 12, Contact disinfection.

Insoluble polymeric contact disinfectants (IPCD) are an alternative to dissolved reactive disinfectants such as chlorine. Demand release disinfectants and surface-bonded microbials provide some of the advantages of IPCD. Resin 12 (a weakly crosslinked chloromethylated polystyrene functionalized with N,N-dimethyldodecylamine) and variations using different quaternary ammonium compounds show promise as disinfectants, particularly in small point-of-use systems. Practical problems remaining are the effect of temperature, counterions, and water hardness and rapid regeneration of the resin.
W86-03543

5G. Water Quality Control

ROLE OF ENVIRONMENTAL TRANSPORT AND FATE MODELS IN IMPLEMENTING THE TOXIC SUBSTANCES CONTROL ACT,
Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5B.
W86-03420

SIGNIFICANCE AND LIMITATIONS OF ENVIRONMENTAL COMPARTMENTALIZATION MODELS IN THE CONTROL OF NEW CHEMICALS BASED ON THE ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT MINIMUM PREMARKETING SET OF DATA,
Umweltbundesamt, Berlin (Germany, F.R.).
A. W. Klein, and F. Schmidt-Bleek.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 73-92, 7 fig, 3 tab, 15 ref, 1 append.

Descriptors: *Model studies, Pollutants, *Economic aspects, Aquatic environment, Fate of pollutants, Prediction, Path of pollutants, Legal aspects, Toxicity.

Because of the increasing concern over potential and actual hazards to man and his environment through the largely uncontrolled use of commercial chemicals, a number of key chemical-producing countries have recently passed, or are in the process of passing, chemical control legislation. Several concepts are emphasized in relation to the 'preventive' control nature of much of the new legislation. These concepts include the entry of potentially dangerous chemicals into the environment, exposure and effect of chemicals, steps toward environmental hazard assessment, significance of environmental exposure analysis within 'hazard ranking' process for chemicals, and, finally, environmental exposure models. (Halterman-PTT)
W86-03423

LEGAL VALIDATION OF ENVIRONMENTAL FATE MODELS,
ERM-Southeast, Inc., Brentwood, TN.
F. G. Ziegler.
IN: Modeling the Fate of Chemicals in the Aquatic Environment, Ann Arbor Science, Ann Arbor, MI. 1982. p 379-386.

Descriptors: *Model studies, *Fate of pollutants, Pollutants, Ecosystems, Mathematical models, Distribution, Toxicity, Kinetics.

Potential legal challenges that will occur as a result of the application of environmental fate models are discussed. Both technical and legal challenges associated with modeling are included. Model adequacy is divided into two categories: adequacy of initial model development; and adequacy of specific applications of the model. Adequacy with regard to a specific application of an environmental fate model dictates to the user a demonstration with a thorough and well designed field sampling investigation followed by proper interpretation of data, as well as calibration and validation. Realistic interpretation of the data and realistic discussions of adequacy regarding its intended purpose must occur within the modeling analysis. (Halterman-PTT)
W86-03434

POLYCHLORINATED BIPHENYLS (PCBS),
California State Water Resources Control Board, Sacramento. Toxic Substances Control Program.
R. P. Ghirelli, and F. H. Palmer.
Special Projects Report No 83-1sp, May 1983. (Reprinted January 1984) 174 p. 19 fig, 40 tab, 194 ref, 8 append.

Descriptors: *Polychlorinated biphenyls, *Monitoring, *Water quality control, *Water pollution sources, Toxicity, Mammals, Carcinogens, Biochemistry, Bass, Pesticides, Mussels, Regulations, Environmental protection, Environmental effects, Chlorinated hydrocarbons, Pollutants, Fish, Shellfish.

In February 1982 the California State Water Resources Control Board initiated an industrial chemicals program based on the premise that the production and use of chemicals should not occur at the expense of water quality protection. This report assesses the properties and uses of polychlorinated biphenyls (PCBs), their environmental fate and toxicology, and the impact of PCBs on human health and California's aquatic resources. The report proposes a water quality strategy for controlling PCBs and actions for consideration by affected state, local, and federal agencies. PCBs, known to be hazardous to humans and aquatic life, are found in air, water, sediment, and biota

throughout the world. Further dissemination into the environment of these long-lived compounds should be presented. Of the 1.4 billion pounds of PCB produced in the U.S. since 1929, over half are still in service. PCBs are chlorinated hydrocarbons that are chemically stable, and have low flammability, high boiling points, and low electrical conductivity. All commercial PCB formulas contain contaminants, such as polychlorinated dibenzofurans (PCDFs), more toxic to humans and aquatic life than PCBs. Airborne transport and deposition is the major pathway for the global distribution of PCBs and other persistent chlorinated hydrocarbons. With extremely low water solubility and high affinity for organic material, PCBs persist in sediments and biological material. Although PCBs are not acutely toxic to mammals except at high doses, their chronic effects are pronounced at relatively low doses. (Fazio-Omniplan)
W86-03446

RICE HERBICIDES: MOLINATE (ORDRAM) AND THIOBENCARB (BOLERO),

California State Water Resources Control Board, Sacramento. Toxic Substances Control Program.
J. W. Cornacchia, D. B. Cohen, and G. W. Bowes.
Special Projects Report No. 84-4sp, April 1984. 176 p. 32 fig, 27 tab, 143 ref, 14 append.

Descriptors: *Rice, *Herbicides, *Thiocarbamate pesticides, *Water quality, *Water quality control, Cultivation, Pesticides, Weed control, Aquatic weed control, Irrigation practices, Environmental effects, Monitoring, Risks, Toxicity, Fisheries, Drinking water, Fish, Anadromous fish, Mammals, Shrimp.

Increased findings of rice herbicides in Sacramento Valley drains and the Sacramento River and Delta raise two issues: What effects do the annual discharge of molinate and thiobencarb, the active ingredients of two rich herbicides (Ordram and Bolero), have on Valley water quality. If these effects are adverse, how can the discharge be controlled or eliminated. This report describes rice cultivation and weed control practices, gives an overview of molinate and thiobencarb environmental monitoring, assesses impacts on aquatic life and human health, and evaluates discharge control alternatives. The Valley supports over 90% of the rice grown in California. During 1977-82 the application of Ordram and Bolero more than tripled. Approximately 6-11% of the Ordram applied in 1981 and 1982 was discharged to the Sacramento River; Bolero discharges ranged between 3-5%. A comprehensive assessment of molinate and thiobencarb hazards of resident and anadromous fish is not possible because there are few chronic toxicity studies of these two chemicals and their mixtures. Warm water recreational fisheries in agricultural drains and sloughs have received the highest rich herbicide exposures. The highest concentrations of both herbicides (over 2,000 parts per billion) have been detected in the edible portions of fish during the rice herbicide use season. The key to minimizing nonpoint source discharge of rice pesticides is the integration of pest control and water management strategies at the rice field, the sub-basin, and the main drainage basins. (Fazio-Omniplan)
W86-03447

RELATIONSHIP BETWEEN STREAM RECREATIONAL USE AND STREAM CHARACTERISTICS WITH IMPLICATIONS FOR MANAGEMENT OF ILLINOIS STREAMS,

Illinois Dept. of Conservation, Springfield.
R. D. Westfall, and M. P. Armstrong.
IN: Proceedings of a Conference on Management Techniques for Water and Related Resources, April 1984. p. 105-112. 2 fig, 1 tab, 14 ref, 1 append. Illinois University at Urbana-Champaign, Water Resources Center, October 1984, Special Report 14.

Descriptors: *Stream profiles, *Streams, *Recreation, *Management planning, Basins, Public access, Surveys.

Basic information on the relationship between recreational use of the type of streams typical of Illinois and their physical characteristics is generally unavailable. The study was designed to develop a preliminary model of recreational use and stream characteristics and to determine if a stream's lack of disturbance was related to its use. The study provides evidence that a simple explanatory model of river recreational use for Illinois can rely on two easily measurable stream characteristics--stream size and public access. Stream disturbance, as measured in this study, does not exhibit a strong negative correlation with recreational use, at least for streams in the Sangamon Basin. Certain stream characteristics such as natural areas, historic sites, and public recreation land, which might be expected to show high positive relationships with recreational use, do not significantly relate to use. The Sangamon River Basin in central Illinois, comprising 5,488 square miles (approximately one-tenth of the state) was selected for study because data on both recreational use and stream characteristics were available and the basin is generally representative of much of Illinois. The study relied on data contained in the Streams Information system, a computerized inventory of physical, chemical, biological, cultural, and recreational characteristics of Illinois rivers. The findings have relevance for recreational management of Illinois' rivers and streams. (Fazio-Omniplan)
W86-03451

PLANNING APPROACH FOR IMPROVED MANAGEMENT OF ILLINOIS STREAMS FOR RECREATION AND CONSERVATION,

Illinois Dept. of Conservation, Springfield. Comprehensive Planning Section.
E. L. Hoffman, R. D. Westfall, and G. Tichacek.
In: Proceedings of a Conference on Management Techniques for Water and Related Resources, April 1984. p 64-78, 2 fig, 1 tab, 14 ref, 1 append. Illinois University at Urbana-Champaign, Water Resources Center, October 1984, Special Report 14.

Descriptors: *Management planning, *Streams, *Recreation, *Conservation, Planning, Long-term planning, Basins, Natural streams, Macroinvertebrates, Riparian vegetation, Public access, Ecosystem.

Degradation of Illinois' streams, especially of their aquatic and riparian habitat, continues at an alarming rate. The Illinois Department of Conservation initiated a long-term Streams Preservation and Recreational Use Planning Project. This paper focuses on the planning element, suggesting a pragmatic approach to streams conservation. The approach includes eight considerations that should make the plan meet most decision maker's criteria of reasonableness. Given those considerations, a method for categorizing streams was developed based on biological integrity, naturalness, recreation value, and the presence of special features such as natural areas, historic sites, and public recreation land and access sites along the stream. This method systematically compares all ten square mile drainage or larger streams in the Sangamon River Basin and is potentially applicable statewide. The paper gives operational definitions of the four stream values and of nine more specific, measureable characteristics. In addition to its usefulness in characterizing individual streams, the categorization system also allows the Basin to be characterized as a whole. The distribution of 127 streams is reasonable even across five categories. For example, the percentage of riparian forest along streams steadily increases from 7% of bank miles (Category V streams with none of the four values) to 21.3% (Category I with all four values). (Fazio-Omniplan)
W86-03452

INDUCED CHANGE AND ITS IMPACT ON AQUATIC COMMUNITY QUALITY IN THE SANGAMON RIVER BASIN OF ILLINOIS,

Illinois Dept. of Conservation, Springfield.
G. Tichacek, R. D. Westfall, and E. L. Hoffman.
In: Proceedings of a Conference on Management Techniques for Water and Related Resources, April 1984. p 24-39, 4 fig, 1 tab, 10 ref, 1 append. Illinois University at Urbana-Champaign, Water Resources Center, October 1984, Special Report 14.

Descriptors: *Aquatic populations, *Aquatic life, *River basins, *Ecosystems, Water quality, Watershed, Fish, Land use, Streams, Stream profiles, Valleys, Sampling, Macroinvertebrates, Riparian waters, Land use, Recreation.

Alterations to streams and stream valleys are often substantial in states like Illinois which have been heavily developed. One of the features thought to be most sensitive is the health of stream aquatic communities. This report focuses on the Sangamon River Basin which covers approximately 10% of Illinois and is typical of the rural, intensively-farmed central portion of Illinois. The analysis relies on data contained in the Illinois Streams Information System which includes both linear stream characteristics and point data. Detailed sampling station data on fish, macroinvertebrates, stream physical characteristics, riparian characteristics and land use, recreational use, water quality, and other information were collected for the Basin in 1981 and 1982. The various multivariate and bivariate analyses did not detect the expected systematic relationships at a statistically significant level. Minor exceptions occurred; however, consistency among relationships involving the three measures of aquatic community quality was not generally evident. Some expected relationships occurred, but in most cases did not reach statistical significance. For example, the Index of Biotic Integrity was positively correlated with preferred substrate. Percent intolerant macroinvertebrates was positively correlated with bankside forest and negatively correlated with disturbance measures. (Fazio-Omniplan)
W86-03453

GROUNDWATER CONTAMINATION AND EMERGENCY RESPONSE GUIDE,

Little (Arthur D.), Inc., Cambridge, MA.
J. H. Guswa, W. J. Lyman, A. S. Donigian, T. Y. Lo, and E. W. Shanahan.
Noyes Publications, Park Ridge, NJ. 1984. Pollution Technology Review, No 111. 490 p.

Descriptors: *Groundwater pollution, *Groundwater management, *Monitoring, *Reviews, *Geohydrology, Groundwater, Waste disposal, Hazardous materials, Decision making, Planning, Water management.

This book provides an overview of groundwater hydrology; a technology review of equipment, methods, and field techniques; and a methodology for estimating groundwater contamination under emergency response conditions. Part I assesses methodology for investigating and evaluating unknown or suspected cases of contamination, developing decision parameters, and selecting a remedial response. Part II surveys groundwater fundamentals, state-of-the-art equipment, monitoring methods, and treatment and containment technologies. This data will supply input to developmental efforts leading to more efficient, durable, and cost-effective monitoring and remedial action technologies. Part III describes possible emergency response actions at toxic spill and hazardous waste disposal sites. It provides a rapid assessment methodology for performing such an evaluation within a 24-hr emergency response time frame. (Geiger-PTT)
W86-03457

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUSTANCES: PROCEEDINGS OF THE 8TH U.S./JAPAN EXPERTS MEETING,

Army Engineer Inst. for Water Resources, Fort Belvoir, VA.
November 8-10, 1982, Tokyo, Japan. July 1984. Thomas R. Patin, editor. 475 p.

Descriptors: *Water quality control, *Fate of pollutants, *Dredging, *Sediments, Lake restoration, Suspended sediments, Turbidity, Accumulation, Bioaccumulation, Fish.

Papers and in-depth discussions on dredging and disposal of contaminated sediments were presented by Japanese and American experts at a November

8-10, 1982 meeting. Dredging without significant resuspension of sediments was a common topic. Several new developments in equipment were described: Clean Up, Refresher, Pneuma pump. Studies included large lakes, harbors, and rivers. Other topics included dissolved oxygen profiles as affected by oxygen-demanding bottom sediments, bioaccumulation of toxic materials in contaminated sediments by biota, restoration of eutrophic lakes, and ocean disposal of dredged materials and sludge. (Cassar-PTT)
W86-03461

DREDGING AND MANAGEMENT PROBLEMS IN LAKE SUWA,

K. Nikado, and M. Akabane.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 251-261, 11 fig, 3 tab.

Descriptors: *Water quality control, *Dredging, *Lake restoration, Lake Suwa, Japan, Dewatering, Sediments, Lake sediments, Coagulation, Filtration, Eutrophic lakes.

Dredging began in Lake Suwa, Japan, in 1969 in an effort to reduce eutrophication conditions. Although the first stage removed 1.5 million cu m of sediment from the shallow areas, no significant improvement was noted in lake water quality. Beginning in 1981 dredging began in the deeper areas with a goal of 5.3 million cu m to be removed (sediment up to 50 cm depth) over 20 years. Since dredged material could not be left near the lake, it had to be dewatered for transport to other locations. Mechanical dehydration proved more feasible than in-pond sedimentation. The dewatering system consisted of addition of 45 ppm of inorganic flocculant (PAC), addition of 3-7 ppm of polymeric coagulant, and filter pressing. (Cassar-PTT)
W86-03462

REMOVAL OF BOTTOM SEDIMENTS IN OSAKA PORT BY THE PNEUMA PUMP DREDGE 'SHUNKAI',

Osaka Port and Harbcur Bureau (Japan).
S. Kasajima.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 16-39, 7 fig, 12 photos, 3 ref.

Descriptors: *Water quality control, *Dredging, *Sediments, Pneuma pump, Osaka, Japan, Water pollution prevention, Pumps, Odor control, Suspended sediments, Turbidity, Oily water, Harbors, Rivers.

The Pneuma pump system has been used successfully since 1974 to dredge polluted mud from the port of Osaka, Japan, and its tributaries. This dredging system can dredge a high solids concentration at any depth without fear of secondary pollution. It consists of a pump body, a distributor, and a compressor. The pump body consists of three cylindrical tanks used as one assembly. Each tank is fitted with an inlet port, an outlet port, and valves. Some results of dredging tests are as follows: a good dredging speed is 1-3 m/min; rubbish on the sea bed does not interfere; the shovel should be designed for the site; water transparency at the surface declines by 15-20 cm during dredging; and pan-floc application is not suitable for mud with very high solids concentrations. Design of the equipment and auxiliary equipment is discussed in detail. Measures for preventing secondary pollution include scrubbing of sulfur-smelling gases, placing a deodorant (95% bentonite, phyroligneous acid, and papain) on the filled barges, control of oily scum, and precipitation of suspended solids in surplus water. (Cassar-PTT)
W86-03463

CAPPING OF DREDGED MATERIAL DISPOSAL MANAGEMENT FOR NEW YORK HARBOR,

Army Engineer District, New York.
J. M. Mansky.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 78-93, 4 fig, 1 tab, 21 ref.

Descriptors: *Water quality control, *Dredging, *Sediments, *Metals, Heavy metals, Polychlorinated biphenyls, DDT, Organic compounds, Borrow pits, Disposal, New York Bight, Ocean dumping.

Monitoring studies conducted on contaminated sediment deposits in the New York Bight indicated that bioaccumulation in indicator mussels was generally less at a site capped with sand than at uncovered dump sites. The highest mean values for heavy metals were found at an uncapped site. These were as follows: Hg, 0.242 ppm; Cd, 0.081 ppm; and Pb, 1.13 ppm. At the capped site Hg levels were 0.030 ppm; Cd, 0.041 ppm; and Pb, 1.04 ppm. No statistically significant data was obtained for polychlorinated biphenyls or DDT. Mean fuel oil bioaccumulation was greater in the capped area than in the uncapped areas. A field trial with uncontaminated sediments indicated that subaqeous borrow pits could be used as disposal pits for contaminated dredged sediments if capped with sand. (Cassar-PTT)
W86-03464

RESTORATION STUDY OF DREDGING IN LAKE KSAUMIGAURA,

F. Kodama, and T. Fukushima.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 94-111, 16 fig, 2 tab.

Descriptors: *Water quality control, *Lake restoration, *Dredging, Lake Kasumigaura, Japan, Eutrophic lakes, Sediments, Lake sediments.

Dredging is underway in the eutrophic Lake Kasumigaura, Japan, as part of a lake restoration project. Located in a drainage basin with 720,000 population, the 220 sq km lake originally had 40-50 cm of sediment. From 1975 to 1981 a total of 300,000 cu m of sediment was removed. The dredging system consists of vacuum suction with pneumatic discharge. Dredged material is dewatered in ponds or by progressive trenching. (Cassar-PTT)
W86-03468

SPECIALIZED DREDGES DESIGNED FOR BOTTOM SEDIMENT DREDGING,

A. Kaneko, Y. Watari, and N. Aritomi.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 450-476, 24 fig, 11 tab, 2 ref.

Descriptors: *Water quality control, *Dredging, *Sediments, *Turbidity, Bottom sediments, REFRESHER dredge.

The REFRESHER, specialized equipment for reducing sediment resuspension while dredging, is based on the conventional cutter suction dredge. It has a gather head which is a ribbon blade with a reducing spiral at the front. It is suitable for cutting soft mud to hard ground. A cover and shutter are structured to prevent turbidity from leaking into the surrounding water. Check valves prevent back flow of sediment water into discharge pipes in an emergency. A gas collector apparatus delivers gas produced to the suction pipe. Field test results are given to show the turbidity created by this equipment. (Cassar-PTT)
W86-03469

PERFORMANCE TESTS OF PNEUMA DREDGE PUMP,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. W. Richardson.
Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 419-433, 16 fig, 1 tab.

Descriptors: *Water quality control, *Dredging, *Sediments, Sand, Pumps, Pneuma pump, Turbidity.

The air-operated Pneuma dredge pump, model 600/1000, was tested at four locations (river channel, lock approach, tidal inlet, and dock) in sand and fine-grained sediments and in water depths from 1.8 to 10.7 meters. The pump removed fine-grained sediment from the bottom at an in situ density but could not achieve the same results in sand. High density discharge could be sustained for only 15 min or less. The pump could only excavate sand in water depths greater than 2.5 m. The Pneuma pump had a lower power efficiency (never greater than 20% and often less than 10%) than a centrifugal dredge pump. Turbidity levels generated by the pump were not excessive. (Cassar-PTT)
W86-03470

BOTTOM SEDIMENT DREDGE 'CLEAN UP' - PRINCIPLE AND RESULTS -,

E. Sato.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 403-418, 6 fig, 3 tab, 1 ref.

Descriptors: *Water quality control, *Dredging, *Turbidity, *Sediments, Suspended sediments, CLEAN UP, Pumps, Bottom sediments.

CLEAN UP, new dredging equipment designed to minimize secondary pollution during dredging contaminated sediments, was constructed and field tested (45 trials) in Japan. It is equipped with a movable wing in front to overlie the bottom sediments, a movable shutter to intercept the inflow of outer water, a mixing device, and sensors to check the dredging conditions. The equipment can also control the contact pressure against the sea bed and stay horizontal regardless of depth. A submerged centrifugal pump was chosen. A swing velocity of 3-4 m/min was best for minimizing turbidity generation. An adequate cutting depth was 0.4-0.5 m. Turbidity was sometimes 80-100 ppm during starting of the pump or changing of the swing direction. The concept of generation unit of turbidity was developed. This is the total dry weight of turbidity that occurs during dredging work per 1 cu m of materials dredged from the sea bed (tons/cu m). (Cassar-PTT)
W86-03471

OVERVIEW OF CORPS RESEARCH PROGRAM ON DREDGING CONTAMINATED SEDIMENTS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. L. Montgomery, and G. L. Raymond.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 381-402, 17 fig, 2 tab, 7 ref.

Descriptors: *Water quality control, *Dredging, *Sediments, *Suspended sediments, Monitoring, Fate of pollutants.

The problems of dredging contaminated sediments with existing conventional equipment and techniques are discussed. Since dredging practices in the U.S. have evolved to be cost efficient, most conventional dredges are not specifically designed or intended for use in dredging highly contaminated sediments. This paper outlines active research at the Waterways Experiment Station on equipment and techniques for dredging contaminated sediments. The question of dredging in contaminated sediments is being addressed in three ways: the assembly and evaluation of available domestic and foreign information concerning sediment resuspension and contaminant release, the development of appropriate laboratory tests to predict contaminant release from resuspended sediments, and the use of field studies to monitor performance and compare dredges operating under various conditions. Preliminary studies involving the cutterhead, dustpan,

and clamshell dredges are discussed. The watertight clamshell appeared to reduce the amount of resuspended sediment in the upper water column, as compared with the conventional open clamshell. The dustpan head showed little advantage over the conventional cutterhead suction dredges. The basic sampling methodology used proved valid. (Cassar-PTT)
W86-03472

FIELD DREDGING TEST OF SOFT MUD LAYER BY A FRONT-OPEN TYPE DRAG HEAD,

Y. Irie.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 326-380, 46 fig, 19 tab, 7 ref.

Descriptors: *Water quality control, *Dredging, *Sediments, Harbors, Chiba Port, Nagoya Port, Mikawa Port, Japan, Bottom sediments, Clays, Turbidity.

Field dredging tests using a front open drag head were carried out in closed harbors. This equipment was designed to dredge soft mud, dredging thinly and widely, in high density. Three tests were carried out--in Chiba Port, Nagoya Port, and Mikawa Port. Sediments were silty clays or clayey silts. Turbidity around the drag head was usually under 10 mg/liter in one test and usually under 30 mg/liter in the other tests. Since conditions were different in the three tests, results cannot be compared. However, information was obtained which permitted further improvements in dredge design and operation. (Cassar-PTT)
W86-03473

OVERVIEW OF A DREDGING DEMONSTRATION IN CONTAMINATED MATERIAL, JAMES RIVER, VIRGINIA,

Army Engineer District, Norfolk, VA.
R. E. Hudson, and R. G. Vann.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 312-325, 4 fig, 3 ref.

Descriptors: *Water quality control, *Dredging, James River, Virginia, Kepone, Insecticides, Sediments, Monitoring, Channels, Suspended solids, Water pollution prevention, Dustpan dredge, Cutter suction dredge, Rivers.

The James River, Virginia, is a tributary of the Chesapeake Bay polluted with the toxic pesticide Kepone. The Norfolk District of the Corps of Engineers accomplished maintenance dredging operations within the polluted portion of the James River channel during fiscal year 1982. As part of the channel maintenance, the District conducted a demonstration of a dredging method designed to contain and remove a polluted layer of sediment with a minimum of resuspension. The method involved modifying and fitting an existing dustpan suction head to a contractor's cutterhead dredge. The dredge was then operated using an anchoring and maneuvering wire arrangement that enabled precise positioning of the suction head within the specified layer of polluted sediment. Monitoring of operating parameters on board the dredge, of resuspension at the suction head, and of water quality around the dredge and disposal area was accomplished with appropriate equipment. The dredge was also operated in the conventional cutterhead configuration for comparison with the dustpan arrangement. The data gathered during this demonstration project permitted evaluation of the dredging and disposal methods utilized and will be useful in planning future projects in the James River and other sites involving polluted dredged material. (Author)
W86-03474

EMERGENCY RESPONSE EQUIPMENT TO CLEAN UP HAZARDOUS CHEMICAL RELEASES AT SPILLS AND UNCONTROLLED WASTE SITES,

Municipal Environmental Research Lab.-Cincinnati, Edison, NJ. Solid and Hazardous Waste Research Div.
I. Wilder.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 8th U.S./Japan Experts Meeting, November 8-10, 1982, Tokyo, Japan. July 1984. p 262-280, 12 fig, 33 ref.

Descriptors: *Water quality control, *Water pollution prevention, *Hazardous materials, Oil spills, Chemical spills, Wastewater treatment, Monitoring, Diversion, Streams, Incineration, Activated carbon, Adsorption, Soil treatment, Disasters, Chemical wastewater, Waste disposal.

This paper reviews some of the research activities of the U.S. Environmental Protection Agency (EPA) regarding the development of emergency response equipment to control hazardous chemical releases. Several devices and systems have been developed by EPA for environmental emergencies involving spills and uncontrolled waste sites. Many of these have already been made available commercially by industry, including a mobile physical/chemical treatment system for processing contaminated water at hazardous incidents and a mobile laboratory for onsite chemical analyses. Other operationally ready devices addressed in this paper include: a mobile stream diversion system for isolating segments of small streams to facilitate the removal of contaminated sediments; a portable back-pack polyurethane foam diking system for the containment of spilled chemicals; and an acoustic emission-based spill alert device for detecting imminent dike failure at lagoons containing toxic and hazardous wastes. Prototypical equipment, described in this paper, which are now undergoing shakedown testing and evaluation include a mobile soils washing system for extracting spilled materials from excavated soils onsite and a mobile, field-use incineration system for the thermal destruction of toxic organic compounds. (Author)
W86-03476

REVIEW OF CONTROL MEASURES FOR OBJECTIONAL ALGAL 'BLOOMS',

Montana Univ., Missoula.
G. W. Prescott.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 5-14, 35 ref.

Descriptors: *Biocontrol, *Algal control, *Algal toxins, *Algicides, *Nuisance algae, Algae, Antibiotics, Copper sulfate, Eutrophication, Taste, Water quality management, Odor, Nutrients, Viruses, Pesticides.

Algae have been responsbile for bad taste and odor in some water supplies. The earliest attempts to purify water of algae may have been in the 1800's when potassium permanganate was used as a cidal agent against both bacteria and algae. The effectiveness of Cu as an algicide was discovered in France and Germany in the late 19th century. It was used in the United States in the early 1900's. After World War II, the United States government began to investigate the effectiveness of different chemicals as algicides. Many chemical companies have prepared algicides for commercial dispensing under trade names during the last 25 years. In recent years, algicidal research has concentrated on biocontrol agents. Cyanophages which are toxic to blue-green algae are generally widely distributed, especially in sewage lagoons. Bacterial parasitism and antibiotics are highly specific control agents that are being studied for algal control. Starvation or the reduction of phosphorus and nitrogen nutrients eventually reduces algal floras. At present, the chemical control methods still remain the most successful and practical, and copper sulfate, one of the least expensive methods for the control of algae in lakes and reservoirs. (Geiger-PTT)
W86-03484

SELECTIVE ALGICIDES,

Algae Acres, McFarland, WI.
G. P. Fitzgerald.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 15-31, 5 tab, 22 ref.

Descriptors: *Algal control, *Algicides, *Copper sulfate, *Chlorine, *Chemcontrol, Pesticides, Algal blooms, Reservoirs, Ponds, Lakes, Swimming pools, Algae, Biodegradation, Nuisance algae, Chlorophyta, Cyanophyta.

Algae may cause problems in fish ponds by fouling fish harvesting nets or causing oxygen depletion which results in fish kills. In reservoirs, algae may cause obnoxious tastes or odor problems. Large algal blooms may cause the closing of beaches or swimming areas. Methods for selecting algicides should be simple procedures that are specific for the type of algae to be controlled. The algae causing problems in lakes and ponds have been found to be particularly sensitive to the toxicity of copper. The algae causing problems in swimming pools are best controlled by halide compounds, usually chlorine or bromine. Quaternary ammonia products may also be used. Copper sulfate has been the chemical of choice for control of algae in lakes, ponds, and reservoirs. As an alternative, potassium permanganate may be used. The effectiveness of algicidal or algistatic chemicals can be evaluated in laboratory or field tests. Chemicals used to control algae can be tested for detoxification (biodegradation) by simple modifications of algicidal or algistatic test procedures. All chemicals to be added to aquatic environments should be evaluated to determine if they will be biodegraded or remain in toxic condition to pollute the environment. (Geiger-PTT)
W86-03485

STATE-OF-THE-ART SUMMARY OF PHOSPHORUS INACTIVATION AS A LAKE RESTORATION TECHNIQUE,

Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke, and R. H. Kennedy.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 32-56, 4 fig, 1 tab, 27 ref.

Descriptors: *Lake restoration, *Nutrient removal, *Phosphorus removal, *Algal control, *Aluminum sulfate, Nutrients, Aluminum, Phosphorus, Algal blooms, Algae, Nuisance algae, Trophic level, Lakes, Case studies.

The addition of aluminum sulfate and/or sodium aluminate, is a lake restoration technique often called nutrient inactivation or precipitation. Al salts are effective in removing inorganic and particulate P and can therefore accelerate improvement in lake trophic state. Two approaches for the addition of Al salts to lakes may be used. The amount of Al which can be added is directly related to lake alkalinity. The addition of Al for the purpose of controlling P release from sediments is the approach of choice for control of algal biomass. Al salts have commonly been applied in both surface and hypolimnetic treatments by barge. Five case studies of lake treatments are reviewed to illustrate the range of procedures available. No apparent toxicity of Al to fish or benthic invertebrates are reported; however, a decline in species diversity of planktonic microcrustacea was noted after Al treatment in West Twin Lake, Ohio. No long-term monitoring effects are available. The technique for lowering P concentration to the point of exerting control of algal biomass appears to be a successful one, although the longevity of effectiveness is not known. (Geiger-PTT)
W86-03486

CONTROL OF NON-POINT NUTRIENT CAUSED ALGAL PROBLEMS ESPECIALLY BY DILUTION,

Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS p 98-120, 3 fig, 8 tab, 25 ref.

Descriptors: *Nonpoint pollution sources, *Nutrients, *Water quality management, *Storm sewers, *Algal control, Watershed management, Phosphorus, Lakes, Nitrogen, Surface waters, Algae, Phosphorus removal, Nuisance algae.

Non-point sources of nutrients that lead to nuisance algae blooms can theoretically be controlled by prevention of excessive development in watersheds thus keeping phosphorus yields below critical limits for the lake in question. Treatment of runoff in wetland areas appears promising; however, there is little evidence to suggest that retention ponds are effective at removing phosphorus and nitrogen. Diversion of stormsewers has been proposed and implemented and should be effective if nutrient concentration in the inflow is high, thus being analogous to sewage effluent diversion. Dilution of non-point sources of nutrients has been successful in at least two situations and has shown enough promise in at least five other instances in the West to be proposed. Lake quality in Moses and Green Lakes, Washington, improved by over 70 and 50 percent, respectively, in terms of chlorophyll a, total phosphorus and visibility. This occurred as a result of dilution rates on the order of 0.5 to 1.0 percent per day during the spring summer growth period - about ten times the normal rates. Dilution of allelopathic excretory products appears to have more merit as a cause for inhibition of blue-greens and favoring diatoms than does the decrease in nutrient content. If so, the addition of even relatively rich water could benefit lake quality. (Author)
W86-03488

LIMITS TO THE CONTROL OF ALGAL POPULATIONS BY GRAZING ZOOPLANKTON: THE ENVIRONMENTAL THEATER AND THE ECOLOGICAL PLAY,

Georgia Univ., Athens. Dept. of Zoology.
K. G. Porter.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 121-130, 1 fig, 2 tab, 7 ref.

Descriptors: *Grazing, *Zooplankton, *Algal control, *Food chains, *Species diversity, Nutrients, Phosphorus, Algae, Species composition, Protozoans, Rotifers, Aquatic populations, Eutrophication, Lake restoration, Ecology.

Grazing zooplankton can control algae that are palatable to them and within a manageable size range. Selective grazing can shift the relative abundance among algal species in a community as demonstrated in in situ manipulation studies. Within limits, grazers can also determine algal abundance and community composition. Mild cases of eutrophication are inhibited by algal filaments while copepod populations increase. Intense eutrophication may cause elimination of larger grazers and promotion of smaller microzooplankton (rotifers and protozoans). Future research to manage algal-zooplankton systems should include examining the food particle spectrum and the role of bacteria and detritus in aquatic food chains, including microzooplankton in analyses of planktonic community composition, determining local and regional variability in algal-zooplankton interactions and developing quick methods for determining grazing potential on the available particle spectrum. (Geiger-PTT)
W86-03489

ALGAL CONTROL THROUGH TROPHIC-LEVEL INTERACTIONS: A SUBTROPICAL PERSEPCTIVE,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. L. Crisman.
IN: Proceedings of Workshop on Algal Management and Control, March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 131-145, 6 fig, 33 ref.

Descriptors: *Algal control, *Grazing, *Zooplankton, *Nuisance algae, *Biocontrol, Phytoplankton, Daphnia, Eutrophication, Crustaceans, Algae, Water quality management, Lakes, Fish, Species composition, Aquatic populations, Aquatic animals, Trophic level.

Numerous investigators have proposed that the composition and abundance of algal populations can be controlled biologically through a manipulation of the community structure of phytoplankton consumers such as macrozooplankton, but the feasibility of this approach has not been evaluated for subtropical zooplankton such as large species of Daphnia exerting a major control over phytoplankton. Subtropical systems are more complex due to the absence of large kaphnids and the domination of fish faunas in eutrophic lakes by phytophagous taxa including shad. It is suggested that management schemes for the biological control of phytoplankton consider regional differences in both the structure of grazer communities and the major 'nuisance' phytoplankton species. Construction of regional rather than a national management scheme for the biological control of algae should be stressed. (Author)
W86-03490

EXTRACELLULAR METABOLITE INVOLVEMENT IN PLANKTON COMMUNITY STRUCTURE,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W86-03491

CYANOPHAGES: ARE THEY POTENTIAL BIOLOGICAL CONTROL AGENTS OF NUISANCE BLUE-GREEN ALGAE,

California Univ., Riverside. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2H.
W86-03492

UTILIZATION OF BACTERIA IN MANAGING CYANOBACTERIAL POPULATIONS: A REVIEW AND UPDATE,

Medical Coll. of Ohio at Toledo. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W86-03493

ALGICIDES AND ALGAL MANAGEMENT AND CONTROL: BIBLIOGRAPHY,

Montana Univ., Missoula.
G. W. Prescott.
IN: Proceedings of Workshop on Algal Management and Control March 9-12, 1980, Pacific Grove, CA. Technical Report E-81-7, May 1981. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. p 259-299.

Descriptors: *Bibliographies *Algicides, *Algal control, Biocontrol, Antibiotics, Nutrients, Algae, Copper sulfate, Grazing, Fish, Pesticides, Chemical treatment.

A bibliography for algicides and algal management and control includes a subject index that is divided into several sections: chemical control by agents other than copper sulfate, and general reports; biological and natural control; physical control; methods of application of chemicals (techniques); cold weather treatment; and other literature. The section on biological and natural control includes references to works on topics of viral and bacterioloical control agents, antibiotics and extrametabolites, grazing (fish and microfauna), and nutrient management. (Geiger-PTT)
W86-03494

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: PUBLIC NOTIFICATION METHODS.

Michigan Dept. of Natural Resources, Lansing. Water Quality Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132662, Price codes: A03 in paper copy, A01 in microfiche. MI/DNR/GW-82/08, July 1982. 28 p, 5 append. P00558801.

Descriptors: *Information systems, *Groundwater, Groundwater management, Water quality, Water pollution, Water quality management, Groundwater pollution, Public health, Public alerting.

Several thousand sites in Michigan have been identified as areas of potential groundwater contamination. The need for an effective system of informing the users of contaminated groundwater supply wells of the dangers associated with continued consumption of their groundwater is stressed. A comprehensive public alerting system consists of two categories of notification methods: short-term notification and long-term notification methods are used to immediately alert the users of a contaminated water supply well. Long-term notification methods are intended to ensure that people do not unknowingly utilize contaminated groundwater at any time after a problem has been detected and initial notification taken place. This report documents current formal and informal methods that are used in Michigan for both short-term and long-term notification of groundwater contamination problems and their consequences. As a result of this documentation, problem areas are identified and recommendations are presented. (Halterman-PTT)
W86-03513

DIRTY DEVIL PROJECT: CLASS II CULTRAL RESOURCES INVENTORY IN CENTRAL UTAH,

P-III Associates, Inc., Salt Lake City, UT.
For primary bibliographic entry see Field 6G.
W86-03518

PERFORMANCE OF SANITARY COMPLETION MEASURES OF WELLS AND BOREHOLES USED FOR RURAL WATER SUPPLIES IN MALAWI,

Department of Lands, Valuation and Water, Lilongwe (Malawi).
W. J. Lewis, and P. J. Chilton.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 235-247, 5 fig, 1 tab, 12 ref.

Descriptors: *Water quality control, *Water pollution sources, *Wells, *Boreholes, *Water supply, Bacterial analysis, MMalawi, Coliforms, Streptococci, Rural areas, Fate of pollutants, Dug wells, Shallow wells, Microbiology, Protection, Seasonal variation.

A microbiological testing program was conducted on the plateau of central Malawi during both dry and wet seasons. Fecal coliforms and fecal streptococci per 100 ml, respectively, were less than 10 and 20 in boreholes and less than 20 and 50 in protected dug wells. However, some lined dug wells, olde boreholes, and about 50% of the unprotected wells had fecal coliform levels in excess of 500 per 100 ml. In the wet season fecal streptococci levels remained below the 20 per 100 ml standard in 59% of backfilled dug wells, 41% of non-backfilled dug wells, and 85% of boreholes. Some possible reasons for the inferior water quality of dug wells as compared with boreholes are (1) water tables of less than 2 m, (2) presence of fissures in the clay dambo soils, voids from plant roots and animal burrows, (3) proximity to livestock watering and grazing, and (4) frequent siting near grossly polluted traditional water sources. The most appropriate defense against pollution of

shallow groundwater supplies are proper siting and good sanitary completion (backfilling, etc.).
W86-03582

WATER RESOURCE DATA AND TREND ANALYSES FOR THE BLUE CREEK WATERSHED PROJECT, PIKE COUNTY, ILLINOIS: PHASE II,

Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
T. E. Davenport.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119917, Price codes: A08 in paper copy, A01 in microfiche. IEPA/WPC/82-0082, September 1982. 161 p, 7 fig, 54 tab, 12 app, 86 ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Illinois, *Water quality, Flow rate, Gaging stations, Sampling sites, Chemical analysis, Water analysis, Water levels.

The Illinois Environmental Protection Agency (IEPA) in cooperation with the United States Department of Agriculture Agencies, Agricultural Stabilization and Conservation Service (ASCS), Cooperative Extension Service (CES) and Soil Conservation Service (SCS), is evaluating the impact of Resource Management Systems (RMS's) implemented under the ACP Special Water Quality Project in the Blue Creek Watershed, Pike County, Illinois. The primary objectives of this project are to identify the most viable agricultural non-point source control strategy, demonstrate its effectiveness, develop a methodology to identify land causing water quality problems and to determine the appropriate RMS's. The physical, biological, and chemical characteristics of the Blue Creek watershed were studied since May, 1980. A comprehensive monitoring network for the entire Blue Creek Watershed was established by IEPA to document the basic hydrological, meteorological, and water quality factors of the project area during 1980. The duration, timing and quantity of NPS pollutants were evaluated to determine land management effects on the water quality/quantity budget. Methods used for field and laboratory procedures are those accepted for agricultural related hydrology research. Analytical techniques are documented, but not detailed. By October 1, 1981, 70% of the soil loss reduction goal had been achieved, and erosion had been reduced by 16,495 tons/year. Precipitation was 17.5% above normal, with variability of streamflow attributed primarily to the precipitation patterns and land cover. High flows were measured from February through June while lower flows were measured during July and August. The rainfall-runoff ratio ranged from 4.7% to 80.1% during July and averaged 41.4% for Water Year 1981. Water samples were collected at seven stations in the Blue Creek Watershed during Phase II of the project, with three types of stations located within the watershed: watershed stations (A,B,C) sub-basin D and field stations (E,F,J).
W86-03610

CANADIAN INLAND WATERS: COASTAL ENVIRONMENTS AND THE CLEANUP OF OIL SPILLS,

Woodward-Clyde Consultants, Victoria (British Columbia).
E. H. Owens.
EPS 3-EC-82-3, July 1982. Department of the Environment, Ottawa (Ontario). 33 p, 11 fig, 8 tab, 4 ref.

Descriptors: *Oil spills, *Shore protection, *Environmental protection, *Fate of pollutants, *Water quality control, Cleanup operations, Lake shores, Rivers, Inland waterways, Protection, Water level, Beaches, Waves, Wind waves, Canada, Water pollution sources, Water pollution prevention.

Guidelines for shoreline protection and cleanup after oil spills in inland waters (lakes and rivers) are presented. Part I describes the spill and environmental information necessary to evaluate the spill impact and environmental sensitivity. Important factors in evaluating the impact and persistence of stranded oil are shoreline type (e.g., mud, sand, vegetation, rock, man-made) and energy levels as affected by waves, water level, wind, and ice. Part II discusses methods of protection and cleanup for each shoreline type. Decision guides are given for various substrates and conditions. Five checklists help to organize the spill and environmental information and to assess shoreline sensitivity, protection methods, and cleanup methods. Among the 23 cleanup methods are use of mechanical equipment (bulldozer, dragline, etc.), flushing, steam cleaning, sandblasting, pumping and vacuum, manual removal, burning, and natural degradation.
W86-03621

EVALUATION OF OIL SKIMMERS AND PUMPS,

Environmental Protection Service, Ottawa (Ontario).
Report EPS 4-EC-81-4, December 1981. 78 p, 13 fig, 12 tab, 9 plates, 16 ref, 3 append.

Descriptors: *Oil skimmers, *Oil recovery, *Pumps, *Evaluation, Oil slicks, Oil, Field tests, Cleanup operations.

A series of laboratory trials was conducted in the test tank of Arctec Canada Ltd., Ontario, in order to evaluate five oil skimmers and a number of related devices. Test were conducted using Venezuelan crude and diesel oils, at oil slick thicknesses of 1 to 10 mm. The program included two stationary skimmers; one remotely controlled semistationary skimmer; two mobile machines (one towed unit and one completely selfconducted skimmer package); and two pumps. The actual oil recovery rate of the oleophilic stationary skimmers evaluated by this test program was closely related to the oil spreading characteristics as well as to the operating characteristics of the skimmer itself. The oil content factor of the oleophilic skimmers was very high and the use of a small settling tank for a short period of time did not noticeably improve the oil content factor of the liquid recovered. Booming off a slick of approximately 2 to 5 mm improved not only the actual oil recovery rate, but the oil content factor of the recovered liquid as well. For oil slick thicknesses of <2 mm, the water content factor increased rapidly, especially in crude oil. The use of a small separator of 1000 l/min was only good for a weir type of skimmer, where the oil content factor was low. A positive displacement pump (preferably multi-chambered) designed for field use was the most adequate transfer pump for oil cleanup operations.
W86-03625

OIL STOP VALVE: OIL SPILL CONTAINMENT RESEARCH AND DEVELOPMENT PROJECT,

Bonneville Power Administration, Portland, OR.
R. D. Bourn.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-019262. Price codes: A02 in paper copy, A01 in microfiche. DOE/BP-121, July 1982. 15 p, 2 fig, 6 app, 25 ref.

Descriptors: *Oil spills, *Water quqlity control, *Valves, *Stormwater, *Powerplants, Oil skimmers, Environmental protection, Floats, Bonneville Power Administration, AFL/Clark Industries, Wate r treatment.

An oil stop valve, produced by AFL/Clark Industries, was tested for use in the Bonneville Power Administration's Oil Spill Containment and Countermeasure Program. The small, direct-acting valve can be used independently or with separator tanks and lagoon systems. Its only moving part is a ballasted float having a specific gravity between that of oil and water. When oil enters the water, usually in a manhole, the float seats itself, closing the valve and allowing the oil to back into a drain. Tests of a 4-inch valve led to modifications and construction of 8-inch and 12-inch models. The 12-inch valve has a 1400 gal per min capacity. Small twigs and leaves do not interfere with the valve's operation or impede water flow. The valve's major limitation is it inability to reopen once closed by a intrusion of oil. Since an automatically opening valve of this size cannot be practically constructed, the valve must be inspected regularly for closure due to oil accumulation or water evaporation.

W86-03627

EVALUATING CHANGES IN DIKE FIELD FISHES WITH COMMUNITY INFORMATION INDICES,

Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 7A.
W86-03628

CONSEQUENCE ASSESSMENT OF HYDROLOGICAL COMMUNICATIONS THROUGH BOREHOLE PLUGS,

INTERA Technologies, Inc., Houston, TX.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-011242, Price codes: A03 in paper copy, A01 in microfiche. Techincal Report 7/1-00G-02, August 10, 1981. 28 p, 8 fig, 10 ref, 2 append. DE-AC04-76DP00789.

Descriptors: *Boreholes, *Radioactive waste disposal, *Fate of pollutants, *Aquifers, *Permeability, *Geohydrology, *Waste disposal, *Groundwater movement, Leaching, Plugs, Waste Isolation Pilot Plant, New Mexico, Hydraulic permeability, Rustler formation, Delaware Mountain formation, Conductance, Hydrologic aspects, Water flow, Underground waste disposal.

Plugging boreholes in a nuclear waste repository with very low permeability plugs is probably not essential to contain the radioactive wastes in the Waste Isolation Pilot Plant, southeast New Mexico. Four hypothetical cases of hydrological communication between aquifer(s) and repository are considered: (1) the U-tube scenario, two wellbores and/or shafts connecting aquifer and repository; (2) a single borehole running through an upper aquifer, the repository, and a lower aquifer; (3) similar to (1) but with multiple boreholes; (4) similar to (2) but with multiple boreholes. Above a borehole conductance of 100 md-ft the borehole conductance approaches a constant rate between 14-260 cu ft per day for the four cases studied. Flow through the repository depends on aquifer connection, plug conductance, borehole distribution, and regional aquifer hydraulic gradient and permeability. Flow rates are greater for the two-aquifer connection than for the one-quifer connection. Flow rates are greater for multiple boreholes than for a single borehole but do not increase linearly with the number of boreholes.
W86-03629

STATUS REPORT ON COMPLIANCE WITH THE CHLOR-ALKALI MERCURY LIQUID EFFLUENT REGULATIONS 1980-81,

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
For primary bibliographic entry see Field 5E.
W86-03633

NONPOINT NITRATE POLLUTION OF MUNICIPAL WATER SUPPLY SOURCES: ISSUES OF ANALYSIS AND CONTROL,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A14 in paper copy, A01 in microfiche. Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. Karl-Heinz Zwirnmann, editor. 302 p.

Descriptors: *Nitrates, *Nonpoint pollution sources, *Agriculture, *Fertilizers, *Water quality control, *Water pollution prevention, Water supply, Water pollution sources, Fate of pollutants, Leaching, Drinking water, Groundwater pollution, Agricultural chemicals, Municipal water, Nitrogen compounds.

The Resources and Environmental Area of the International Institute for Applied Systems Analysis is concerned with nonpoint pollution of water resources by intensive agricultural activities, particularly use of chemical fertilizers. The exploratory study began with an analysis of the physical

system to be controlled (water resources, nitrogen input and output). A management system for controlling nitrate pollution included the system to be controlled (municipality, environment, water supply, and agricultural production), management objectives, and the management subsystem. Papers presented at the Task Force meeting were of three types: identification of the problem, control options, and methodology-oriented approaches.
W86-03649

EFFECTS OF REGIONAL WATER MANAGEMENT ON N-POLLUTION IN AREAS WITH INTENSIVE AGRICULTURE,

Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
P. E. Rijtema.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A03 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1082, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 15-42, 8 fig, 5 tab, 9 ref.

Descriptors: *Nitrates, *Nonpoint pollution sources, *Agriculture, *Wells, *Drainage effects, *Water management, *Land use, *Water quality control, Fertilizers, Deep wells, Fate of pollutants, Groundwater pollution, Municipal water, Water pollution sources. Aquifer management, Surface runoff, Runoff, East Gelderland, The Netherlands, Surface water, Phreatic level, Model studies, Nitrogen compounds.

Local drainage improvements do not extensively affect the net subsurface inflow of the groundwater aquifer in East Gelderland, an intensively cultivated agricultural region of The Netherlands. However, drainage channels, constructed to lower the phreatic level, reduce surface runoff and increase the discharge by interflow through the soil system. The resulting increase in residence time of the precipitation excess in the soil system permits additional denitrification, reducing the nitrogen load on the surface water. Deep well pumping for the muncipal water supply causes low-lying areas which do not normally drain into the groundwater aquifer to do so. Nitrate loads in the region vary widely, depending on hydrological conditions and land use. Inflow concentrations of nitrogen (in g per cu m) are assumed to be 10.7 from grasslands, 36.0 from arable land, 2.5 from forests, and 10.0 from urban areas.
W86-03650

IMPACT OF NITROGEN FERTILIZER APPLICATION ON THE NITRATE CONCENTRATION IN GROUNDWATER: COST-BENEFIT ANALYSIS CONSIDERATIONS,

Goettingen Univ. (Germany, F.R.).
H. de Haen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A03 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 57-80, 7 fig, 3 tab, 13 ref.

Descriptors: *Water quality control, *Nitrates, *Cost-benefit analysis, *Agriculture, *Fate of pollutants, *Nonpoint pollution sources, Benefits, Fertilizers, Economic aspects, Drinking water, Nitrogen compounds, Groundwater pollution, Federal Republic of Germany, Model studies, Water pollution prevention.

A cost-benefit analysis for dealing with the effect of nitrogen fertilizer application on nitrate concentration of groundwater is developed, using data collected in the Federal Republic of Germany. Graphs show the relationships between costs of reducing nitrate levels in drinking water vs. benefits (prevention of damage to health). From this, an acceptable nitrate concentration limit can be chosen. Nitrate flows in soils and aquifers are modeled. An economic analysis at the catchment level is proposed. Results of this type of study can be used to formulate policies for managing nitate pollution, for example, regulation of crop type or taxation of fertilizer use.
W86-03652

POSSIBILITIES OF CONTROLLING NITRATE CONCENTRATIONS IN DRINKING WATER,

M. Roman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A02 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 117-134, 8 tab, 13 ref.

Descriptors: *Drinking water, *Nitrates, *Water quality control, *Nonpoint pollution sources, *Water treatment, Municipal water, Nitrogen compounds, Stormwater, Poland, Surface water, Vistula River, Runoff, Ammonia, Nitrites, Organic nitrogen, Groundwater pollution, Rivers, Water pollution sources.

The problem of nitrates in drinking water should also take account of organic nitrogen, ammonia, and nitrites, which may be transformed to nitrates under certain conditions. Three integrated nonpoint sources of nitrogen pollution are identified and described in detail as studied in Poland: (1) stormwater, (2) soil, and (3) surface runoff. The nitrate level in drinking water supplies for large Polish cities is no problem. The highest levels, found in only three cities, were 5-10 mg N-NO3 per liter. However, some small local water supply systems based on shallow groundwater had over 100 mg N-NO3 per liter. River water tends to be higher in organic nitrogen and ammonia compounds. Since traditional water treatment is not effective in eliminating nitrates, several 'non-treatment' methods, such as a dual-quality water supply system, are suggested.
W86-03653

POSSIBILITIES OF WATER MANAGEMENT FOR PROTECTING AND TREATING DRINKING WATER RESOURCES IN CASE OF NITRATE POLLUTION,

D. Lauterbach, and H. Klapper.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A03 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 135-161, 5 fig, 4 tab, 11 ref.

Descriptors: *Water management, *Water quality control, *Nonpoint pollution sources, *Nitrates, *Drinking water, Municipal water, Groundwater pollution, Water pollution prevention, Water treatment, Protection, Water pollution sources, Wastewater treatment, Nutrients, Algae, Denitrification, Reservoirs, Ion exchange, Infiltration.

This paper gives an overview of some of the methods for managing the nitrate problem from the point of view of water management. The main types of methods distinguished are those for reducing or preventing nitrate inputs into water bodies, for controlling or treating water bodies with too high a nitrate content, and treatment in water works. Within the first group mentioned, particular attention is given to the establishment of drinking water protection zones, while the discussion of the second group addresses methods such as hydralically controlling, or biologically treating surface water bodies. Ion exchange and artificial infiltration are recommended for implementation in water works. (Author)
W86-03654

MODELLING NITRATE POLLUTION IN WATER RESOURCE SYSTEMS: THE THAMES NITRATE PROJECT,

Thames Water Authority, London (England).
J. Blake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A02 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 231-245, 6 fig, 2 ref.

Descriptors: *Water treatment, *Nitrates, *Drinking water, *Water quality control, Model studies, Thames River, Dentrification, Reservoir management.

The Thames Nitrates Project is a three-phase approach to the problem of rising nitrate concentrations in drinking water. The first two phases, problem identification and strategy development, are described. The mean annual nitrate concentration at Walton on the lower Thames increased from 4.2 mg N per liter in 1968 to 7.7 mg N per liter in 1979. For 62 days in 1976/1977 the concentration of nitrate was above the recommended limit of 11.3 mg N per liter. By the end of the century nitrate concentrations in this section of the Thames could reach 9.8-15.2 mg N per liter. Several options for nitrate management were developed: denitrifying sewage effluent, storing raw water for natural denitrification, blending high- and low-nitrate water, managing reservoirs, and installing denitrification plants at treatment works. This information will be modeled to ascertain an effective solution.
W86-03657

INTEGRATED PHYSICAL-ECONOMIC SYSTEMS ANALYSIS OF IRRIGATED AGRICULTURE,

California Univ., Davis. Dept. of Agricultural Economics.
D. J. Dudek, and G. L. Horner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A04 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982. Laxenburg, Austria. Series No. CP-82-S4, 1982. p 247-299, 20 fig, 3 tab, 15 ref.

Descriptors: *Nitrates, *Nonpoint pollution sources, *Irrigation effects, *Agriculture, *Economic analysis, *Water quality control, Nitrogen compounds, Model studies, Environmental effects, Social impact, Economic impact, Environmental protection, Planning, Water policy, Water management, Legislation, Land use, Resources management, San Joaquin Valley, California, Hydrologic models, Mathematical models, Drainage effects, Surface runoff, Tailwater, Scheduling, Water reuse.

This paper presents an integrated physical-economic methodology for the evaluation of nonpoint source pollution control technologies in an irrigated agricultural setting. The economic model determines the optimal allocation of resources and provides the capacity to assess the socio-economic impacts of nonpoint source control. Its physical counterpart estimates effects on the quality and quantity of groundwater as a result of the normative cropping pattern derived in the economic model. Four alternative control policies are then evaluated: continuation of current practices, mandatory tailwater recycling, mandatory irrigation scheduling, and recycling in concert with scheduling. Although the results presented emphasize the nitrate pollution of groundwater, the production of drainage effluent, salinity, surface runoff, and changes in subsurface drainage are also examined. Results are described in aggregate for the region by parameter and time period and by spatially differentiated production units. These results show the need for integrating the physical and socio-economic aspects of the agricultural production system within a single analytical methodology in order to generate policy relevant information. (Author)
W86-03658

POND MANAGEMENT: WATER QUALITY CRITERIA AND CONTROL,

Alabama Agricultural Experiment Station, Auburn.
W. D. Hollerman.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 121-129, 3 fig, 1 tab, 28 ref.

Descriptors: *Water quality control, *Ponds, *Fish farming, *Aquaculture, *Dredging, *Aquatic habitats, *Fish ponds, Habitats, Dissolved oxygen, Oxygen, Aeration, Carbon dioxide, Water hardness, Alkalinity, Nitrites, Suspended sediments, Turbidity, Ammonia, Hydrogen ion concentration, Clays.

Proper management of water quality variables in aquaculture operations, including those in dredged material containment areas, is imperative if success is expected. Dissolved oxygen, perhaps the most critical factor in fish culture systems, can be managed with mechanical aeration. Carbon dioxide may be harmful to fish when oxygen concentrations are low. Hydrated lime is effective in removing carbon dioxide from water. An imbalance between calcium hardness values and alkalinity concentrations may cause high pH levels lethal to fish. Ammonia and nitrite often accumulate in aquaculture systems. A pond treatment of sodium chloride protects fish from nitrite toxicity. Filter alum may be used to remove colloidal clay particles from water, eliminating turbidity that may limit photosynthesis. (Author)
W86-03708

PHYTOPLANKTON EFFECTS OF RESERVOIR USE,

Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
W. L. Poppe, J. S. Crossman, and S. W. Hixson.
In: Papers Presented at Workshop, April 10-12, 1979, Monterey, CA. Technical Report E-81-13, September 1981. p 263-275, 43 ref.

Descriptors: *Water quality control, *Lakes, *Reservoirs, *Taste, *Odor-producing algae, *Algae, *Eutrophication, *Nutrients, Geosmin, Musidone, Actinomycetes, Algicides, Zooplankton, Fish, Aeration, Ultrasound, Reservoir releases, Water treatment.

Taste and odor problems related to nuisance algae are reviewed, and control measures are suggested. Although algae were associated with bad taste and odor in water as early as 1897, the specific compounds were not identified until recently. These compounds, usually producing earthy or musty odors, are geosmin, musidone, and 2-exo-hydroxy-2-methylborane. Geosmin is produced by algae, actinomycetes, and some streptomycetes. In southwestern reservoirs actinomycetes have been blamed for taste and odor problems. A hypothesis was developed to explain that algal blooms and taste/odor problems do not always coincide. When algae are healthy, actinomycetes are controlled. However, under nutrient-limiting conditions the relationship shifts to a parasite-host type in which algae are the host. Of the biological control methods, viral algicides look more promising than use of zooplankton grazing or fish predation. Chemical control methods, which often are toxic to the whole aquatic system, include potassium permanganate and copper sulfate. Nutrient limitation can be accomplished by controlling point and nonpoint inputs, dilution with nutrient-poor water, and waste treatment. Mechanical means include ultrasonic radiation, shock waves, and destratification by aeration. Some management techniques have been helpful: use of multilevel water intakes, water treatment, and releasing a slug of hypolimnetic water (alters temperature and streamflow in downstream water).
W86-03722

PROBLEMS ON THE UPPER MISSISSIPPI RIVER AND ITS TRIBUTARIES: NEED FOR A LONG-TERM RESOURCE MONITORING PROGRAM,

Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station.
For primary bibliographic entry see Field 7A.
W86-03751

CHANGES IN GROUND-WATER CHEMICAL COMPOSITION IN DRAINED PEAT BOGS IN CONNECTION WITH ENVIRONMENTAL PROTECTION MEASURES,

Akademiya Navuk BSSR, Minsk.
For primary bibliographic entry see Field 2F.
W86-03764

VALIDATION AND PRIORITY POLLUTANT ANALYSIS,

Dow Chemical U.S.A., Midland, MI.
For primary bibliographic entry see Field 5A.
W86-03792

WYCOAL GAS COAL-GASIFICATION PROJECT; PRELIMINARY DRAFT ENVIRONMENTAL IMPACT STATEMENT, VOLUME 2.

Woodward-Clyde Consultants, San Francisco, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83-001084. Price codes: A17 in paper copy, A01 in microfiche. DOE/RA/50404 -- 1232 -- AppQ-Vol 2, August 1981. 382 p, 10 fig, 40 tab, 340 ref, 5 append, glossary. DE-F-CO2-81RA50404.

Descriptors: *Water pollution control, *Pollution control, Water pollution effects, Environmental protection, Water pollution prevention, Water pollution sources, Coal, Coal gasification, Coal mines.

The environmental consequences (effects and impacts) of the proposed actions and alternatives, regarding the construction of a coal gas plant are discussed. Effects are defined as the changes or permutations caused by the proposed action or alternatives, but not the final or ultimate change. Impacts are the residual effects on the final or ultimate change. Discussions of the impacts from the project components (plant, water supply system, product pipeline, railroad and mine) are organized into construction, operation and maintenance, and abandonment phases. Energy efficiency analysis, health and safety, mitigation measures, monitoring programs, unavoidable adverse impacts are also discussed. (Halterman-PTT)
W86-03840

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES: PROCEEDINGS OF THE 9TH US/JAPAN EXPERTS MEETING.

Army Engineer Inst. for Water Resources, Fort Belvoir, VA.
Held on October 17-19, 1983, Jacksonville, FL. March 1985. Edited by Thomas R. Patin. 244 p.

Descriptors: *Dredging, *Eutrophication, *Sediments, *Toxic wastes, Limnology, Toxicity, Dewatering, Model studies, Turbidity, Suspended solids, Oil pollution, Aquaculture.

The proceedings of a conference of dredging experts from the United States and Japan are presented. Experts from both countries present technical papers on a variety of subjects, including arresting and reversing eutrophication in both saltwater and freshwater water bodies, dewatering of dredged sediments, control and minimization of turbidity during dredging, management of dredged sediment disposal and containment activities, alternatives to ocean disposal of dredged sediments, effects of contaminated sediments on the chemical and biological environments, rehabilitation of contaminated water bodies, and constructive uses for dredged sediments. (Halterman-PTT)
W86-03867

AERATION EFFECTS ON MARINE EUTROPHICATION,

I. Yamashita, M. Shikamori, and T. Horie.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 8-26, 18 fig, 2 tab.

Descriptors: *Aeration, *Eutrophication, Phosphorus, *Toxic wastes, Toxicity, Phosphate, Destratification, Stratification, Shimizu, Japan.

The results of a study on the application of an aeration system to a marine environment are presented. A multi-hole, tube type aeration device was tested in a nearly closed sea area. This study, which includes preliminary studies, laboratory, and field experiments, and simulation studies, confirmed the effectiveness of the system with regard to destratification. However, more detailed studies and refinement of the methods are needed. Studies are needed on the effects of a system in which several types of air tubes are combined and operated in a wider sea area, the effects of longer operating time, the effects of intermittent operation, and the effects of differing air rates. (Halterman-PTT)
W86-03868

THEORETICAL CONSIDERATIONS OF GRAVITY DEWATERING OF DREDGED MATERIAL THROUGH THE BOTTOM OF A CONTAINMENT AREA,

Japan Bottom Sediment Management Association, Tokyo.
For primary bibliographic entry see Field 5D.
W86-03870

RAPID DEWATERING TEST OF DREDGED MATERIAL IN SITU,

Japan Bottom Sediment Management Association, Tokyo.
For primary bibliographic entry see Field 5D.
W86-03871

MECHANICAL DEWATERING OF DREDGED SLURRIES,

Rexnord, Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5D.
W86-03872

THEORETICAL CONSIDERATION OF POND AND SPILLWATER TREATMENT DESIGN,

Japan Bottom Sediment Management Association, Tokyo.
Y. Yoshida, and M. Natori.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 132-144, 7 fig.

Descriptors: *Dredging, *Dewatering, Sludge drying, Spoil banks, Pollution, Sediments, Sedimentation, Settling basins.

The importance of correctly evaluating laboratory tests for determining pond design or spill water treatment design is discussed. Theoretical considerations of sedimentation testing (including precipitation curves and descending clarified liquid surfaces), settling velocity, swelling of dredged material, suspended solids removal coefficient, and removal of pollutants, are presented. Although the settling tube test is the most popular method for planning settling ponds and spill water treatment, there is some question about the correct evaluation of test results. The theoretical analysis presented here will hopefully be useful in making correct evaluations. (Halterman-PTT)
W86-03876

REHABILITATION OF ESTUARIES IN TSUMATSUSAKA HARBOR,

S. Hamaguchi.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 198-209, 12 fig, 3 tab.

Descriptors: *Dredging, *Sedimentation, *Toxic wastes, Suspended sediments, Spoil banks, Pollution, Turbidity, Toxicity, Chemical composition, Harbors, Japan.

To improve the water quality of Matsusaka Harbor, Japan, it was necessary to remove the

polluted sediments from the Shitomo and Iwata Rivers, which flow into the harbor. The removal criteria, depth of dredging, disposal of dredged materials, deodorization, and spill water treatment are discussed. The most important factor considered in determining the depth of sediment removal was the sulfide concentration vertical profile. Sediments with sulfides greater than 1 mg/mg were removed, which meant dredging to a depth of 4.5 m in the lower portion of the Shitomo River. Turbidity was controlled with the use of silt curtains deployed above and below the dredging sites. After completion of the dredging work in the Shitomo River, the foul odors disappeared completely, and numbers of water birds, fish and shellfish increased. (Halterman-PTT)
W86-03880

PROCEEDINGS OF THE CONFERENCE ON COMBINED MUNICIPAL/INDUSTRIAL WASTEWATER TREATMENT.
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5D.
W86-03883

MINIMIZING COSTS BY GOOD FINANCIAL MANAGEMENT,
Synthetic Organic Chemical Manufacturers Association, Inc., Washington, DC.
For primary bibliographic entry see Field 6C.
W86-03886

WATER POLLUTION: INDUSTRY AND GOVERNMENT WORKING TOGETHER - A CASE STUDY OF MUNCIE, INDIANA'S INDUSTRIAL PRETREATMENT PROGRAM,
For primary bibliographic entry see Field 5A.
W86-03898

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER 2000, VOLUME IX: PLAN MANAGEMENT SUMMARY,
New Castle County Water Resources Agency, DE.
November 1984. 57 p. 8 Ref, 2 Append.

Descriptors: *Water management, Resources management, *Future planning, *Projections, Policy making, Public policy, Administrative agencies, Data collections, Project planning, Multiobjective planning, Long-term planning, Management planning.

This is the ninth and last volume in the WATER 2000 Plan, which is a cooperative planning effort to meet the water needs of New Castle County residents to the year 2000 and beyond. These reports contain four integrated management strategies--Demand Management, Facility Management, Resource Management and Plan Management--each of which has been divided into its pertinent key issues. This report summarizes the first eight reports and also formulates the management policies necessary to administer, review and revise WATER 2000 throughout the planning period. The two main management concerns are the administrative structure including the responsibility and authority of all parties, and the informational requirements for monitoring the plan. Based on a discussion of those considerations six Plan Management recommendations are made: (1) revise the Memorandum of Understanding between the state and other concerned county and local agencies; (2) establish a New Castle County management council to coordinate the activities of the multiple parties involved; (3) prepare an annual Water Resources Agency program and budget; (4) re-establish a Water Resources Advisory Committee to assist the WRA in implementing the WATER 2000 Plan; (5) complete an annual Water Resources Review and Report to analyze resource availability, capabilities, demand and results; and (6) prepare a WATER 2000 plan revision every five years. Implementation procedures are outlined for each of the recommendations. (Atkins-Omniplan)
W86-03435

NONLINEAR PROGRAMMING MODEL OF A WASTEWATER TREATMENT SYSTEM: SENSITIVITY ANALYSIS AND A ROBUSTNESS CONSTRAINT,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-03511

AFRICAN GROUNDWATER DEVELOPMENT-THE CHALLENGES FOR HYDROGEOLOGICAL SCIENCE,
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-03563

6B. Evaluation Process

WATER 2000, VOLUME IX: PLAN MANAGEMENT SUMMARY,
New Castle County Water Resources Agency, DE.
For primary bibliographic entry see Field 6A.
W86-03435

PLANNING APPROACH FOR IMPROVED MANAGEMENT OF ILLINOIS STREAMS FOR RECREATION AND CONSERVATION,
Illinois Dept. of Conservation, Springfield. Comprehensive Planning Section.
For primary bibliographic entry see Field 5G.
W86-03452

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

MINIMIZING COSTS BY GOOD FINANCIAL MANAGEMENT,
Synthetic Organic Chemical Manufacturers Association, Inc., Washington, DC.
S. Sacks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-142174, Price codes: A03 in paper copy, A01 in microfiche. IN: Proceedings of the Conference on Combined Municipal/Industrial Wastewater Treatment, March 25-27, 1980, Dallas, Texas. Robert S. Kerr Environmental Research Lab., Ada, OK, April 1981. p 24-30.

Descriptors: *Wastewater treatment, *Wastewater, *Waste treatment, Economic aspects, Financial feasibility, Financing, Taxes, Tax rates.

There are a number of Federal financial programs that can be used to minimize the cost of pollution control facilities. The Small Business Administration has an Economic Injury Loan Program for pollution control covering requirements for air, water, RCRA, and TSCA as well as other Federal regulations. The direct loans are currently being offered at 8 1/4% and may extend up to thirty years. An alternative, Pollution Control Revenue Bond Program guaranteed by the Small Business Administration can save a company roughly 25% of their financing costs over a period of 25 years over conventional financing plans. The bonds are tax-exempt and guaranteed by the full faith and credit of the U.S. Government. The program is open to the smaller companies that are at a competitive disadvantage with the larger companies. The bond program should be considered for companies seeking sums over $150,000. Companies may also take advantage of tax incentives and tax credits such as the rapid tax amortization program and the Tax Reform Act of 1978. (Author)
W86-03886

6D. Water Demand

VIABILITY OF INTERBASIN, INTERSTATE/INTERNATIONAL TRANSFERS OF WATER,
Colorado State Univ., Fort Collins.
H. P. Caulfield.
Paper presented at Symposium on Rivers and River Management, July 10, 1984. 15 p, 9 ref.

Descriptors: *Water transfer, *Interbasin transfers, Agriculture, Future planning, Water supply, Foods, Fiber crops, Alternative water use, Drought, Carbon dioxide, Atmosphere, China.

Some take for granted that major interbasin, interstate, and international water transfer are inevitable and that they are now viable or soon will be. The thesis of this paper is: If no shortage of food and fiber is present or foreseen and if water has already been fully appropriated for beneficial uses, then future municipal and industrial needs can be met most efficiently in arid and semi-arid areas by transfers of water out of agricultural use. Thus no large-scale interbasin, international, or interstate transfers of water are justifiable. On the other hand if a fundamental shortage of food and fiber is present or foreseen and if water has already been fully appropriated for beneficial use, then large-scale interbasin, interstate, or international transfers might be justifiable. The author concludes: (a) the United States should not consider any such major transfers; (b) the Peoples Republic of China should pursue its present planning and consideration of interbasin, interprovincial water transfers. The logic of these opposite answers related to the abundance of food and fiber that promises to be available to the U.S. and inadequate supplies that China appears to face. Two implications for adequacy of water supply should be studied: (1) the probabilities of sustained/severe droughts, their probable effects, and strategies for coping with them; and (2) the build-up of CO2 in the atmosphere, causing temperature to rise and precipitation to fall. (Fazio-Omniplan)
W86-03436

TEXAS MANUFACTURING WATER USE: LONG-TERM PROJECTIONS,
Texas Dept. of Water Resources, Austin.
M. L. Wright, and F. G. Bloodworth.
LP-193, November 1983. 113 p, 13 fig, 17 tab, 24 ref, 1 append.

Descriptors: *Industrial water, *Texas, *Water use, *Projections, *Long-term planning, Economic production, Growth rates, Statistical models, Food processing industry, Pulp and paper industry, Chemical industry, Oil industry, Metals.

The Texas Department of Water Resources is required by law to project water requirements in the State for a 50-year period. Forecasted demands upon water resources are categorized according to purpose of use. The report concentrates upon the five largest water-using industries: chemicals, petroleum, paper and pulp, metals, and food processing. The growth in industrial water use is projected to double by the year 2015 and almost triple by 2030. Chemicals production will require most (59%) of the manufacturing volume throughout the period, an increase of 692,000 acre-feet of annual use. Total water use in Texas for manufacturing is forecasted to grow from 1.5 million acre-feet in 1980 to 4.4 million acre-feet by 2030. The Department made the projections described in the report by several methods. The key feature was consultation with industry representatives, which produced valuable information about the anticipated future of each major water-using industry. All available long-term forecasts of industry growth were studied. The Department projected growth statistically. Probable economic events, such as a slowdown in production of primary metals and fuels, were included in the final determination of future changes in industry outputs. (Fazio-Omniplan)
W86-03441

WATER 2000, VOLUME V: WATER SUPPLY FACILITY OPTIMIZATION IN NORTHERN NEW CASTLE COUNTY.

New Castle County Water Resources Agency, DE.
For primary bibliographic entry see Field 5F.
W86-03443

WATER 2000, VOLUME VI: FORECAST OF FUTURE WATER DEMAND IN NEW CASTLE COUNTY.

New Castle County Water Resources Agency, DE.
October 1983. 74 p, 10 fig, 56 tab, 22 ref.

Descriptors: *Water demand, *Water requirements, *Potential water supply, *Water distribution, *Water management, Planning, Population dynamics, Water districts, Employment, Data acquisition, Peak demand.

This report forecasts water demand to the year 2010; these data can be used to determine if existing facilities can meet future demands and to identify the types and sizes of any new facilities needed. Water demand projections are shown for residential, commercial, industrial, institutional, irrigation and unaccounted categories. The latter includes inaccurate meters, leakage, hydrants, backwash and unauthorized uses. The projections have been separated by water use category and by utility to account for differences in demand among sectors and geographic areas. Total water use for both public and self-supplied water will exceed 91 mgd by the year 2010, up 18%, from 78 mgd in 1978. The commercial category is expected to increase the most, 9.4 mgd in 1978 to 14.12 mgd in 2010. Water use in this category was projected from employment forecasts, sales forecasts and related data. Increases in employment are expected to be modest, however, there may be significant shifts from one industry to another, e.g., nondurable goods to sevices, which would create a higher rate of water use per employee. For the county as a whole, residential water use is the second largest projected increase a 3.37 mgd increase to a level of 32.48 mgd in 2010. However, residential use will create the largest demand for the individual water utilities, with the exception of the City of Wilmington. These forecasts will help determine the amount of water needed and where the demand will be located. (Atkins-Omniplan)
W86-03444

WATER 2000: CONSERVATION PROGRAM.

New Castle County Water Resources Agency, DE.
For primary bibliographic entry see Field 3D.
W86-03445

DROUGHT-RELATED IMPACTS ON MUNICIPAL AND MAJOR SELF-SUPPLIED INDUSTRIAL WATER WITHDRAWALS IN TENNESSEE, (PART A AND PART B),

Geological Survey, Nashville, TN. Water Resources Div.
F. M. Alexander, L. A. Keck, L. G. Conn, and S. J. Wentz.
Available from OFSS, USGS, Box 25425, Lakewood, Co 80225. USGS Water-Resources Investigation Report 84-4074, 1984. 414 p, 47 fig, 55 tab, 44 ref.

Descriptors: *Water use, Water users, Available water, Surface water, Groundwater, Wells, *Drought effects, Aquifers, *Industrial water, *Tennessee.

A state-wide water use survey was conducted of all public water suppliers and large, self-supplied industries in Tennessee. This report contains a summation of the data received from 463 public-water suppliers and 129 self-supplied water users. Analysis of the study results and findings indicate that many communities in Tennessee do experience occasional water supply, quantity-related shortages. A total of 142 problems were reported by 107 of the public water suppliers. However, only 22 of the problems were a result of inadequate source supply. Although only three industries reported a water shortage problem, 20 were identified as having a potential water-supply source problem. West Tennessee was the only section of the state where all communities and industries surveyed reported an adequate water supply. The effects of a drought on the environment--specifically, wetlands, fish wildlife, and recreational-users--are briefly described, although there was no evidence that water withdrawn by communities or industry would directly affect the environment. This study appears to verify the conclusions that an extended drought, although directly affecting the supply to some communities and industries, may actually affect water quality and wastewater treatment more accurately by decreasing the ability of the source to assimilate wastes. (USGS)
W86-03560

CHALLENGES IN AFRICAN HYDROLOGY AND WATER RESOURCES: PROCEEDINGS OF THE HARARE SYMPOSIUM,

Ministry of Water Development, Salisbury (Zimbabwe).
For primary bibliographic entry see Field 2F.
W86-03562

APPLIED CLIMATOLOGY.

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Geographisches Inst.
For primary bibliographic entry see Field 2B.
W86-03846

6E. Water Law and Institutions

VIABILITY OF INTERBASIN, INTERSTATE/INTERNATIONAL TRANSFERS OF WATER,

Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 6D.
W86-03436

HUMAN ADAPTATION ALONG THE COLUMBIA RIVER 4700-1600 BP.: A REPORT OF TEST EXCAVATION AT RIVER MILE 590, NORTH CENTRAL WASHINGTON,

Central Washington Univ., Ellensburg.
J. C. Chatters, G. C. Cleveland, and D. E. Semko.
Central Washington University Occasional Paper, No 1, Research Report 84-1, January 1984. 135 p, 24 fig, 24 tab, 11 plates, 56 ref, 9 append. DACW67-82-C-0062.

Descriptors: *Environmental effects, *Rivers, *Archeology, Columbia River, Indians, Washington, Rufus Woods Lake.

Test excavations were conducted at Columbia River Mile 590 near Belevedere, Washington, to assess archeological sites which could be impacted by a 10-ft rise in Rufus Woods Lake. Four time periods were identified: I, over 4700 years ago; II, 4700-3500 years ago; III, 3500-2500 years ago; and IV, 3500-1600 years ago. The oldest known house structure, dating to 5300 years ago, in the state of Washington was discovered at the site. This was oval, unlike the round or square houses commonly found. In Period II the climate was warm, and the river flooded frequently. Pithouses were built on high terraces, except for field camps. As the river continued to aggrade, houses were built on the more stable flood plain as well as on high terraces. Hunting camps appeared at all locations. Erosion began about 2500 years ago with flash floods cutting away the flood plain and causing occupation sites for this period to be on higher ground. Settlement in all periods occurred near intermittent streams or no streams at all and changed with the nature of the river. (Caesar-PTT)
W86-03460

JOINT HYDROGEOLOGICAL SURVEYS,

GRW Engineers, Lexington, KY.
G. F. J. Jeurissen, and G. P. Kruseman.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 211-219, 1 fig, 2 tab.

Descriptors: *Water policy, Geohydrology, *Surveys, *Water resources development, *Research facilities, *Institutional constraints, Africa, Exploration, Geological surveys, International agreements, Monitoring, Wells, Hydrology.

Many African countries are in need of hydrogeological investigations as a basis for the rational development of their groundwater resources. They lack the necessary research institutes, however, because of the low priority given to groundwater investigations in the past. Experience has shown that at the national level the constraints to the rational development and management of the water resources are: the lack of a well defined water policy, lack of coordination, and conflicting interests between different institutions. At the institutional level the constraints arise from weak management and the lack of qualified personnel. The research institutes can be strengthened through cooperation programs with sister institutes from countries that have well developed groundwater survey institutes. Such programs should aim at training national personnel (on-the-job and through courses), during the joint execution of hydrogeological investigations and water resources assessment projects. Education institutions and other organizations responsible for water exploitation should be strengthened in a similar way. (Author)
W86-03579

HYDROGEOLOGICAL DATA COLLECTION, STORAGE, RETRIEVAL AND WATER LAW IN BOTSWANA,

Botswana Geological Survey, Lobatse.
For primary bibliographic entry see Field 7C.
W86-03580

LEGAL ENVIRONMENT OF A CONTAINMENT SITE: LAWS GOVERNING THE ACQUISITION, MAINTENANCE, AND OPERATION OF DREDGED MATERIAL DISPOSAL SITES,

Army Engineer District, Galveston, TX.
R. Harrison.
In: Aquaculture in Dredged Material Containment Areas: Proceedings September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 191-196.

Descriptors: *Legal aspects, *Dredging, *Aquaculture, *Ponds, *Water law, Real estate, Easements, Leases, Property rights.

Prospective aquaculturists should be aware of the legal instruments governing the ownership and use of containment areas. The Corps of Engineers (CE) does not usually own disposal property, it only holds the easement to dispose of dredged material on the property. State real estate law governs the rights and the relationships pertaining to the property. Disposal easements grant the holder (the CE) all necessary and incidental rights to enjoy the easement, including construction and maintenance of levees, water control structures, etc. These do not have to be specifically identified in the easement instrument. The owner reserves all other rights. Activities by the owner or any leasor may not interfere with the easement holder in enjoying his easement rights, i.e., they may not interfere with the CE's disposal activities. Clearly, as a first step, the leasor or prospective culturist must deal with both the owner, to lease the right to use the property for aquculture, and with the CE, to obtain a consent document for this activity. Only with these two agreements in hand can any other activity proceed. (Author)
W86-03715

LEGAL IMPLICATIONS OF COASTAL EROSION IN LOUISIANA,

Louisiana State Univ., Baton Rouge. Sea Grant Legal Program.
P. Hribernick, and M. Wascom.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 128-139, 50 ref.

Descriptors: *Wetlands, *Erosion, *Legal aspects, *Louisiana, Marshes, Coastal marshes, Environmental effects, State jurisdiction, Mineral resources, Resource management.

Erosion in the coastal zone of Louisiana has serious legal consequences for all property owners--private, State, and Federal. When a private property owner and the State are placed in an adversarial position, the general rule of Louisiana law dictates that erosion works against the private property owner's interest and works in favor of the State's interest. When the State and Federal Government are placed in an adversarial position, the general rule of law dictates that erosion works against the State's interest and works in favor of the Federal Government's interest. Following these general rules, if the forces of nature work to erode a private property owner's land, he may lose title of that land which erodes, and is valuable mineral resources, to the State. Similarly, if the forces of nature work to erode the coastline of Louisiana, the State may lose to the Federal Government, title to land in the Outer Continental Shelf in an amount corresponding to the number of acres of coastline that has eroded. At stake are invaluable mineral resources which pass with the ownership of the land. (Author)
W86-03860

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,
Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
For primary bibliographic entry see Field 6G.
W86-03861

6F. Nonstructural Alternatives

LEVEE POLICY FOR THE NATIONAL FLOOD INSURANCE PROGRAM,
National Research Council, Washington, DC. Committee on a Levee Policy for the National Flood Insurance Program.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-134619, Price codes: A06 in paper copy, A01 in microfiche. National Academy Press, Washington, DC. 1982. 107 p, 5 fig, 3 tab, 6 app.

Descriptors: *Levees, *Insurance, *Flood damage, *Flood plain management, *Flood control, *Policy making, *Economic aspects, Disasters, Local governments, Hazards, Inspection, Maintenance, Regulation, Flood protection, Flood plain zoning, Earthworks, Embankments, Mapping, National Flood Insurance Program, Flood insurance rate maps, Risks, Floodways.

This report formulates principles for a levee policy to help make decisions regarding flood insurance rates, land occupancy regulation, flood insurance puchase requirements, siting of critical facilities, notification of flood hazard, and warning/evacuation programs. Recommendations are mainly directed to levees along rivers with conditions that may threaten life, not to levees on smaller streams. Levees fulfilling certain conditions of construction, inspection, and operation and maintenance are recognized as reducing risks of flood damage. The community's responsibilities in floodplain development and levee management are also specified. For example, existing levees providing protection against 25-year floods and new levees providing protection against 100-year floods generally reduce flood damage. However, each levee is evaluated individually. Guidelines are given for rating procedures and mapping flood plains.
W86-03622

6G. Ecologic Impact Of Water Development

DISTRIBUTION AND RELATIVE ABUNDANCE OF FISHES IN WISCONSIN; V: GRANT AND PLATTE, COON AND BAD AXE, AND LACROSSE RIVER BASINS,
Wisconsin Dept. of Natural Resources, Madison.
D. Fago.
Technical Bulletin No 152, 1985. 112 p, 4 fig, 17 tab, 27 ref, 2 append.

Descriptors: *Baseline studies, *Fish populations, *Wisconsin, *River basins, *Surveys, Fish management, Natural resources, Species diversity, Water resources development, Data collections.

A statewide survey of the island waters of Wisconsin was initiated by the Bureau of Research, Wisconsin Department of Natural Resources to establish a comprehensive data base on the distribution and relative abundance of all fish species, including nongame species. The Grant and Platte, and Coon and Bad Axe, and La Crosse River basins were sampled from 1975 through 1982 by personnel from research at 327 stations, from fish management at 14 stations, and from U.S. Fish and Wildlife Service at 2 stations. An additional 124 stations were partially sampled by fish management personnel. A total of 74 species was collected from the Grant and Platte River basin, 63 from the Coon and Bad Axe River basin, and 60 from the La Crosse River basin. The endangered boldeye and the threatened Ozark minnow were included in the sampling. The weed shiner, pirate perch, and mud darter on the Department's watch list were also collected. Data from recent collections for the Grant and Platte, Coon and Bad Axe, and La Crosse River basins were compared to those from the 1900-28 and the 1950-74 periods. Twenty-four species which had not been previously reported were collected from the Grant and Platte River basin, 14 from the Coon and Bad Axe River basin, and 23 from the La Crosse River basin. Four species have apparently been extirpated from the Grant and Platte River basin, 14 from the Coon and Bad Axe River basin, and 4 from the La Crosse River basin. (Geiger-PTT)
W86-03501

INFLUENCE OF CHANNEL REGULATING STRUCTURES ON FISH AND WILDLIFE HABITAT: APPENDIX - VOLUME I, FIGURES AND PHOTOGRAPHS.
Missouri Univ.-Rolla. Inst. of River Studies.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-121582, Price codes: A12 in paper copy, A01 in microfiche. August 1982. 259 p, 228 fig, 70 photos. DACW43-81-C-0061.

Descriptors: *Channel improvements, *Navigation, Channel morphology. Dikes, Earthworks, Spur dikes, Dams, Embankments, Dam effects, Environmental effects.

This appendix contains the following list of illustrations: plan view of study area; study area tracings; dike histories; discharge hydrograph (1981) data collection periods; plan and range lines; contour lines; dike profiles; velocity profiles; gradation curves; examples of bed and water area calculations; an artificial substrate sampler; location of water quality and grab (dredge) sampling sites; river stages at Chester, Illinois, in 1981; the effect of river stage on gear efficiency; and various photographs, both aerial and land, showing dikes used within the study area. The report to which this volume is appended, evaluates aquatic habitat diversity, and various other physical characteristics in the vicinity of channel regulating structures, and recommends data needs and structural modifications to protect fish and wildlife and maintain an acceptable navigating channel. (Halterman-PTT)
W86-03509

IMPOUNDED RIVERS: PERSPECTIVES FOR ECOLOGICAL MANAGEMENT,
Loughborough Univ. of Technology (England). Dept. of Geography.
G. E. Petts.
John Wiley and Sons, Chichester, England, 1984. 326 p.

Descriptors: *Rivers, *Reservoirs, *Dam effects, *Ecological effects, *Environmental effects, Reservoir operation, Fisheries, Dams, Environmental impact statement, Water resources development, Channel morphology, Macroinvertebrates, Dam construction, River basins, Water quality, Plankton, Fish.

The book presents a geographical analysis of impounded rivers. It seeks to generate an improved awareness of the fate of rivers, and of the scale of change in space and time after dam construction. The focus is placed initially on the physical and chemical alterations to river systems imposed by impoundment, and then on the implications of these alterations for the biological components. The first chapter describes the global distribution of impounded rivers, the history of related scientific inquiry, and the spatial variability of natural river systems, leading to a preliminary appraisal of the different effects of impoundment. Chapter two considers the primary effects of impoundment upon hydrological characteristics, while chapter three examines the impacts on water quality. Chapter four studies the effects of river impoundment on the mineral and plankton components of seston transport. The effects of these primary impacts upon channel morphology is examined in chapter five. In chapter six, aquatic, riparian, and floodplain vegetation changes are discussed. The effects of these changes on the benthic macroinvertebrates and on fish and fisheries are discussed in chapters seven and eight, respectively. In chapter nine, the environmental considerations that are most pertinent to successful river management are discussed, namely the problems of forecasting ecological change prior to impoundment, and the potential effectiveness of responsive approaches. (Geiger-PTT)
W86-03516

DIRTY DEVIL PROJECT: CLASS II CULTRAL RESOURCES INVENTORY IN CENTRAL UTAH,
P-III Associates, Inc., Salt Lake City, UT.
B. L. Tipps, and K. W. Russell.
Cultural Resources Report 8402-1-8406, 1984. Cultral Resources Program: Bureau of Reclamaton. 45 p, 8 fig, 6 tab, 73 ref, 1 append.

Descriptors: *Land use, *Cultural resources inventory, *Planning, *Water quality control, *Salt ponds, Salinity, Saline water intrusion, Saline water, Water quality management, Ecological effects, Ponds, Topology, Intermittent streams.

The report documents the results of a Class II cultural resource inventory conducted for the Bureau of Reclamation in central Utah. The work was required to collect data on cultural resources prior to the construction of salinity ponds along several intermittent drainages near Hanksville and Emery, Utah. The work was part of the Dirty Devil Salinity Project, an endeavor designed to reduce salt flow into Muddy Creek and the Dirty Devil River through the construction of the salinity ponds. The inventory was necessary to assist the Bureau of Reclamation in fulfilling their legal obligations and environmental planning responsibilities concerning cultural resources. A pedestrian survey of approximately 650 acres resulted in the discovery and documentation of six prehistoric sites within the study area. Although the sites vary in size and density, all of the sites can be characterized as lithic scatters or lithic source area. Due to a lack of diagnostic artifacts and/or features, none of the sites could be identified according to cultural affiliation or chronological placement. None of the sites are considered potentially eligible to be recorded in the National Register. (Geiger-PTT)
W86-03518

FINAL ENVIRONMENTAL IMPACT STATEMENT: REGIONAL FLOOD CONTROL TONAWANDA CREEK, GENESEE COUNTY, NEW YORK,
Corps of Engineers, Buffalo, NY. Buffalo District.
For primary bibliographic entry see Field 4A.
W86-03626

IMPACTS OF FLOODING REGIME MODIFICATION ON WILDLIFE HABITATS OF BOTTOMLAND HARDWOOD FORESTS IN THE LOWER MISSISSIPPI VALLEY,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. V. Klimas, C. O. Martin, and J. W. Teaford.
Technical Report EL-81-13, October 1981. Final Report. 200 p, 15 tab, 300 ref, append.

Descriptors: *Flood plain management, *Floods, *Forests, *Wildlife habitats, Hardwood, Aquatic animals, Literature review, Logging, Land clearing, Mississippi River.

This is a literature review concerning the impacts of flooding regime modification on bottomland hardwood forest wildlife habitats of the lower Mississippi Valley. The composition and structure of the bottomland forest are an important determinant of the quality and type of wildlife habitat available. These forest characteristics are largely influenced by the flooding regime. Overstory diversity and perennial understory diversity and productivity are lowest in near-permanently flooded habitats and increase in areas flooded less frequently and for shorter periods of time. Nonflooded areas are often, but not always, less diverse and productive than infrequently flooded areas. Tree growth, regional habitat diversity, and land clearance patterns may also be influenced by modifications to the hydrologic regime. Bottomland forests are considered productive wildlife habitat due to high soil fertility, abundant moisture, and the diversity and abundance of wildlife food and cover. Modifications in the magnitude, frequency, and duration of flooding are expected to bring about a wide variety of impacts on different species. Impacts of flooding regime modifications are discussed for mammals, birds, reptiles, and amphibians. Aquatic and semiaquatic species are generally adversely affected by flood reduction and are benefitted by normal flooding conditions. Species that are principally terrestrial may be severely impacted by major flooding events, but they may respond more to secondary influences such as land clearing and logging. Where known, both direct and indirect impacts of flooding regime modifications are discussed by species or species groups occurring in the study area.
W86-03634

EFFECTS OF FLUCTUATING RESERVOIR WATER LEVELS ON FISHERIES, WILDLIFE, AND VEGETATION: SUMMARY OF A WORKSHOP, 24-26 FEBRUARY 1981,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Miscellaneous Paper E-83-2, U.S. Army Environmental and Water Quality Operational Studies, July 1983, Final Report. Edited by Hollis H. Allen and Larry R. Aggus. 55 p.

Descriptors: *Environmental effects, *Habitats, *Wildlife, *Vegetation, *Fish management, *Reservoir operation, *Water level fluctuations, Fluctuations, Drawdown, Shoreline cover, Multipurpose reservoirs, Aquatic habitats, Lakes, Aquatic plants, Waterfowl, Wetlands, Planting management, Water management.

A workshop on the environmental effects of fluctuating water levels in reservoirs concerned three general topics: vegetation, wildlife, and fisheries. Abstracts of principal papers and a summary for each topic are presented. Adverse effects of shorelines denuded of vegetation are loss of food and habitat for animals, increased erosion and turbidity, leaching of soils, and loss of nutrients from decomposing organic matter. Some promising methods for evaluating effective shoreline revegetation are described. A simple screening method for perennial plant species uses a survey of the literature and of the local plant community, field and laboratory investigations of candidate plants, and recommendations for large-scale plantings. Only a small fraction of potentially useful plants has been tested thus far. Wildlife concerns are closely related to vegetation conditions. Reservoirs should be managed on an individual basis. Many reservoirs can be managed on a subimpoundment level, taking advantage of existing conditons to increase habitat quality. Good fisheries management often conflicts with reservoir operation. Although management strategies for reservoirs are highly individual, some general principles were noted. Water levels are raised in spring to promote spawning and lowered in summer to permit regrowth of vegetation. Fall and winter drawdown is often used to control aquatic vegetation and concentrate prey species. Drastic and prolonged drawdown for revegetation and later restocking of fish is effective but often conflicts with reservoir operation. In coldwater reservoirs, management policies usually favor salmonids over vegetation.
W86-03642

POTENTIAL BIOLOGICAL IMPACTS OF NAVIGATION TRAFFIC,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
T. D. Wright.
Miscellaneous Paper E-82-2, U.S. Army Environmental and Water Quality Operational Studies, June 1982. Final Report. 25 p, 28 ref.

Descriptors: *Navigation, *Aquatic life, *Environmental effects, *Water pollution sources, *Sedimentation, *Transportation, Literature review, Ships, Turbulent flow, Aquatic animals, Aquatic environment, Suspended solids, Propellers, Waves, Water current, Aquatic insects, Insects, Drawdown, Dissolved oxygen, Oxygen, Particulate matter, Nutrients, Fate of pollutants, Oil spills, Chemicals.

A literature search was conducted to identify research relating physical and chemical changes associated with navigation traffic potential biological impacts. It was found that, although some information on physical and chemical changes was available, documentation to demonstrate biological impacts was generally lacking. Where possible impacts were identified, they were observed at the organism level, rather than population, community, or ecosystem level. A particular problem was encountered in attempting to separate impacts of navigation from those caused by natural and/or anthropogenic perturbations. It was concluded that biological impact analysis beyond the organism level may not be within existing state-of-the-art technology. (Author)
W86-03645

CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: PROCEEDINGS OF THE 15TH ANNUAL MEETING OF THE MISSISSIPPI RIVER RESEARCH CONSORTIUM.

Butterworth, Boston. 1984. Edited by James G. Weiner, Richard V. Anderson, and David R. McConville. 368 p.

Descriptors: *Environmental effects, *Fate of pollutants, Rivers, *Sediments, *Erosion, *Channeling, *Aquatic habitats, Aquatic animals, Backwater, Metals, Wildlife, Water quality, Planning, *Mississippi River.

Concerns for the future of the Upper Mississippi River were presented at a meeting featuring synthesis and original research papers. The ecological history of this section of the river emphasized the effects of channel improvement, starting with rudimentary works in 1824 and continuing with construction of locks and dams to form a series of navigation pools. The degraded Illinois River was described as a possible fate of the Upper Mississippi. Sedimentation studies showed the origin and transport of sediments and that many backwater lakes are likely to become marshes within 50-100 years. Analysis of trace substances in water, wildlife, plants, and sediments indicated that levels of several metals, including cadmium, mercury, and lead, were high in certain sections, namely Lake Pepin, Fountain City Bay, and other pools downstream of the Twin Cities region. Concentrations of polychlorinated biphenyls and organochlorine pesticides in sediments and waterfowl eggs were documented. Monthly water chemistry monitoring of 12 common parameters showed that most variations were related to river discharge rates. A mathematical model was used to predict impacts of navigation on the river for the near future and for the years 2000 and 2040.
W86-03737

ECOLOGICAL HISTORY OF THE UPPER MISSISSIPPI RIVER,

Winona State Univ., MN.
C. R. Fremling, and T. O. Claflin.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 5-24, 7 fig, 22 ref.

Descriptors: *Environmental effects, *Ecological effects, Rivers, *Aquatic habitats, *Channel improvement, *Navigation, History, Mississippi River, Aquatic life, Fish, Wetlands, Sedimentation, Invertebrates, Sediment transport, Erosion, Dams, Locks, Rivers and Harbors Act, Marshes, Water pollution sources.

The Upper Mississippi Valley, opened to Caucasians by Joliet's explorations in 1673, was the site of rapid population growth and trading during the 1700's. This section of the river was surveyed in the early 19th century. The beginning of steamboat travel in 1823 led to navigation improvements by the Army Corps of Engineers starting in 1824. Settlements continued to grow in number and population, stimulating cutting of forests for lumber and agricultural activities, particularly steepland farming. These practices contributed to erosion and degradation of the river system. The Rivers and Harbors Acts of 1878, 1890, and 1907 resulted in channel deepening and other construction works in the section from Minneapolis to the Ohio River. These works used wing and closing dams, shore protection, and auxiliary dredging, permitting open-channel navigation. By 1870 the fisheries were rapidly declining as a result of wide fluctuations in water level which stranded fish in backwaters. Fish rescue operations were begun in 1879 and continued until the 1950's in a few locations. In the 1930's more extensive channelization projects started. The channel was deepened to 9 ft by construction of locks and dams (29 built during this period), supplemented by dredging. As a result of the impoundments, the river habitat has changed, vastly increasing the marsh area and slack water area habitat available for invertebrates, periphyton, fish (139 species), furbearers, and waterfowl. Some long-term detrimental changes caused by the channel modifications include accelerated sedimentation (changing wetlands into floodplains), eutrophication, and accumulation of industrial wastes.
W86-03738

ROLE OF CONTAMINANTS IN THE DECLINE OF THE ILLINOIS RIVER: IMPLICATIONS FOR THE UPPER MISSISSIPPI,

Illinois Natural History Survey, Champaign.
R. E. Sparks.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 25-66, 17 fig, 103 ref.

Descriptors: *Environmental effects, *Water pollution effects, *Ecological effects, Rivers, *Aquatic habitats, *Channel improvement, *Navigation, Mississippi River, Aquatic life, Fish, Wetlands, Sedimentation, Invertebrates, Sediment transport, Erosion, Agricultural watersheds, Marshes, Water pollution sources, Illinois River, Vegetation, Aquatic plants, Lakes, Water quality, Waterfowl, Clams, Ducks.

The Illinois River, similar in geologic origin, history, and stream biota to the Upper Mississippi River, has suffered ecological changes from human activities since 1870. The river channel has been deepened in the center. Fingernail clams, snails, naiads, caddisflies, largemouth bass, mayflies, and other aquatic species have disappeared or diminished significantly. Water levels and sediment transport have increased. Sediments are suspended and relocated by boat traffic. Quiver Lake, adjoining the river, has changed from a clear lake with aquatic vegetation and an abundance of macroinvertebrates to a sediment-filled basin, rapidly turning into a willow-cottonwood forest. Nearby Thompson Lake, which contained abundant fish, waterfowl, and muskrats in the 1870's was drained and turned into farmland. The Upper Mississippi is

less susceptible to changes of this type because it is larger and land use more favorable (more orchards, hay, and pastures and less plowed land). Nevertheless, during drought, warning signs appear in the Mississippi, namely high ammonia levels, low dissolved oxygen levels, decline in fingernail clams. A study of the Upper Mississippi may help prevent the irreversible changes that have occurred in the Illinois River.
W86-03739

SEDIMENTS OF THE UPPER MISSISSIPPI RIVER: THEIR SOURCES, DISTRIBUTION, AND CHARACTERISTICS,
Winona State Univ., MN.
For primary bibliographic entry see Field 2J.
W86-03740

RECENT RATES OF SEDIMENTATION IN THE MISSISSIPPI RIVER,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2J.
W86-03741

INVESTIGATION OF EFFECTS OF NAVIGATION TRAFFIC ACTIVITIES ON HYDROLOGIC, HYDRAULIC, AND GEOMORPHIC CHARACTERISTICS IN THE UPPER MISSISSIPPI RIVER SYSTEM,
Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 5B.
W86-03750

CONTAMINANTS IN THE UPPER MISSISSIPPI RIVER: SUMMARY AND CONCLUSIONS,
Geological Survey, Menlo Park, CA.
S. N. Luoma.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. p 345-356, 23 ref.

Descriptors: *Environmental effects, *Fate of pollutants, *Aquatic habitats, Rivers, *Channeling, Sediments, Erosion, Locks, Dams, Navigation, Water quality, Ecological effects, Aquatic animals, Wildlife.

Within an ecologically relevant temporal context (more than 100 years) the Upper Mississippi can be viewed as a system responding to perturbations that drastically changed the direction of natural successional trends between 1900 and 1930. The system appears to be moving rapidly toward the ecological simplification that so often characterizes human perturbation: fewer waterfowl, less benthic diversity, and poorer fisheries. Such a fate would be less likely in an unchanneled, free-flowing river. Superimposed on the trends initiated by physical modification is an input of toxic and organic wastes, which the system will be increasingly less able to assimilate as succession proceeds, and which have played some detectable role in biological simplification of at least one major tributary. The present trend of change in the Upper Mississippi was established 50 to 75 years ago when the river was channelized and the locks and dams were constructed. Better waste treatment, less use of toxins in the watershed, and more soil conservation could slow the trend toward ecological simplification. The need for these expensive mitigating measures is much greater today than if the system had not been modified physically. The ultimate fate of the river is now a function of its new identity, which includes a series of partial impoundments. The major question is how to slow or reverse succession in these input-sensitive impoundments. If possible at all, this will only occur if humans assume responsibility for the assimilative functions once provided by the free-flowing river. (Author)
W86-03752

WYCOAL GAS COAL-GASIFICATION PROJECT; PRELIMINARY DRAFT ENVIRONMENTAL IMPACT STATEMENT, VOLUME 2.
Woodward-Clyde Consultants, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W86-03840

PROCEEDINGS: 2ND ANNUAL GULF OF MEXICO INFORMATION TRANSFER MEETING.
Minerals Management Service, Metairie, LA. Gulf of Mexico OCS Regional Office.
For primary bibliographic entry see Field 10D.
W86-03841

PROCEEDINGS OF THE CONFERENCE ON COASTAL EROSION AND WETLAND MODIFICATION IN LOUISIANA: CAUSES, CONSEQUENCES, AND OPTIONS.
Louisiana Universities Marine Consortium, Chauvin.
For primary bibliographic entry see Field 2J.
W86-03850

WETLAND LOSS DIRECTLY ASSOCIATED WITH CANAL DREDGING IN THE LOUISIANA COASTAL ZONE,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
W. B. Johnson, and J. G. Gosselink.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 60-72, 5 fig, 6 tab, 15 ref.

Descriptors: *Wetlands, *Canals, *Dredging, *Marshes, *Louisiana, Canal construction, Inland waterways, Banks, Erosion, *Bank erosion.

Wetland losses resulting from canals, including initial construction practices and subsequent canal bank erosion, are discussed. Results of field measurements indicated that the average width of newly dredged canals exceeded the permit specifications by 13.4 m. The total width affected, including berm and spoil deposits, exceeded the permit specifications by an average of 81.7 m. Continued widening due to erosion, as illustrated by several case histories, is discussed. Canals in areas of greatest boat activity widened at a rate of 2.58 m/yr, while those in areas of minimal boat activity widened at a rate of 0.95 m/yr. (Halterman-PTT)
W86-03854

CANALS AND WETLAND EROSION RATES IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. E. Turner, R. Costanza, and W. Scaife.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 73-84, 7 fig, 2 tab, 15 ref.

Descriptors: *Wetlands, *Canals, *Dredging, *Marshes, *Louisiana, Canal construction, Inland waterways, Banks, Erosion, *Bank erosion.

Canals have increased in area from practically zero at the beginning of the century to about 2.4% of the Louisiana coastal surface area in 1978. The annual increase in canal area is continuing to climb in 1981 as a result of new canal dredging and the widening of existing canals. Land loss rates across the coastal zone since the 1890's, among hydrologic units, and within areas of similar substrates and equal distances to the coast, are all positively related to estimates of canal density. Further, estimates of land loss at zero canal density (from regression equations) are similar to the 7,000 year coast-wide rate of gain in land. Within 7 1/2' quadrangle maps, the new 'holes' or ponds in the marsh have appeared close to canals, not near natural channels. Coastwide, canal surface is about 10% of the total land loss. Based on the analysis presented, it was concluded that coastal erosion rates in Louisiana are largely an indirect result of canal dredging activities or use. The mechanism for the effect probably involved an alteration in wetland hydrology, but a complete understanding is presently lacking. (Author)
W86-03855

EFFECT OF COASTAL ALTERATION ON MARSH PLANTS,
Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
For primary bibliographic entry see Field 2L.
W86-03856

EFFECTS OF WETLAND DETERIORATION ON THE FISH AND WILDLIFE RESOURCES OF COASTAL LOUISIANA,
Fish and Wildlife Service, Lafayette, LA.
For primary bibliographic entry see Field 2L.
W86-03857

SOME CONSEQUENCES OF WETLAND MODIFICATION TO LOUISIANA'S FISHERIES,
Louisiana Dept. of Wildlife and Fisheries, Baton Rouge.
For primary bibliographic entry see Field 2L.
W86-03858

WETLAND LOSSES AND COASTAL FISHERIES: AN ENIGMATIC AND ECONOMICALLY SIGNIFICANT DEPENDENCY,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W86-03859

ECONOMIC AND CULTURAL CONSEQUENCES OF LAND LOSS IN LOUISIANA,
Nicholls State Univ., Thibodaux, LA. Dept. of Earth Science.
D. W. Davis.
IN: Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, October 5-7, 1981, Baton Rouge, Louisiana. FWS/OBS-82/59, September 1982. p 140-158, 50 ref.

Descriptors: *Wetlands, *Erosion, *Economic aspects, *Louisiana, Marshes, Coastal marshes, Environmental effects, Louisiana, Wildlife, Resource management, Fisheries.

Various aspects of the loss of lowland marshes along the coast of Louisiana are discussed. An important nursery ground and habitat for migratory waterfowl, fur and hide-bearing animals and fisheries will be lost. 'High' land, already scarce, will be at a premium and the cumulative economic effect is estimated to be in the billions of dollars. Loss of offshore oil royalties is estimated to be nearly $20 million for each mile of coastal retreat. The loss of unique lifestyles and cultural heritage is also discussed. (Halterman-PTT)
W86-03861

7. RESOURCES DATA

7A. Network Design

SOME CRITICAL ISSUES WITH MONITORING CRYSTALLINE ROCK AQUIFERS FOR GROUNDWATER MANAGEMENT IN RURAL AREAS,
Prakla-Seismos Geomechanik, Accra (Ghana).
For primary bibliographic entry see Field 2F.
W86-03567

APPRAISAL OF SEDIMENT TRANSPORT MEASUREMENT IN GHANAIAN RIVERS,
Water Resources Research Inst., Accra (Ghana).
S. A. Akrasi, and N. B. Ayibotele.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 301-312, 5 fig, 4 tab, 20 ref.

Descriptors: *Network design, *Erosion, *Sediment transport, *Sediment yield, Data collections, *Hydrologic data collections, Ghana, Volta River, Rivers, Bed load, Sedimentation.

A sediment monitoring network for Ghana is proposed. Existing data are used to establish a framework; the new system is designed to confirm doubtful data and fill in missing information. Thus, a less expensive network is possible. Current sedimentation problems involve construction of bridges over the Tano River, the effect of gold dredging on the Offin River, sedimentation around the intakes of several water supplies, and sedimentation in the Oti River. In the Volta drainage basin information needs include bed load movement, particle size distribution of the suspended load, the relationship between runoff and sediment discharge per unit area of land, and sediment discharges of several tributaries. In the southern and coastal drainage basins, more must be known about the suspended load, sediment transport at higher river discharges, and further measurements to confirm the station and regional rating curves.
W86-03596

EVALUATING CHANGES IN DIKE FIELD FISHES WITH COMMUNITY INFORMATION INDICES,

Oak Ridge National Lab., TN.
H. N. Polovino, M. P. Farrell, and C. H. Pennington.
Technical Report E-83-14, June 1983. Final Report. U. S. Army Environmental and Water Quality Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 47 p, 21 fig, 6 tab, 46 ref.

Descriptors: *Network design, *Fish populations, *Sampling, *Dikes, *Aquatic habitats, *Species composition, *Environmental effects, Wildlife, Mississippi River, Ecological distribution, Habitats, Spatial distribution, Classification, Similarity coefficients, Water temperature, Temperature, Water level, Water management, Distribution patterns, Species diversity.

Researchers characterizing ecological communities are often faced with the problem of collapsing large species lists into a single numeric expression of community structure. Historically, quantitative species diversity indices have been used to assess spatial and temporal changes in ecological communities. However, other classification estimates (e.g., binary similarity coefficients and quantitative dissimilarity measures) offer methodologies for delineating community composition that may be more sensitive to sampling error. This study evaluates the relative performance of (1) binary similarity coefficients; (2) dissimilarity measures; and (3) diversity indices, calculated for three sampling methods, in detecting changes in fish communities associated with two dike fields on the Mississippi River. Dike field fish communities were sampled and evaluated for five hydrologic seasons, based on water temperature and flow velocities, and were found to be least similar during high-water low-temperature conditions. During the evaluation, the informaiton derived from electroshocking was the most representative when compared with hoop net and seine information. Of the three families of community information measures, binary similarity coefficients proved to be the most sensitive indicators of change in dike field fish communities. It was further found that measures based on species presence/absence represent a valid alternative method for characterizing change in community structure. This is especially true when species abundance data are highly variable, which is the case in many fisheries assessments. (Author)
W86-03628

WATER QUALITY MONITORING: A SYSTEM'S PERSPECTIVE,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. C. Ward.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119222, Price codes: A03 in paper copy, A01 in microfiche. In: Nonpoint Nitrate Pollution of Municipal Water Supply Sources: Issues of Analysis and Control, Proceedings of an IIASA Task Force Meeting, February 10-12, 1982, Laxenburg, Austria. Series No. CP-82-S4, 1982. p 163-205, 1 fig, 65 ref.

Descriptors: *Monitoring, *Water quality, *Nonpoint pollution sources, *Sampling, *Water analysis, *Network design, Data acquisition.

Water quality monitoring is an effort to obtain information about the physical, chemical and biological characteristics of water via statistical sampling. The usefulness of the information is highly dependent upon a monitoring program, or system, being properly designed and operated. A monitoring system is defined as a sequence of operations: (1) sample collection; (2) laboratory analysis; (3) data handling; (4) data analysis; and (5) information utilization. The design of each component is discussed in the context of how it affects the overall usefulness of the resulting information. The data collection/utilization balance, a scientific understanding of water quality, data utilization strategies and network design documentation are specific aspects of monitoring where improvements can be made, thus greatly enhancing our ability to obtain useful information on water quality. With the system's perspective of monitoring and a discussion of specific areas for improvement, it is hoped that the important role water quality monitoring should play in enhancing management of water quality can be more readily visualized and that monitoring, with its better defined role, will ultimately provide a basis for a much more scientific understanding of water quality than that currently available. (Author)
W86-03635

CAN THE LINEAR BALANCE MODEL BE EXTENDED TO THE WHOLE ALPS,

Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
For primary bibliographic entry see Field 2C.
W86-03697

PROBLEMS ON THE UPPER MISSISSIPPI RIVER AND ITS TRIBUTARIES: NEED FOR A LONG-TERM RESOURCE MONITORING PROGRAM,

Columbia National Fisheries Research Lab., La Crosse, WI. Field Research Station.
G. A. Jackson, C. E. Korschgen, P. A. Thiel, J. M. Besser, and D. W. Steffeck.
In: Contaminants in the Upper Mississippi River: Proceedings of the 15th Annual Meeting of the Mississippi River Research Consortium, Butterworth, Boston. 1984. 325-343 p, 1 fig, 14 ref.

Descriptors: *Network design, *Planning, *Environmental effects, *Monitoring, *Aquatic habitats, Rivers, Mississippi River, Erosion, Sedimentology, Fate of pollutants, Wildlife, Great River Environmental Action Team, Recreation, Habitats.

A comprehensive long-term resource monitoring program has been proposed to mitigate adverse environmental effects of human activities in the Upper Mississippi River area. The program will provide a solid foundation of scientific data within a totally integrated framework so that managers will have information on which to base decisions. This involves both coordination with existing programs and standardization of methods to promote system-wide comparisons. The goal is to plan ahead rather than react to each threat to the environment. Major problems facing this section of the river are upland erosion and sedimentation of aquatic habitats, point and nonpoint source pollution, navigation-related activities, and habitat encroachment. Monitoring efforts should involve land use, meteorology, hydrology and sedimentology, water and sediment, contaminants, aquatic vegetation, amphibians, birds, fish, mammals, and recreation. Of the monitoring alternatives suggested, Level II is recommended. This includes comprehensive and completely integrated monitoring in selected pools, certain routine measurements throughout the entire system, and special studies at sites of particular importance to the entire system and site involved in mitigation, enhancement, or habitat rehabilitation.
W86-03751

DESIGN OF A HYDROCHEMICAL DATA COLLECTION PROGRAMME,

Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
Y. Bachmat.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 153-165, 2 tab, 14 ref.

Descriptors: *Hydrologic data collections, *Data acquisition, *Data interpretation, *Decision making, *Network design, *Planning, *Economic aspects, *Resources management, Data collections, Management planning, Chemical properties, Design criteria.

Collection of hydrochemical data is considered in the context of producing data, which may be used for managing natural water resources and their interaction with the human-controlled environment. Imperfect data and/or misuse of information result in opportunity losses owing to suboptimal management decisions. The value of data is measured by their actual contribution to the reduction of risk associated with errors. This contribution can be increased by improving the utilization of existing data in the decision-making process and by the acquisition of new usable data. Both ways take time and require an investment of human and financial resources. An optimal data collection program is one which covers both the structural and non-structural aspects, is physically realizable and economically optimal in a space-time framework. The design of the program involves identifying information errors and quantifying their relationships to the associated losses and to the design parameters of the program. The problem of planning a hydrochemical data collection program is formulated and the hierarchical structure of the planning process is emphasized. Outlines of the feasibility study of the program and of the steps comprising the preliminary design of the observation network are given. The need to match the types of decisions to be made at the various phases of the planning process with the methods of arriving at the decisions is emphasized.
W86-03767

TEMPORAL CHANGES IN GROUND WATER QUALITY IN THE PHREATIC ZONE UTTAR PRADESH (INDIA) AND THEIR IMPACT ON SAMPLING SCHEDULE,

Central Chemical Lab., Lucknow (India).
For primary bibliographic entry see Field 2F.
W86-03768

RELIABILITY OF INFORMATION IN HYDROGEOCHEMICAL INVESTIGATIONS,

Akademiya Navuk BSSR, Minsk.
L. Babiy.
IN: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 179-185, 12 ref.

Descriptors: *Water sampling, *Geochemistry, *Hydrological data collections, *Data interpretation, *Errors, *Theoretical analysis, *Geohydrology, *Thermodynamics, Data collections, Hydrologic models, Statistical models, Statistical methods, Chemical properties.

The reliability of hydrogeochemical conclusions depends firstly on the quality of primary data. Errors in hydrochemistry are associated with the object of study (type of natural water and its location), the method of study (instruments and sample preparation) and by the quality of the investigation. The reliability of hydrogeochemical conclusions also depends on the methods of data interpretation used. Errors in interpreting statistical results occur when linear connections of a statistical model are identified with the natural situation. Investigations of stagnant waters should not be based on characterization by inorganic components alone since organic matter predominates in this type of water. Physical-chemical modelling, based on methods of equilibrium thermodynamics and allowing only for thermodynamic constants

for inorganic matter, provides only a qualitative characteristic of system development. The reliability of hydrogeochemical data is increased if silt, soil and pore waters are studied simultaneously with the various water types and if modern analytical methods of geophysical and other sciences are also applied.
W86-03769

CONDITIONS AND FREQUENCY OF SAMPLING FOR ELUCIDATIONS OF TRANSPORT MECHANISMS AND ELEMENT BUDGETS IN UPLAND DRAINAGE BASINS,

Aberdeen Univ. (Scotland). Dept. of Soil Science.
A. C. Edwards, J. Creasey, and M. S. Cresser.
In: Hydrochemical Balances of Freshwater Systems: Proceedings of the Uppsala Symposium, September 1984. IAHS-AISH Publication No 150, 1984. p 187-202, 10 fig, 4 tab, 19 ref.

Descriptors: *Water sampling, *Chemical properties, *Hydrologic data collection, *Storm runoff, *Seasonal variation, *Regression analysis, *Cycling nutrients, Sampling, Automation, Planning, Catchment areas, Data collections, Storm water, Weathering, Sulfur, Data interpretation, Leaching, Nitrogen.

Strategies appropriate for sampling geochemical weathering rates of two typical upland drainage basins in the Grampian Region of North East Scotland are discussed. When planning a sampling program for the study of factors influencing the solute composition of natural waters or for the estimation of the net inputs and outputs of species to and from drainage basins, it is particularly important to assure sufficient sampling frequency over the winter months. Seasonal trends in concentration are of considerable importance in studies involving N cycling, and to a lesser extent, sulfate-S cycling. Sampling before and after storms is important because storm events can greatly alter the concentrations of certain stream constituents through dilution or leaching during overland flow. Since increasing sampling frequency is often unfeasible, regression equations may be employed to relate concentration to discharge. For detailed studies of changes in solute composition with time through precipitation events, the variability of rainwater composition with time, and, for larger basins, over the catchment, should not be overlooked. The operation of a simple, inexpensive mechanical device for automatic fractionation of precipitation and drainage water samples throughout storm events is described.
W86-03770

SUBSURFACE INVESTIGATION FOR DREDGING PROJECTS,

Canonie Engineers, Chesterton, IN.
R. F. Brissette.
IN: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the 9th US/Japan Experts Meeting. March 1985. p 210-225, 5 fig, 1 tab, 3 ref.

Descriptors: *Dredging, Harbors, Test holes, Testing procedures, Tunnels, Tunneling, Channel improvement.

Dredging and tunnel projects have achieved considerable notoriety within the geotechnical community. On reviewing the history of many of these projects, it becomes apparent that the reputation arises not from a failure to adopt so-called 'state-of-the-art' technology, but rather a failure to organize investigations to address anticipated problems and to understand the significance of the data acquired. Even when these two elements are present, projects flounder when those charged with executing the work do not have a clear grasp of the engineering properties of the materials they are likely to encounter. As dredging techniques are more frequently being used to correct environmental problems, the techniques of investigation and data management will assume greater importance. The problems of establishing the types of data to be acquired, the extent of the data, and how it is to be used are still with us. Failure to address these problems rigorously results in excessive costs, unsatisfactory project results, and, in some cases, abandonment of projects altogether. Suggestions for methods to solve these problems are made. They include examination of the literature and of existing records, charting an investigative plan, and the appropriate use of laboratory analysis and geotechnical engineering. (Halterman-PTT)
W86-03881

7B. Data Acquisition

1981 CCOPE PROBE MESONET CALIBRATION AND MAINTENANCE PROCEDURES,

Montana Dept. of Natural Resources and Conservation, Helena.
L. Holman, and J. McInerney.
Technical Report, June 1983. 67 p, 11 fig, 6 tab, 5 ref, 3 append. 1-07-81-V0175.

Descriptors: *Measuring instruments, *Meteorological data collection, Data collection, Cooperative Convective Precipitation Experiment, Portable Remote Observation of the Environment mesonet, Calibration, Monitoring, Quality control, Wind, Temperature, Atmospheric pressure, Humidity, Precipitation, Maintenance.

Preparation and shutdown activities associated with the operation of the 1981 CCOPE (Cooperative Convective Precipitation Experiment) PROBE Mesonetwork involved testing and calibrating instruments to assure a quality data set. Data quality control was sought during all phases of the 1981 CCOPE PROBE Mesonetwork operations for wind speed, wind direction, temperature, pressure tendency, relative humidity, and precipitation instruments and for the electronic interfacing and transmission equipment. Testing of equipment began in August 1979 and continued through June 1982. Because of the prototype nature of the PROBE stations, many of the calibration procedures and techniques had not been thoroughly tested for operations in Montana. Subsequently, the further calibration and maintenance measures were at times by trial and error. Calibration and maintenance exhibited reasonable consideration for the many constraints encountered. As a result, the data quality for each parameter was generally good. Overall station performances were considered acceptable. (Author)
W86-03481

JOINT HYDROGEOLOGICAL SURVEYS,

GRW Engineers, Lexington, KY.
For primary bibliographic entry see Field 6E.
W86-03579

LOW COST HYDROLOGICAL DATA COLLECTION,

Institute of Hydrology, Wallingford (England).
I. Strangeways.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 229-233, 2 fig, 3 append.

Descriptors: *Data aquisition, *Measuring instruments, *Gages, *Data collection, *Hydrological data collections, Water level, Sensors, Rain gages.

Low-cost hydrological instruments, a rain gage and a water level sensor, were devised for use in developing countries. The rain gage, made by vacuum-forming, has improved aerodynamic properties and a stainless steel rim. Its improved logger uses microchips, single-pole plugs instead of multi-pin plugs, and a magnetic probe instead of toggle switches. The sensor for measuring groundwater level uses a simplified bubble technique. A small-bore plastic tube is left between the well's outer casing and the inner pumping tube, terminating in a tube connector at the well head. Air is compressed by a bicycle pump into the air reservoir. As the air escapes to the well via an adjustable valve, it displaces water in the sensing tube. Air pressure in the tube rises until it reaches a constant value. The pressure is then read and correlated with depth.
W86-03581

CONTINUOUS MONITORING OF RAINFALL, STREAMFLOW AND SUSPENDED SEDIMENT CONCENTRATION IN SEMIARID ENVIRONMENTS,

Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
A. Van, B. Weaver, and D. A. Hughes.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 363-371, 1 fig, 2 tab, 11 ref.

Descriptors: *Data acquisition, *Measuring instruments, *Semiarid lands, *Monitoring, Gages, *Suspended sediments, *Rainfall, *Streamflow, Computers, Rain gages, Stream gages, Sediments, Hydrologic data collections, Turbidity, Data collections, Data storage and retrieval, Ecca River, South Africa, Water level recorders, Weirs.

Hydrological instruments used in semiarid lands must be designed to measure extremely wide ranges of weather events and must be suitable for remote, rarely attended locations. Weather commonly develops rapidly and lasts a short time. For example, sediment concentrations in semiarid rivers have varied from 4 to 40 g per liter within 50 min, resulting from 15 mm of rain falling within 24 min. Good accuracy at high and low values and the ability to record at short intervals (10 min or less) is very important. Variable recording is also desirable. This provides high resolution recording during rapidly changing conditions and long recording intervals during slow or zero changing conditions. For remote stations, equipment should have sufficient storage capacity and power supply, be simple to operate, and avoid the conventional clockwork recording systems. A microcomputer recording system was tested in five small drainage basins in the Ecca River region of South Africa. Two tipping bucket rain gages with variable sampling frequency have performed without failure for 9 months. Tests on a float-type streamflow recorder were not conclusive. Weirs designed for flow measurement in semiarid regions can be compound (with a sharp crested V-notch for low flows) or deep and narrow throated flumes. Sediment concentrations are measured with a three-component system: turbidity sensor, water level sensor, and recording unit. Although the probe became clogged and the vegetal detrites deposited in the weir throat, calibration showed a strong linear relationship between turbidity meter readings and sediment concentration.
W86-03591

REMOTE SENSING APPLICATIONS IN AFRICAN EROSION AND SEDIMENTATION STUDIES,

Reading Univ. (England). Dept. of Geography.
A. C. Millington, and J. R. G. Townshend.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No. 144, 1984. p 373-384, 2 fig, 2 tab, 15 ref.

Descriptors: *Remote sensing, *Satellite technology, *Aerial photography, *Vegetation, *Erosion, *Sedimentation, Soil erosion, Maps, Landsat, Soil loss, Sierra Leone, Senegal, Africa, Photography, Semiarid lands, Arid lands.

Several types of remote sensing imagery (aerial photography, Landsat 1-3, Landsat 4, and SPOT) were evaluated for use identifying erosion and sedimentation in Africa. All these have been successfully used or are feasible in the applications mentioned: splash erosion, sheet wash, rilling, gullying, mass movement, channel and bank erosion, and sedimentation within channels and lakes/impoundments. Identification of erosion is a function of the scale of the process and pixel size, the height of the sensor platform, the wavelength of the imagery, and the amount of vegetative cover. Direct observation is easy in arid and semiarid regions but difficult in the humid tropical biomes. Two case studies were described. Multitemporal monitoring of sediment source areas using vegetation mapping from NOAA-7 AVHRR showed the movement of the greenwave northward with the onset of the rains and the subsequent progressive die-back with

the onset of the dry season. Changes in land use in Sierra Leone were monitored by high flight aerial photography.
W86-03592

MULTI-PARAMETER REMOTE MEASUREMENT OF RAINFALL,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W86-03618

INVESTIGATIONS OF LARGE SCALE STORM SYSTEMS: FINAL REPORT,
Air Force Geophysics Lab., Hanscom AFB, MA.
For primary bibliographic entry see Field 2B.
W86-03647

INVENTORY OF CANADIAN GLACIERS: PROCEDURES, TECHNIQUES, PROGRESS AND APPLICATIONS,
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 2C.
W86-03677

HYDROLOGICAL BASINS IN WEST GREENLAND AND THEIR RELATIONSHIP TO A PRELIMINARY SECTORIAL DIVISION OF THE INLAND ICE SHEET,
Groelands Geologiske Undersoegelse, Copenhagen (Denmark).
For primary bibliographic entry see Field 2C.
W86-03678

SOME PROBLEMS OF GLACIER INVENTORY IN THE HIMALAYAS,
For primary bibliographic entry see Field 2C.
W86-03680

PROBLEMS AND RESULTS OF STUDIES OF MOUNTAIN GLACIERS IN THE SOVIET UNION,
Akademiya Nauk SSSR, Moscow.
For primary bibliographic entry see Field 2C.
W86-03686

STUDIES OF GLACIER FLUCTUATIONS IN THE USSR,
For primary bibliographic entry see Field 2C.
W86-03687

SPECIAL PROBLEMS OF GLACIER INVENTORY IN AFGHANISTAN,
For primary bibliographic entry see Field 2C.
W86-03688

SOME COMMENTS ON THE SWISS GLACIER INVENTORY,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2C.
W86-03690

PROBLEM OF A GLACIER INVENTORY OF ANTARCTICA,
British Antarctic Survey, Cambridge (England).
For primary bibliographic entry see Field 2C.
W86-03693

PARAMETERIZATION OF GLACIER EQUILIBRIUM LINE ALTITUDE,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2C.
W86-03696

USE OF LANDSAT DIGITAL INFORMATION FOR ASSESSING GLACIER INVENTORY PARAMETERS,
Nebraska Univ. at Omaha. Remote Sensing Applications Lab.
For primary bibliographic entry see Field 2C.
W86-03702

SATELLITE IMAGE ATLAS OF GLACIERS,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2C.
W86-03703

DATA COLLECTION FOR HYDROCHEMICAL BALANCES: THEORETICAL ASPECTS,
Oslo Univ. (Norway). Inst. of Geophysics.
For primary bibliographic entry see Field 2A.
W86-03766

USE OF DIFFERENT PHYSICAL SEPARATION TECHNIQUES FOR TRACE ELEMENT SPECIATION STUDIES IN NATURAL WATERS,
Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-03771

HYDROMETEOROLOGICAL DATA ACQUISITION: INNOVATIVE, HIGH-RESOLUTION PROGRAMMABLE INSTRUMENTATION FOR STORMWATER MANAGEMENT,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
W. James, H. Haro, M. A. Robinson, D. Henry, and R. Kitai.
In: Proceedings of Stormwater and Water Quality Management Modeling Users Group Meeting, March 25-26, 1982, Washington, DC. EPA-600/9-82-015, August 1982. p 128-151, 10 fig, 2 tab, 9 ref.

Descriptors: *Rainfall intensity, *Data acquisition, *Stormwater management, Water management, Meteorological data collections, Computer applications, Hydrologic data collections.

This project compares new and existing instrumentation for sensing and recording rainfall intensity at a high time resolution. The data logger incorporates an audio cassette unit for data retrieval and a single chip microcomputer programmed to record appropriate time series data in compact form. The data on the retrieved cassettes is input and stored on removable hard-disc packs via a PDP 1123 microcomputer through a specially devised decoder, also incorporating a single chip microcomputer. Special interactive FORTRAN applications software on the 1123, processes the time series data files and plots hyetographs on a desk-top plotter. Sample input/output is provided. The entire system is designed to be inexpensive, for use in real-time control. The system is being extended to monitor water depth (discharges), temperature, conductivity and pH.
W86-03829

7C. Evaluation, Processing and Publication

MATHEMATICAL ANALYSIS OF GROUNDWATER RESOURCES,
Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-03478

EVALUATION OF COMMUNITY INFORMATION INDICES FOR MISSISSIPPI RIVER FISHERIES,
Oak Ridge National Lab., TN. Environmental Sciences Div.
H. N. Polovino, M. P. Farrell, and C. H. Pennington.
Available from the National Technical Information Service, Springfield, VA 22161 as DE83-002588. ORNL/TM-8272, Publication No. 1950, November 1982. 62 p, 21 fig, 6 tab, 45 ref. W-7405-eng-26.

Descriptors: *Fish populations, *Species composition, *Species diversity, *Dikes, *Stream fisheries, Fisheries, Fish management, Sampling, Ecology, Temporal distribution, Spatial distribution, Seasonal variation, Comparison studies, Evaluations.

Historically, quantitative species diversity indices have been used to assess spatial and temporal changes in ecological communities. However, other classification schemes, namely binary similarity coefficients and quantitative dissimilarity measures, offer alternative methodologies for delineating community composition that may offer less sampling error. The study evaluates the relative performance of binary similarity coefficients, dissimilarity measures, and diversity indices, calculated for three sampling methods, in detecting changes in fish communities associated with two dike fields on the Mississippi River. Dike field fish communities were studied for five discrete hydrologic seasons based on water temperature and flow velocities. Dike field fish cmmunities were found to be least similar during high-water, low-temperature conditions. Electroshocking proved to be the single most representative gear type when compared to hoop net and seine data. Of the three families of community information measures, binary similarity coefficients proved to be the most sensitive indicators of change in dike field fish communities. Measures based on species presence/absence represent a valid alternative method for characterizing compositional change in community structure. This is especially true when species abundance data are highly variable, which is the case in many fisheries assessments. (Geiger-PTT)
W86-03499

USE OF LOG-NORMAL STATISTICS IN ENVIRONMENTAL MONITORING,
R. B. Dean.
IN: Chemistry in Water Reuse: Volume 1, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by William J. Cooper. p 245-258, 7 fig, 3 tab, 15 ref.

Descriptors: *Data interpretation, *Pollutant identification, *Water analysis, *Statistical analysis, Log-normal distribution, Monitoring, Mathematical studies, Errors, Trace levels, Distribution patterns, Lake Tahoe.

Most real data obtained in analytical laboratories follow log-normal statistics. In order to make use of the most powerful statistics that are available the data should be transformed to logs. If log-normal data are treated as if they were normal, quite erroneous estimates of large deviations from the central value will be made. Conversely, if truly normal data are treated as log-normal, the errors will usually be small and conservative. One should justify in each case the use of normal statistics rather than log-normal on all data, such as concentrations, where values less than zero are impossible. (Author)
W86-03531

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1984,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W8o-03553

DIRECTORY OF MEMBER ORGANIZATIONS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10D.
W86-03557

HYDROGEOLOGICAL DATA COLLECTION, STORAGE, RETRIEVAL AND WATER LAW IN BOTSWANA,
Botswana Geological Survey, Lobatse.
M. Sekwale.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 221-228, 1 append.

Descriptors: *Data collections, *Hydrologic data collections, *Water law, *Data storage and retrieval, Botswana, Boreholes, Regulations, Permits.

Botswana has required borehole registration and submission of all relevant borehole data for a decade. This allows hydrogeological data collection at reduced cost to the government. To date, almost 10,000 boreholes have been registered. Relevant information, kept by the Department of Geological Survey, is available to the public. Four storage and retrieval systems exist: borehole completion certificate files, borehole location maps, lithological samples, and hydrochemical data. Computerized information manipulation saves time and allows for more detailed analyses. A copy of the borehole completion certificate is included.
W86-03580

USE OF THE DATA OF GLACIER INVENTORIES FOR COMPILATION OF THE WORLD ATLAS OF SNOW AND ICE RESOURCES,
Akademiya Nauk SSSR, Moscow.
For primary bibliographic entry see Field 2C.
W86-03701

STUDY OF THE SELECTION, CALIBRATION AND VERIFICATION OF MATHEMATICAL WATER QUALITY MODELS,
National Council of the Paper Industry for Air and Stream Improvement, Inc., Medford, MA.
For primary bibliographic entry see Field 5B.
W86-03823

8. ENGINEERING WORKS

8A. Structures

REVETMENT STABILITY STUDY, FORT FISHER STATE HISTORIC SITE, NORTH CAROLINA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. G. Markle.
Technical Report HL-82-26, November 1982. Final Report. 93 p, 6 fig, 1 tab, 54 photos, 10 plates, 1 append.

Descriptors: *Hydraulic models, *Model studies, *Design criteria, *Breakwaters, *Structural engineering, Models, Revetments, Hydraulic structures, Gabions, Stability analysis, Wave action, Sea walls.

A hydraulic model study was conducted using a two-dimensional stability model at an undistorted linear scale of 1:24 to develop both special- and random-placed armon-stone revetment designs that would be stable for specified storm conditions, to determine the stability response of all plans to depth-limited breaking waves, and to check the stabilities of the optimum designs when exposed to depth-limited breaking waves. Test results showed that 5,900-lb, special placed and 8,600-lb, random-placed armor stones would be stable for the depth-limited breaking wave conditions produced at the +10.7 still-water level. The 5,900-lb, special-placed armor-stone design was tested on revetments that had a 30-ft-wide gabion toe and a 14-ft-wide Sta Pod toe and proved to be stable for both cases. The 8,600-lb, random-placed armor-stone design was only tested on the revetment with the 30-ft-wide gabion toe. The 30-ft-wide toe included a six-row gabion blanket and the 14-ft-wide toe used 8.919 lb Sta Pods as buttressing on the outer sea-side toe. All of the acceptable designs showed slightly higher degrees of damage, but none of them failed when exposed to depth-limited breaking waves at the +13.0 and +15.0 still-water levels. None of the designs showed any additional stability problems when exposed to the depth-limited, breaking waves at the +8.0 and +5.0 still-water levels. (Geiger-PTT)
W86-03479

PRESENT AND POTENTIAL USE OF MICRO-HYDRO-ELECTRIC SCHEMES IN REMOTE LOCATIONS,
Lincoln Coll. (New Zealand). Tussock Grasslands and Mountain Lands Inst.
R. J. Blakely, and K. F. O'Connor.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-904687. Price codes: A03 in paper copy, A01 in microfiche. NZERDC--68, October 1981. 43 p, 16 fig, 11 tab, 20 ref, 4 append. 3173.

Descriptors: *Hydroelectric plants, *New Zealand, *Powerplants, Electric power, Electric power production, Farm management, Turbines, Steam turbines, Hydraulic turbines.

The renewal of interest in the potential farm-application of water turbines in New Zealand within the past five to ten years has led to the development of management plans by which the water resources of small catchments could be conserved and used for local micro-hydro-electric power generation. The results of research to survey the present use of very small hydro-electric power schemes in remote locations of New Zealand and to assess the demand for recently developed small scale systems in such areas are discussed. Results indicate that only 10% of the farmers with appropriate water bodies are using hydroelectric power. However, replies from government departments, tourist facilities, and other private users indicated a very high interest in future use of small-scale hydroelectric power generation. (Halterman-PTT)
W86-03505

8C. Hydraulic Machinery

SOLAR POWERED GROUNDWATER PUMPING FOR MEDIUM HEADS,
Ward (Peter) and Associates, Vancouver (British Columbia).
P. R. B. Ward, and W. G. Dunford.
IN: Challenges in African Hydrology and Water Resources: Proceedings of the Harare Symposium, July 1984. IAHS Publication No 144, 1984. p 249-258, 7 fig, 5 ref.

Descriptors: *Hydraulic machinery, *Pumps, *Solar energy, *Electrical equipment, Wells, Zimbabwe, Rural areas, Cavity pumps.

Solar-powered water pumps for remote locations in Zimbabwe have costs comparable to diesel-powered pumps. The electric-powered progressive cavity pump, already in use throughout Africa, is adaptable to solar power. Pumping requirements in this region of deep water tables and fractured crystalline rocks are 2.5 cu m per hour per 10-hour day at heads of 35-70 m. The pump uses a steel helical drive shaft turning in an outer rubber jacket and shaped in a double helix. It works with high efficiency at low speeds. It can pump water when working at a half or quarter of the design speed. With about 1 kW per sq m solar irradiation under conditions in Zimbabwe, 10.5 sq m of photovoltaic cells would be required to produce 2.5 cu m per hour of water at a head of 35 m. Use of a DC-DC converter can overcome the problem of obtaining sufficient torque to start the motor during periods of low radiation.
W86-03583

DISCHARGE FORECASTING FROM GLACIERIZED AREAS TO OPTIMIZE HYDROELECTRIC POWER MANAGEMENT,
Grande Dixence Societe Anonyme, Sion (Switzerland).
G. Dayer, and Y. Rey.
IN: Applied Climatology, Proceedings of the 25th International Geographical Congress Symposium No 18: Applied Geography, 1984. p 59-66, 2 fig, 4 tab, 22 ref.

Descriptors: *Runoff forecasting, *Snowmelt, *Model studies, Forecasting, Alpine regions, Glaciers, Ablation, Hydroelectric power.

High-head hydroelectric energy production in Switzerland derives its raw material essentially from snow and glacier meltwater, with water being stored in seasonal accumulation basins. Forecasting on both a long- and short-term basis is necessary to assess the probability of filling the basin. In this discussion, short-term (2-3 days) meltwater runoff is forecast in order to optimize pumping operations for the Grande Dixence S.A. power scheme, which is located in the pennine Alps. The prediction model uses the autoregressive moving average (ARMA) model techniques. A case study is presented in which the results of this method are applied to the Z'Mutt glacier's meltwater discharge. (Halterman-PTT)
W86-03848

8I. Fisheries Engineering

EVALUATION OF COMMUNITY INFORMATION INDICES FOR MISSISSIPPI RIVER FISHERIES,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 7C.
W86-03499

IMPOUNDED RIVERS: PERSPECTIVES FOR ECOLOGICAL MANAGEMENT,
Loughborough Univ. of Technology (England). Dept. of Geography.
For primary bibliographic entry see Field 6G.
W86-03516

PROCEDURE FOR DEVELOPING BIOLOGICAL INPUT FOR THE DESIGN, LOCATION, OR MODIFICATION OF WATER-INTAKE STRUCTURES,
Battelle Pacific Northwest Labs., Richland, WA.
D. A. Neitzel, and D. H. McKenzie.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-020946. Price codes: A05 in paper copy, A01 in microfiche. PNL-3688/UC-97e, December 1981. 83 p, 5 fig, 3 tab, 67 ref, 2 append. 14-16-0009-79 1401.

Descriptors: *Entrainment, *Fish ladders, *Design criteria, *Fish behavior, *Intake gates, Intakes, Environmental effects, Fish management, Shellfish, Ecological effects, Fish passages, Structural engineering, Structural models, Models.

The report reviews behavioral, physiological, and ecological literature of fish and shellfish. A compilation of data describing the relationship between environmental stimuli associated with water intake structures and behavioral and physiological responses of fish and shellfish is presented. The report set up a system to provide biological information for engineering models used to design, locate, or modify water intake structures. Examples of biological research that are potentially applicable to the design criteria presented are reviewed. The literature reviewed stresses the need for predictive laboratory studies and field verification studies for developing biological input into intake design and location. Two of the most important biological characteristics that need to be included in all research are ontological changes and the threshold limits of the species tested. As a fish or shellfish grows or develops, its response to stimuli will change. Biologists and engineers must understand this so biological data used related to the life stages of fish or shellfish most likely to be entrained or impinged. The threshold response of an organism to a stimulus must also be considered. The functions that relate the behavioral, physiological, and ecological information to the process of intake engineering must be developed and described. It will then be possible to describe the data requirements to develop further functions for biological characteristics of fish and shellfish relevant to the design, location, and operation of water intake structures. (Geiger-PTT)
W86-03519

AQUACULTURE IN DREDGED MATERIAL CONTAINMENT AREAS: PROCEEDINGS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.

For primary bibliographic entry see Field 2H.
W86-03704

SITE DESCRIPTION OF DREDGED MATERIAL CONTAINMENT AREAS: AN OVERVIEW OF PHYSICAL, CHEMICAL, BIOLOGICAL FEATURES,
Army Engineer District, Galveston, TX.
For primary bibliographic entry see Field 2H.
W86-03705

REVIEW OF SPECIES SUITABLE FOR CONTAINMENT SITE CULTURE (FRESH WATER),
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 2H.
W86-03706

POND MANAGEMENT: POLYCULTURE VS. MONOCULTURE,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 2H.
W86-03707

HEALTH AND DISEASE CONTROL FOR AQUATIC ANIMALS IN DREDGED MATERIAL CONTAINMENT SITES,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 5C.
W86-03709

POND DESIGN AND MANAGEMENT FOR COASTAL AQUACULTURE,
Alabama Dept. of Conservation and Natural Resources, Gulf Shores. Claude Peteet Mariculture Center.
For primary bibliographic entry see Field 2H.
W86-03710

MARICULTURE IN OLD RICE FIELD IMPOUNDMENTS: AN ANALOGY FOR DREDGED MATERIAL CONTAINMENT AREAS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2L.
W86-03711

DESIGN CRITERIA FOR AQUACULTURE PONDS ON DREDGED MATERIAL,
Soil Conservation Service, Washington, DC.
R. E. Highfill.
In: Aquaculture in Dredged Material Containment Areas: Proceedings, September 1982, Galveston, TX. Miscellaneous Paper D-83-2, October 1983. p 163-168, 3 tab, 2 ref.

Descriptors: *Ponds, *Dredging, *Aquaculture, *Aquatic habitats, *Fish ponds, *Fish farming, Lakes, Aquatic life, Aquatic animals, Design criteria, Spillways, Dams, Water depth.

Design criteria for aquaculture ponds constructed at dredged material sites are listed. The minimum elevation of the top of a pond embankment should be 1 ft above the water surface. The design height should also allow for wave action. Minimum embankment top widths depend on the height--6 ft wide for an embankment 10 ft or less in height, 15 ft wide for an embankment 35 ft or more in height. Spillways are necessary if runoff has no natural escape. Wells are the ideal water supply; the minimum rate should be 15-25 gal per min per surface acre. Depth depends on the species and climate. Most desirable depths in warm climates are as follows: channel catfish, 4-6 ft; crawfish, 1.5-2 ft; minnows and other bait fish, 4-6 ft; and trout, 3-5 for flowing water and 10-12 ft for still water. Extra depth should be allowed for ponds in cold climates. Pond bottoms should be smooth and sloped toward the outlet at a minimum of 2 ft per 100 ft.
W86-03713

AQUACULTURE AND DREDGED MATERIAL CONTAINMENT SITES: SIGNIFICANCE OF CONTAMINATED SEDIMENTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 5B.
W86-03714

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

ALGICIDES AND ALGAL MANAGEMENT AND CONTROL: BIBLIOGRAPHY,
Montana Univ., Missoula.
For primary bibliographic entry see Field 5G.
W86-03494

AQUACULTURE THESAURUS: DESCRIPTORS USED IN THE NATIONAL AQUACULTURE INFORMATION SYSTEM,
Virginia Inst. of Marine Science, Gloucester Point.
J. A. Lanier, F. L. Lawrence, E. V. Collins, and M. B. Hollinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB268-760, Price codes: A07 in paper copy, A01 in microfiche. Virginia Institute of Marine Science Special Scientific Report 79, 1977. National Oceanic and Atmospheric Administration, Rockville, MD. Office of Sea Grant. 145 p, 14 ref. SG-04-06-158-44047.

Descriptors: *Thesauri, *Aquaculture, *Indexing, Information retrieval, Descriptors, Subject indexing.

The Aquaculture Thesaurus consists of the descriptors used in entering material into the National Aquaculture Information System (NAIS). Terms have been arranged in a format similar to that used in the Thesaurus of Water Resources Terms published by the U.S. Department of the Interior. The National Aquaculture Information System provides computer assisted access to a broad range of information on growig marine, brackish and freshwater organisms.
W86-03643

10D. Specialized Information Center Services

DIRECTORY OF MEMBER ORGANIZATIONS OF THE NATIONAL WATER DATA EXCHANGE (NAWDEX),
Geological Survey, Reston, VA. Water Resources Div.
C. D. Blackwell.
USGS Open-File Report 84-469, 1983. 66 p.

Descriptors: Organizations, *Information exchange, Information systems, *NAWDEX membership, Directories, *Information retrieval, *Data collections, *Data storage and retrieval.

The National Water Data Exchange (NAWDEX) is a national confederation of water-oriented organizations working together to improve access to water data. It consists of member organizations from all sectors of the water-data community. This Directory provides the names, addresses, and telephone numbers of all NAWDEX member organizations and their designated NAWDEX representatives. (USGS)
W86-03557

PROCEEDINGS: 2ND ANNUAL GULF OF MEXICO INFORMATION TRANSFER MEETING.
Minerals Management Service, Metairie, LA. Gulf of Mexico OCS Regional Office.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-900198. Price codes: A06 in paper copy, A01 im microfiche. Held April 30 - May 1, 1981, New Orleans, LA. Technical Report No 81-5-T, November 1981. 108 p, 16 fig, 5 tab, 2 append.

Descriptors: *Gulf of Mexico, *Information exchange, Marine biology, Biological oceanography, Marine resources, Marine environment, Marine fisheries, Marine geology, Ecological effects, Economic aspects, Ecology.

The meeting discussed here was held in order to provide a forum for exchange of current data and information generated through environmental studies in the Gulf of Mexico. Topics discussed include: topographic features; effects of oil and gas activities on reef fish populations; assessment of the IXTOC oil spill damage; economic aspects of the IXTOC I spill and BURMA AGATE spill; geology studies; recreational fisheries investigations; marine ecological mapping projects; deep sea biology; polychaete studies; southwest Florida shelf ecosystems studies; satellite oceanography; southwest Florida shelf circulation; coastal ecological characterizations; and endangered species studies. (Halterman-PTT)
W86-03841

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES: PROCEEDINGS OF THE 9TH US/JAPAN EXPERTS MEETING.
Army Engineer Inst. for Water Resources, Fort Belvoir, VA.
For primary bibliographic entry see Field 5G.
W86-03867

10F. Preparation Of Reviews

MILITARY HYDROLOGY; REPORT 3: A REVIEW OF ARMY DOCTRINE ON MILITARY HYDROLOGY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. L. Stinson.
Miscellaneous Paper EL-79-6, June 1981. Report 3 of a Series. 62 p, 1 tab, 1 append. 4A762719AT40.

Descriptors: *Hydrology, *Military hydrology, *Documentation, *Surface water, *Subsurface water, Doctrine, Meteorology, Soil water, Streamflow, Water supply.

Military hydrology is a specialized area of study that deals with the characteristics of surface and subsurface water features that may affect the planning and conduct of military operations. A study was conducted to review Army doctrine on military hydrology to determine its relevance to modern Army needs. Documents were reviewed with respect to five thrust areas: (1) organization, (2) meteorology, (3) soil moisture, (4) streamflow, and (5) water supply. It was found that many of the documents reviewed, including Army Regulations, Field Manuals, Technical Bulletins, and Technical Manuals, incorporated doctrinal concepts and technologies of the 1950's. Recommendations were made including suggestions on what modern methodologies and doctrinal concepts should be adopted and what changes can be made to facilitate better understanding of the documents. (Author)
W86-03456

EVALUATION OF THE PUBLISHED LITERATURE IN THE WATER REUSE/RECYCLE AREA,
Versar, Inc., Springfield, VA.
For primary bibliographic entry see Field 3E.
W86-03521

REMOVAL OF VARIOUS TOXIC HEAVY METALS AND CYANIDE FROM WATER BY MEMBRANE PROCESSES,
Trace Metal Data Inst., El Paso, TX.
For primary bibliographic entry see Field 5D.
W86-03532

SEDIMENT YIELDS OF AFRICAN RIVERS,
Exeter Univ. (England).
For primary bibliographic entry see Field 2J.
W86-03584

LITERATURE SURVEY OF RESERVOIR CONTAMINANT PROBLEMS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5B.
W86-03623

POTENTIAL BIOLOGICAL IMPACTS OF NAVIGATION TRAFFIC,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W86-03645

SUBJECT INDEX

ACCUMULATION

Longitudinal Distribution of Trace Elements (As, Cd, Cr, Hg, Pb, and Se) in Fishes and Sediments in the Upper Mississippi River,
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ACID-MINE WATER

Hydrology of Area 1, Eastern Coal Province, Pennsylvania,
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Physico-Chemical Characteristics of Surface Waters and Hydrological Behavior of a Small Granitic Basin (Vosges Massif, France): Annual and Daily Variations,
W86-03775 5B

Water Quality and Water Pollution Problems on the Indian Sub-Continent,
W86-03781 5B

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Hydrochemical Budgets of Some Dutch Woodland Soils with High Inputs of Atmospheric Acid Deposition: Mobilization of Aluminum,
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Full Scale Experience with Activated Carbon Treatment of Joint Municipal - Industrial Wastewater,
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W86-03445 3D

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SELECTED WATER RESOURCES ABSTRACTS

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

VOLUME 19, NUMBER 10
OCTOBER 1986

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 10
OCTOBER 1986

W86-03901 -- W86-04681

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 **WATER CYCLE**

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 **WATER SUPPLY AUGMENTATION AND CONSERVATION**

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 **WATER QUANTITY MANAGEMENT AND CONTROL**

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 **WATER QUALITY MANAGEMENT AND PROTECTION**

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 **WATER RESOURCES PLANNING**

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 **RESOURCES DATA**

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 **ENGINEERING WORKS**

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICO-CHEMICAL DATA AND MICROSCOPICAL OBSERVATIONS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2K.
W86-04125

2. WATER CYCLE

2A. General

PRELIMINARY ESTIMATION OF NATURAL RUNOFF IN THE HUAI HE BASIN,
Academia Sinica, Beijing (China). Inst. of Geography.
T. Qicheng, C. Tianwen, and L. Lukai.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 245-255, 3 fig, 3 tab, 5 ref.

Descriptors: *Water transfer, *Diversion, *Water supply, *Water use, *Runoff, *China, Annual runoff, Runoff volume, Canals, Water supply development.

As part of the evaluation of the proposed south-north water transfer project in eastern China, the runoff in the Huai He Basin was estimated. The general characteristics of the basin, the average annual precipitation, and the average annual evapotranspiration, are provided as background information, and as part of the calculations. The average annual volume of natural runoff was calculated to be 35.08 cu km. (Halterman - PTT)
W86-03935

ATMOSPHERIC MOISTURE BALANCE IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
S. Jianzhu, W. Yonglian, Z. Changduo, and Q. Geng.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 333-350, 9 fig, 3 tab, 9 ref.

Descriptors: *Water transfer, *Water supply, *Meteorology, *Precipitation, *China, Water supply development, Diversion, Canals, Irrigation, Environmental effects, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, meteorological data from May and July, 1969-1973, were used to make some rough estimates of atmospheric water vapour content and transport, the moisture cycle and the possible change in precipitation in the region which would be affected. There are large year-to-year variations in depth in precipitable water and water vapour transport value. On the average, 11 to 25 percent of precipitation is formed by water vapour from local evaporation. There is year-to-year variation in the effect of the endogenous cycle which causes a higher percentage of total precipitation in a dry year than in a wet year. The average increase in precipitation during May would be about 3 percent. (Halterman - PTT)
W86-03942

CONSIDERATIONS FOR DEVELOPMENT OF A BASIN MODEL FOR BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
M. S. K. Chowdhury, and A. Nishat.
IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 62-68, 1 fig, 9 ref.

Descriptors: *Planning, *Hydrologic models, *River basins, *Model studies, *Bangladesh, Water management, Water resources development, Mathematical models, Political constraints.

Requirements for a mathematical model to use in planning a river basin model for Bangladesh are presented. Conditions peculiar to this region are the three river systems (Ganges, Brahmaputra, and Meghna), extreme flatness of the landscape, uneven rainfall distribution, and political problems. (Cassar - PTT)
W86-03961

CONTRIBUTION OF ISOTOPE TECHNIQUES IN THE DETERMINATION OF THE RELATIONSHIP SURFACE WATER/GROUNDWATER IN BANGLADESH (GANGES AND BRAHMAPUTRA AREAS),
International Atomic Energy Agency, Vienna (Austria).
M. Dray.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 158-170, 7 fig.

Descriptors: *Surface-groundwater relationships, *Recharge, *Groundwater movement, *Geochemistry, *Isotope studies, *River basins, Ganges River, Brahmaputra River, Bangladesh, Tritium, Water level, Radioisotopes.

Isotopes studies of the rivers of Bangladesh (Ganges and Brahmaputra) showed that the Ganges does not have rapid interaction with groundwater with respect to the water transfer, as shown by very different chemistry and isotope contents. Nevertheless, the Ganges has an important role in minimizing water table fluctuation by ensuring the base level. During flooding the Ganges groundwater recharge exists by is very slow. The Karatoya-Atrai River in the north behaves similarly to the Ganges. However, the Brahmaputra system surface water and groundwater are remarkably similar. This difference in behavior as compared with the Ganges is related to different particle size and permeability of alluvial deposits, which are probably coarser in the Brahmaputra River bed. Here tritium is found in wells of 250-ft depth, whereas in the Ganges area wells of 100-ft depth are tritium free. (Cassar-PTT)
W86-03969

GROUND-WATER MODELS, VOLUME I: CONCEPTS, PROBLEMS, AND METHODS OF ANALYSIS WITH EXAMPLES OF THEIR APPLICATION.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 2F.
W86-03974

APPLICABILITY OF MODELS TO ALLUVIAL VALLEYS: ARKANSAS RIVER VALLEY, COLORADO, U.S.A.,
Geological Survey, Reston, VA.
L. F. Konikow, and J. D. Bredehoeft.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 27-37, 6 fig, 2 tab, 12 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, *Rivers, Arkansas River, Colorado, Alluvial rivers, Irrigation effects.

The complex hydrologic and water quality variations that exist in an irrigated alluvial stream-aquifer system can be simulated with a digital simulation model that couples a finite-difference technique, used to solve the flow equation with the method of characteristics, used to solve the solute-transport equation. This modeling technique was successfully applied to an 18-km reach of the Arkansas River valley in southeastern Colorado for a 1-year period. The simulation results greatly aided the understanding of hydrologic and water quality variations within this area and their relations to irrigation practices. Changes in the dissolved solid concentration of groundwater were predominantly controlled by convective transport and by mixing with recharged water of different quality. In this simulation the influence of hydrodynamic dispersion was relatively minor. Once calibrated, the model can be used to predict future trends and the effects of changes in water management practices on the quality and quantity of ground and surface water. Analysis of the predictive tests for the study area indicated that initial or short-term responses to changes in irrigation practices are strongly related to antecedent conditions, and do not necessarily reflect actual long-term responses to these changes. (Author's abstract)
W86-03975

MODEL ANALYSIS OF GROUND WATER IN THE SAN LUIS VALLEY, COLORADO, U.S.A.,
Geological Survey, Louisville, KY.
P. A. Emergy.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with examples of their Application, The UNESCO Press: Paris, France, 1982. p 53-66, 9 fig, 8 ref.

Descriptors: *Hydrologic models, *Groundwater, *Rivers, *Model studies, San Luis Valley, Rio Grande River, Conejos River, Colorado, Water loss.

A three-layer analog model of the San Luis Valley, Colorado, was used to simulate the groundwater reservoir of the Rio Grande and Conejos River. Several conclusions were developed. (1) The source of more than one-half the water withdrawn from the confined aquifer by large-capacity wells in 1950-1970 was water in storage and evapotranspiration salvage in the unconfined aquifer. (2) During this time withdrawal by large-capacity wells in the confined aquifer depleted the total flow of the Conejos River by 270 million cu m. If more groundwater and less surface water were used, additional water could be salvaged from evapotranspiration. For example, doubling the 1970 rate of withdrawal by large-capacity wells in the confined aquifer would result in the salvaging from evapotranspiration of an additional 185 million cu m of water during the first 10 years. If withdrawal rates were held constant, a new equilibrium would eventually be established and all withdrawn would be derived from salvaged evapotranspiration and streamflow. (Cassar - PTT)
W86-03977

AQUIFER OF ULLUM-ZONDA VALLEY (ARGENTINA),
United Nations, New York.
For primary bibliographic entry see Field 2F.
W86-03978

ASSESSMENT OF EXPLOITABLE GROUNDWATER RESOURCES OF THE SOKH DEBRIS CONES,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-03980

ASSESSMENT OF EXPLOITABLE GROUNDWATER RESOURCES IN FISSURED-KARSTIC FORMATIONS IN THE SERGA RIVER VALLEY (SERGINSKOE AQUIFER, URAL),
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
L. S. Yazvin, and I. I. Krashin.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 137-142, 3 fig, 1 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, Serga River, USSR, Serginskoe aquifer, Karst, Surface-groundwater relations, Aquifers, Wells, Recharge.

Groundwater resources were studied in karstic formations of the Serga River Valley, USSR. The Serginskoe aquifer, on the western slope of the Ural Mountains, supplied a highly developed industrial area with a dense population. Although the Serga River is polluted and unsuitable for drinking water, it serves as recharge to the aquifer. Model predictions showed optimum well locations and pumping rates. Calculations showed that during the January-February period of low water, discharge of Groundwater from both aquifers to the Serginskoe takes place. In March the groundwater discharge is equal to the low water discharge of the river. In the flood period, when part of the valley is filled with water, a sharp increase of infiltration to the aquifer from the Serga River takes place. This water recharges the alluvium. At the end of the flood period infiltration from the river decreases and a portion of the storage in the alluvium is discharged. Later this discharge ceases, and infiltration from the Serga River is maintained until the end of the period of high waters. (Cassar - PTT)
W86-03986

ESTIMATION OF EXPLOITABLE RESOURCES OF A MULTILAYERED WATER-BEARING SYSTEM IN THE SOUTH-WESTERN PART OF THE DNEPROVO-DONETSKY ARTESIAN BASIN,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
B. V. Borevsky, and I. I. Krashin.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 177-182, 2 fig, 2 ref.

Descriptors: *Hydrologic models, *Model studies, *Groundwater, *Recharge, Groundwater recharge, Kiev, USSR, Aquifers, Dneprovo-Donetsky basin, Artesian basins.

The multilayered aquifers in the Dnieper River basin in the area of Kiev, USSR, were characterized by model studies. The total balance of exploitable groundwater resources was established for the principal aquifers. The main sources replenishing these resources are surface runoff and water from the overlying aquifers. Elastic resources play a more or less important role only during a relatively short period of time after withdrawals are increased. In particular, with a sharp increase of the water intake capacity (5 times as high as the existing capacity), the withdrawal will be provided from elastic resources in the initial period discharge from the Cenomanian-Callovian aquifer complex (20%) and from the middle Jurassic aquifer (80%). However, after 10 years of exploitation, almost all the water withdrawn from the Cenomanian-Callovian aquifer and 70% of the water withdrawn from the Jurassic aquifer are derived from recharge. (Cassar - PTT)
W86-03990

DIAGNOSTIC HYDROLOGY,

Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
R. J. M. de Wiest.
Ground Water GRWAAP, Vol. 24, No.3, p 332-341, May-June 1986. 10 fig, 2 tab, 12 ref.

Descriptors: *Surface-groundwater relations, *Hydrologic properties, *Diagnostic methods, Pumping, Groundwater movement, Aquifers, Recharge, Basins, Hydrographs, Runoff, North Carolina, Ramona, California.

The paper examines two cases of surface water/groundwater interrelationships, one in Beaufort County, North Carolina and one in Ramona, California. Differential diagnoses are made between alternate solutions rendered by hydrologic methods. In the first case, it is proven that the pumping and subsequent wastage to the ocean of 65 mgd in order to operate the Texas Gulf Sulphur phosphate mine, poses no threat to the environment. In the second case, attempts were made to obtain, by means of the theory of groundwater flow, an estimate of the physiographic volume of the Santa Maria creek groundwater basin in Ramona. The outcome of these calculations have been submitted to test the compatibility with the results of an actual pumping test, and with pumping records made available by the Ramona Municipal Water District. Results show a water storage capacity on the order of 4,600 AF for the entire basin. In order to correlate recharge of the basin directly with the precipitation on the basin, a hydrograph analysis has been done for the 20 largest runoff-producing months of the streamflow records 1965-1982. From this study it follows that the average (annual) recharge to the basin is of the order of 1,340 AF/yr and that the physiographic volume, as derived previously, is amply adequate to absorb this recharge. (Lantz-PTT)
W86-04277

MOMENTS OF CATCHMENT STORM AREA,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
W. Ainliang.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1185-1194, August 1985. 8 fig, 1 tab, 14 ref, NSF Grant No. ATM-8114723, NASA Grant No. NAG 5-388.

Descriptors: *Rainfall-runoff relationships, *Spatial distribution, *Catchment areas, *Models, *Rainstorms, Precipitation, Mathematical models, Mathematical studies, Flood frequency, Storm runoff.

The portion of a catchment covered by a stationary rainstorm is modeled by the common area of two overlapping circles. Given that rain occurs within the catchment and conditioned by fixed storm and catchment sizes, the first two moments of the distribution of the common area are derived from purely geometrical considerations. The variance of the wetted fraction is shown to peak when the catchment size is equal to the size of the predominant storm. The conditioning on storm size is removed by assuming a probability distribution based upon the observed fractal behavior of cloud and rainstorm areas. (Author's abstract)
W86-04316

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 1. THEORY,

Geological Survey, Denver, CO.
B. M. Troutman.
Water Resources Research, Vol. 21, No. 8, p 1195-1213, August 1985. 78 ref.

Descriptors: *Error analysis, *Runoff, *Rainfall-runoff relationships, *Hydrologic models, *Mathematical studies, *Statistical analysis, Statistical methods, Models, Mathematical models, Precipitation, Prediction, Regression analysis, Flood frequency.

Errors in complex conceptual precipitation-runoff models may be analyzed by placing them into a statistical framework. This amounts to treating the errors as random variables and defining the probabilistic structure of the errors. By using such a framework, a large aray of techniques, many of which have been presented in the statistical literature, becomes available to the modeler for quantifying and analyzing the various sources of error. A number of these techniques are reviewed in this paper, with special attention to the peculiarities of hydrologic models. Known methodologies for parameter estimation (calibration) are particularly applicable for obtaining physically meaningful estimates and for explaining how bias in runoff prediction caused by model error and input error may contribute to bias in parameter estimation. (Author's abstract)
W86-04317

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 2. CASE STUDY,

Geological Survey, Denver, CO.
B. M. Troutman.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1214-1222, August 1985. 6 fig, 20 tab, 4 ref.

Descriptors: *Case studies, *Storm runoff, *Models, *Error analysis, *Rainfall-runoff relationships, Sensitivity analysis, Hydrologic models, Model studies, Mathematical models, Mathematical studies, Runoff.

Errors in daily-mode and storm-mode runoff predictions given by the U.S. Geological Survey precipitation-runoff modeling system are examined for a 28-month data set from Blue Creek in Alabama. Several error measures are compared, and in some cases, error measures computed after a logarithmic transformation on runoff predictions may be more representative of model performance. By use of a split sample validation period, various calibration methods are compared. It was shown that maximum-likelihood-based procedures that are derived from the error structure exhibited by model predictions usually yield better parameter estimates. Sensitivity analyses are employed to aid in selecting parameters for calibration and computing estimates of uncertainty in calibration results. Leverage of individual values on calibration results is examined using influence statistics. Residual plots are shown to be very useful in identifying error structure and in interpreting calibrations. It is concluded, that, in general, the various tools presented in the statistical regression literature are valuable in interpreting errors in modeling and in determining appropriate calibration strategies. (Geiger-PTT)
W86-04318

WATER BALANCE OF LAKE VICTORIA,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2H.
W86-04386

OPERATIONAL TESTING OF HYDROLOGICAL SIMULATION MODELS,

National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W86-04391

VARIABILITY OF PESTICIDE LOADS TO SURFACE WATERS,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W86-04491

DIURNAL MIXED LAYER,

Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W86-04510

PERIODIC AUTOREGRESSIVE-MOVING AVERAGE (PARMA) MODELING WITH APPLICATIONS TO WATER RESOURCES,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W86-04529

FOURIER INFERENCE: SOME METHODS FOR THE ANALYSIS OF ARRAY AND NON-GAUSSIAN SERIES DATA,

California Univ., Berkeley. Dept. of Statistics.
For primary bibliographic entry see Field 7C.
W86-04530

BAYESIAN MODELS OF FORECASTED TIME SERIES,

Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 805-814, October 1985. 7 fig, 24 ref. NFS

CEE-8300928.

Descriptors: *Snowmelt, *Runoff, *Forecasting, *Markov processes, *Time series analysis, *Statistical methods, Mathematical models, Runoff forecasting.

Bayesian Processor of forecasts (BPF) combines a prior distribution, which describes the natural uncertainly about the realization of a hydrologic process, with a likelihood function, which describes the uncertainty in categorical forecasts of that process, and outputs a posterior distribution of the process, conditional upon the forecasts. The posterior distribution provides a means of incorporating uncertain forecasts into optimal decision models. In this paper fundamentals of building BPF of time series are presented. They include a general formulation, stochastic independence assumptions and their interpretation computationally tractable models for forecasts of an independent process and a first-order Markov process, and parametric representations for normal-linear processes. An example is shown of an application to the annual time series of seasonal snowmelt runoff volume forecasts. To make rational decisions and to derive the full economic benefit from uncertain forecasts, the decision maker needs a parsimonious description of forecast uncertainty. The concept of BPF offers a framework for obtaining such a description in the form of posterior distributions. (Rochester-PTT)
W86-04532

2B. Precipitation

MODEL ANALYSIS OF GROUND WATER IN THE SAN LUIS VALLEY, COLORADO, U.S.A.,

Geological Survey, Louisville, KY.
For primary bibliographic entry see Field 2A.
W86-03977

CHEMICAL TRANSFORMATIONS IN GROUNDWATER,

SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
W. R. Mabey, and T. Mill.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 61-64, 3 tab, 17 ref.

Descriptors: *Groundwater pollution, *Chemical transformation, *Chemical analysis, Chemical degradation, Groundwater, Groundwater movement, Transformation.

The presence of chemicals in groundwater is of concern because groundwater is the major source of drinking water for 70% of the US population. Unlike chemicals in surface waters that are effectively removed via natural or treatment processes and are readily sampled to monitor concentrations, chemicals in the unsaturated region and in groundwater will be a source of chemicals for many years because they move slowly and are not accessible for economical short term remedies. Therefore, understanding how fast the chemicals move in groundwater and the transformation reactions that may alleviate or create problems posed by the chemicals is important for future planning of groundwater use. The ability to predict the rates of various transformation processes in groundwater will assist in explaining the persistence or absence of chemicals in these systems, and in guiding future studies as to which properties should be measured and which chemical species (especially products) should be sought in future studies. This paper reviews the chemical transformation processes that may be important for transforming some anthropogenic chemicals in groundwater. (Author's abstract)
W86-04057

CLIMATOLOGICAL VARIABILITY,

Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W86-04140

STOCHASTIC MODELING OF THE SPACE-TIME STRUCTURE OF ATMOSPHERIC CHEMICAL DEPOSITION,

Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 5B.
W86-04171

KINETICS OF ALUMINUM FLUORIDE COMPLEXATION IN ACIDIC WATERS,

Maine Univ. at Orono. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04226

STOCHASTIC DYNAMICS OF PRECIPITATION: AN EXAMPLE,

Toronto Univ. (Ontario). Dept. of Physics.
H.-R. Cho.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1225-1232, August 1985. 5 fig, 7 ref.

Descriptors: *Precipitation, *Stochastic hydrology, *Cyclonic precipitation, *Rainfall distribution, *Mathematical models, Stochastic process, Air temperature, Mathematical studies, Cyclones, Model studies, Models.

An example is developed to illustrate how atmospheric dynamics may naturally lead to stochastic behavior in precipitation. Due to a process in the atmosphere known as scale contraction, large fluctuations in precipitation may be induced by small mesoscale inhomogeneities in the initial temperature field. During the development of a mid-latitude cyclone, scale contraction occurs naturally over the cyclonic region of the the system. The rate of contraction is determined by the rate of growth of the baroclinic wave. With such a contration imposed at the large scale, it is expected that small mesoscale temperature modifications will be able to induce additional mesoscale ageostrophic features. A three-dimensional numerical model simulating the growth of a baroclinic wave has been used to study this effect. Results of these simulations show that small temperature perturbations of the order of a few Kelvin at the mesoscale can induce, during the growth of a baroclinic wave, strong mesoscale ageostrophic flow which may cause the formation of rainbands. The degree of randomness in precipitation distribution may be considerably amplified if latent heating effect is included in the models. (Geiger-PTT)
W86-04319

GENERALIZED SCALE INVARIANCE IN THE ATMOSPHERE AND FRACTAL MODELS OF RAIN,

Etablissement d'Etudes et de Recherches Meteorologiques, Paris (France).
S. Lovejoy, and D. Schertzer.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1233-1240, August 1985. 11 fig, 1 tab, 43 ref. CNRS No. ATP-RA(84) 16.

Descriptors: *Rain, *Precipitation, *Coriolis force, *Mathematical models, *Model studies, *Stochastic hydrology, Mathematical studies, Probability distribution, Rainfall, Clouds, Simulation analysis, Theoretical analysis.

By developing previous work on scaling and intermittency in the atmosphere, the scope of rain models can be greatly extended. While the atmosphere cannot be self-similar, it does obey a related symmetry principle called generalized scale invariance in which the relationship between small-scale and large-scale structures involves not only magnification but also differential rotation and stratification. On the other hand, the richness of atmospheric structures and the phenomenology of sudden changes (intermittency) require that fluctuations be very strong or hyperbolic in form. These theories were illustrated in the fractal sums of pulses process (FSP) which models the rain field by a hierarchy of simple pulse shapes, and by the scaling cluster of pulses process (SCP) in which the pulse centers are clustered so that the basic element may be regarded as a complex (fractal) pulse. The SCP gave closer agreement with the measured fractal parameters of rain and served as a crude model of mid-latitude cyclones. The FSP process was used to illustrate both the horizontal stratification of rain and the differential rotation associated with the Coriolis force; simulations were visually realistic and could display the perpendicularity of the large- and small-scale structures visible in many real cloud photographs. A numerical procedure was also developed which enabled fractal dimensions to be accurately calculated. The question of multidimensionality was considered along with future developments. (Geiger-PTT))
W86-04320

PARAMETER ESTIMATION FOR A MODEL OF SPACE-TIME RAINFALL,

Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and A. F. Karr.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1251-1257, August 1985. 1 fig, 3 tab, 15 ref, append.

Descriptors: *Model studies, *Rainfall, *Mathematical models, *Spatial distribution, *Temporal distribution, Rainstorms, Models, Mathematical models, Hydrologic models, Rain gages, Networks, Mathematical studies, Numerical analysis, Data collections.

Parameter estimation procedures, based on data from a network of rainfall gages, are developed for a class of space-time rainfall models. The models, which are designed to represent the spatial distribution of daily rainfall, have three components, one that governs the temporal occurrence of storms, a second that distributes rain cells spatially for a given storm, and a third that determines the rainfall pattern within a rain cell. Maximum likelihood and method of moments procedures are developed and limitations on model structure that are imposed by restricting data sources to rain gage networks are illustrated. The estimation procedures are applied to a 240 sq mi catchment in the Potamac River basin. The problems described for circular rain cells of fixed radius will be more acute for models which accomodate additional structure such as elliptical rain cells or cells with varying radii. While both estimation procedures can be implemented, the method of moments procedure requires substantially less computational effort than the maximum likelihood procedure. Numerical results emphasize the role of spatial scale in model development. Topographically induced inhomogeneities should also play a major role in determining the appropriate scale or formulation of space-time rainfall models. (Geiger-PTT)
W86-04321

APPROXIMATIONS OF TEMPORAL RAINFALL FROM A MULTIDIMENSIONAL MODEL,

Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. B. Valdes, I. Rodriquez-Iturbe, and V. K. Gupta.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1259-1270, August 1985. 7 fig, 4 tab, 13 ref. Army Research Office Grant No. 21078-GS.

Descriptors: *Temporal distribution, *Rainfall, *Models, *Rainfall intensity, *Simulation analysis, Numerical analysis, Mathematical models, Statistical methods, Mathematical studies, Model studies.

The feasibility of representing the temporal structures of a multidimensional rainfall process with simpler stochastic models and a study of the effect of parameter robustness on the time scale is studied by use of controlled numerical experiments. A multidimensional representation for precipitation is used to simulate rainfall in space and time. Two-year traces of rainfall intensities at fixed gage stations were generated at 0.1 hr intervals for three climates. These traces are then aggregated at different time scales ranging from 1 to 24 hr. First and second-order statistics are examined from the series at each aggregation level and are used for estimating the parameters of three one-dimensional models of temporal rainfall at a point: Poisson model with independent marks, rectangular pulses

with independent intensity and duration, and Neyman-Scott with independent marks. The compound Poisson model was able to reproduce the statistical structure of the simulated traces only at very high levels of aggregation. The rectangular pulses model had parameters which varied significantly with the time scale of aggregation and caused large distortions in the mean depth and duration of storm events. The Neyman-Scott model was the most stable model throughout the different time scales, and it also reproduced quite well the average storm characteristics at the event level. None of these three models gave a satisfactory reproduction of the simulated extreme value distribution of the multidimensional model. (Geiger-PTT)
W86-04322

SCALING LIMITS AND SELF-SIMILARITY IN PRECIPITATION FIELDS,

Oregon State Univ., Corvallis. Dept. of Mathematics.
E. Waymire.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1271-1281, August 1985. 1 fig, 51 ref. NSF Grant No. CEE-830864.

Descriptors: *Precipitation, *Hydrologic models, *Model studies, Mathematical studies, Mathematical models, Probabilistic process, Stochastic process.

In the literature on rainfall hydrological models, the exact calculations of probabilities for models incorporating cluster structure are typically not possible. Consequently, limiting approximations are often used that involve some important issues for both theoretical as well as experimental considerations in precipitation research. The present paper systematically describes these issues as they pertain to rainfall models. Some specific large-scale approximations are given for Poisson and compound Poisson models, double stochastic Poisson models, rectangular pulse models, Neyman-Scott models, and space-time models. Two different conceptual approaches for obtaining representations at the coarser scale are also discussed. (Geiger-PTT)
W86-04323

NEW APPROACH FOR INSTANTANEOUS RAIN AREA DELINEATION IN THE MIDLATITUDES USING GOES DATA,

Atmospheric Environment Service, Downsview (Ontario).
A. A. Tsonis, and G. A. Isaac.
Journal of Climate and Applied Meteorology, Vol. 24, No. 11, p 1208-1213, November, 1985. 9 fig, 4 tab, 18 ref.

Descriptors: *Satellite technology, *Rainfall area, *Rainfall distribution *Infrared imagery, *Radar, Cloud physics, Mathematical studies, Models, Prediction, Temperate zone, Remote sensing, Convective precipitation.

A new approach is presented for instantaneous rain area delineation in the midlatitudes using GOES visible and infrared data. In the first part of the method, a technique for the differentiation between raining and nonraining clouds is developed based on the location of peaks in the visible/infrared domain. In the second part, a scheme which delineates the rain area is presented. Use of the approach showed that during daylight, the visible image contains more information about rainfall than does the infrared image in the midlatitudes. However, in some instances, the infrared data are useful in differentiating between raining and nonraining clouds that give similar responses. The scheme was found to be very satisfactory in delineating the instantaneous rain area in convective cases, suggesting that the method could also be used in the tropics. When convective and nonconvective cases are considered, the resulting average probability of detection was about 66% and the false alarm ratio was about 37%. (Geiger-PTT)
W86-04325

RADIOMETRIC OBSERVATIONS OF SUPERCOOLED LIQUID WATER WITHIN A SPLIT FRONT OVER THE SIERRA NEVADA,

Bureau of Reclamation, Auburn, CA. Auburn-Folsom South Unit.
M. F. Heggli, and D. W. Reynolds.
Journal of Climate and Applied Meteorology, Vol. 24, No.11, p 1258-1261, November, 1985. 3 fig, 5 ref.

Descriptors: *Cloud seeding, *Sierra Nevada, *Clouds, *Weather modification, *Artificial precipitation, Radiometry, Precipitation, Ice, Storms, Artificial storms, Models, Model studies, Radar, California, Katafront, Supercooled liquid water, Water supply development.

A storm bearing close structural resemblance to a katafront was observed from the ground with a microwave radiometry and a vertically pointing Ka-band radar over the Sierra Nevada of California to study opportunities for precipitation enhancement. The onset and duration of supercooled liquid water (SLW) was determined and matched to a split front model used to describe the synoptic features of a katafront. Previous studies show a tendency for SLW to be in shallow clouds where low level moisture fields appear to show the greatest potential for cloud seeding. Results indicate that prior to the passage of the upper front no SLW was observed. This portion of the storm provided the deepest clouds and coldest cloud tops. SLW was most prevalent after the upper front passage, and persisted until the suspected surface front passage. The duration of the measured SLW was 16 hr. Future studies will attempt to assess the amount of SLW that constitutes a seedable situation and the seeding strategy to be used to extract this water effectively in order to increase the region's water supply. (Geiger-PTT)
W86-04326

CHARACTERISTICS OF THUNDERSTORMS IN ZARIA, NIGERIA,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Geography.
E. O. Oladipo, and M. E. Mornu.
Weather WTHRAL, Vol. 40, No. 10, p 316-322, October 1985. 4 fig, 1 tab, 9.

Descriptors: *Diurnal distributions, *Thunderstorms, *Nigeria, *Afternoon evening thunderstorm regime, *Monthly variation, Conditional instability, Weather mechanisms, Squall lines, Rainfall distribution, Weather patterns, Convection, Tropical regions, Zaria, Nigeria.

Monthly variation, diurnal variation, and thunderstorm-day and rain-day events in the vicinity of Zaria, Nigeria, were analyzed. The results of the diurnal variation analysis indicate that the thunderstorm regime is an 'afternoon evening' type. Explanations for the afternoon-evening nature of thunderstorms over a continental zone such as Zaria are complex. No single hypothesis is capable of explaining the evening maximum thunderstorm activity over Zaria. An explanation is suggested here in which conditional instability, which is nearly always present in the tropics, combines with a diurnal cycle of convection to produce thunderstorms. The timing of convection of Zaria is controlled principally by the passage of disturbance lines or squall lines. With the passage of a disturbance line, there is always a sharp decrease in temperature and an increase in relative humidity. A high rate of generation of squall lines has been observed in the Jos Plateau of Nigeria, mainly in the afternoon. Because the Jos Plateau is only 200 km east of Zaria, the disturbance lines(s) formed in the region would pass over Zaria mostly in the afternoon-early evening period, thus accounting for a sizeable proportion of the thunderstorms in this area. (Rochester-PTT)
W86-04509

AIRBORNE MERCURY IN PRECIPITATION IN THE LAKE SUPERIOR REGION,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W86-04525

FOURIER INFERENCE: SOME METHODS FOR THE ANALYSIS OF ARRAY AND NON-GAUSSIAN SERIES DATA,

California Univ., Berkeley. Dept. of Statistics.
For primary bibliographic entry see Field 7C.
W86-04530

STUDIES OF THE EFFECTS OF COLD FRONTS DURING THE RAINY SEASON IN ZIMBABWE,

Meteorological Office, Bulawayo (Zimbabwe).
A. V. Smith.
Weather WTHRAL, Vol 40, No. 7, p 198-203, July 1985. 2 fig, 1 tab, 2 ref.

Descriptors: *Zimbabwe, *Rainfall, *Satellites, *Barometric pressure, South Africa, Mozambique, Zambia, Infra-red imagery, Summer, Weather patterns.

Synoptic occasions that produce the major part of Zimbabwean rainfall were studied by the following means: (1) daily Meteosat infra-red satellite photographs covering February 1978 until April 1979; 700 millibar wind patterns and surface pressure gradients from Durban, South Africa to Beira, Mozambique; and rainfall charts, from which the number of stations reporting over 25 mm of rain daily were totalled for every day. Changes in surface pressure gradients from Durban to Beira were correlated with the number of stations recording over 25 mm of rainfall. The surface pressure surges on the Natal Coast (Durban) reflect the intensity of cold fronts/trough affecting South Africa. The major increase in rainfall over Zimbabwe occurs as the 24-hour pressure changes reach Natal and are therefore best predicted by a prebaratic chart for the next day. Satellite pictures indicate that most of the rainfall over Zimbabwe reflects development over South Africa (apart from the occasional tropical disturbance moving west into Zimbabwe from the Mozambique Channel). The amount of annual rainfall over Zimbabwe is thus related to the intensity and vigor of the cold fronts affecting Durban each summer season. Rainfall is greatest when the meridional flow is greatest. (Rochester-PTT)
W86-04557

EXCEPTIONALLY HEAVY SPRING RAINS IN SYDNEY,

D. White.
Weather WTHRAL, Vol. 40, No. 7, p 210-212, July 1985. 3 fig.

Descriptors: *Weather pattern, *Rainfall, *Australia, Barometric pressure, Rainfall intensity, Sydney.

Between 5 and 12 November 1984, Sydney, Australia, had 471 mm of rain, or just under 40% of its annual average. The nearby suburbs of Randwick had 628 mm of rain in the same week. This was the wettest week in Sydney in this century; on three separate occasions in the space of four days parts of Sydney received 2-hr rainfalls that, based on past records, would have a return period of well in excess of 100 yr. An isohyet map of Sydney and its suburbs, synoptic charts for Australia, and upper-air (500 mbar) charts are included that cover early-mid November 1984. (Rochester-PTT)
W86-04558

INTERNATIONAL CORRELATION BETWEEN SEA LEVEL AIR PRESSURE AND RAINFALL IN THE BRITISH ISLES - NORTH SEA REGION,

P. L. Woodworth.
Weather WTHRAL, Vol. 40, No. 9, p 285-292, September 1985. 2 fig, 3 tab, 5 ref.

Descriptors: *Weather patterns, *Rainfall, *Barometric pressure, *England, *Scotland, *North Sea, *England, Sea level pressure, Rainfall measurements, Principal components analysis, Rainfall estimator.

The correlation between annual means of sea level barometric pressure (SLP) and rainfall was sought in long-term weather records at 21 stations in the British Isles-North Sea area. More than 30 yr of data were available for most stations. Anticorrela-

tions between SLP ranged from -0.35 to -0.72 at the 21stations, with an average of -0.58. The magnitude of the anticorrelation varies from station to station owing to the large amount of 'local variability' contained in the individual monthly mean rainfall and, to a lesser extent, SLP records. 'Regionally representative' time series of rainfall and SLP, obtained by principal components analysis (PCA) of data from a geographical spread of stations, were even more strongly anticorrelated throughout the year, with a maximum anticorrelation of -0.90 in October-November, although the proportionality between rainfall and SLP changes from month to month. A PCA of British Isle-North Sea SLP could therefore be considered a highly efficient regional 'rainfall estimator' over long time scales. (Rochester-PTT)
W86-04590

INTEGRATED ANALYSIS OF ACIDIFICATION IN EUROPE,

National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W86-04589

SIMPLE STOCHASTIC MODEL OF THE PRECIPITATION PROCESS,

Uppsala Univ. (Sweden). Meteorologiska Institutionen.
H. Alexandersson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 12, p 1285-1295, December 1985. 11 fig, 3 tab, 18 ref.

Descriptors: *Precipitation, *Mathematical models, *Model studies, *Stochastic process, Mathematical studies, Precipitation intensity, Convective precipitation, Poisson ratio, Rainfall, Sweden, Markov Process.

The compound Poisson-exponential (Cpe) model, a simple and rather general model of the precipitation process is reviewed using some applications and comparisons found in data from Sweden. The Cpe model, which is a continuous stochastic process, links together models simulating time series of precipitation, hitherto as a rule using Markov chains applied to sequences of dry and wet days, and empirical distributions used for integrated amounts or extreme daily amounts. The basic assumptions of the simple Cpe model can be modified to allow for a more realistic description of the precipitation process without losing the natural parameters involved. The modified Cpe process gives a realistic time structure of the true precipitation process as far as daily autocorrelations are concerned. The model can also incorporate memory, making nearby events correlated and no longer independent, or the precipitation process can be separated into two (or more) parts, one describing the convective precipitation, the other the frontal or less intense precipitation. A very fast method of deriving percentiles from a single table for a Cpe distribution is presented. (Geiger-PTT)
W86-04592

CLIMATIC PATTERN ANALYSIS OF THREE- AND SEVEN-DAY SUMMER RAINFALL IN THE CENTRAL UNITED STATES: SOME METHODOLOGICAL CONSIDERATIONS AND A REGIONALIZATION,

Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
M. B. Richman, and P. J. Lamb.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 12, p 1325-1343, December 1985. 9 fig, 3 tab, 85 ref, append. NSF Grant ATM 81-00158.

Descriptors: *Climatology, *Rainfall, *Regional analysis, *Networks, *Meteorological data collection, Analysis of variance, Variability, Seasonal variation, Mathematical studies, Statistical methods, Eigenvectorial methods.

Results of climatic pattern analyses of three- and seven-day summer rainfall totals for the central United States are presented. A range of eigenvectorial methods is applied to 1949-1980 data for a network of 402 stations extending from the Rocky to the Appalachian Mountains and from the Gulf Coast to the Canadian border. The entire domain variance fractions cumulatively explained by the first 10 correlation-based unrotated Principal Components (PCs) and the 10 orthogonally rotated (VARIMAX) criterion. PCs derived from them are identical for the same data. They vary between 35-47%, depending on the data time scale and form. the highly contrasting sets of unrotated and VARIMAX PC spatial loading patterns receive little physical support from analyses performed separately for subareas of the domain or from comparison with the interstation correlation matrix from which they are derived. The VARIMAX PC loading patterns, in contrast, derive strong physical support from those verifications. Each of these patterns emphasizes a relatively strong anomaly in a different part of the domain; they collectively yield a regionalization of the domain into 10 subareas within which three- and seven-day summer rainfall tends to be spatially coherent. The regionalization shows potential for use in crop-yield modeling, short-range weather prediction, and research into climatic variation and change. (Geiger-PTT)
W86-04593

WARM SEASON NOCTURNAL PRECIPITATION IN THE GREAT PLAINS OF THE UNITED STATES,

Arizona State Univ., Tempe. Dept. of Geography.
R.C. Balling, Jr.
Journal of Climate and Applied Meterology JCAMEJ, Vol. 24, No. 12, p 1383-1387, December 1985. 6 fig, 32 ref. NOAA Grant NA84RAA07418.

Descriptors: *Precipitation, *Spatial distribution, *Temporal distribution, *Rainfall distribution, *Diurnal distribution, Thunderstorms, Seasonal variation, Rainstorms, Nebraska, Oklahoma, Texas, Rainfall intensity, Model studies.

This paper identifies temporal and spatial patterns in the diurnal cycle of hourly warm season precipitation events over the Great Plains of the United States. Results from 30 yr of hourly precipitation records from 515 stations indicate that over 60% of all warm season rainfall (> or = 0.25 mm) occurs at night from southern Nebraska to panhandle Oklahoma and portions of northern Texas. The larger precipitation events (> or = 2.54 mm) display a much larger region where 60% of the warm season precipitation occurs at night. Harmonic analysis reveals all remarkably uniform longitudinal gradient in the timing of maximum rainfall frequencies across much of the Great Plains. The more precise identification of these spatial and temporal patterns should be particularly useful in assessing the many theories of nocturnal precipitation in the central United States, verifying numerical precipitation models for the models for the region, and generating rainfall forecasts for various times of the day. (Author's abstract)
W86-04594

SUB-SAHARAN RAINFALL 1981-1984,

Clark Univ., Worcester, MA. Dept. of Geography.
S. E. Nicholson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 12, p 1388-1391, December 1985. 3 fig, 3 tab, 15 ref. NSF Climate Dynamics Grant ATM 821878 and NOAA Contract NA 84AA-H-00007.

Descriptors: *Drought, *Rainfall intensity, *Semiarid lands, *Climatology, *Meteorological data collection, Rainfall distribution, Semiarid climates, Rainfall, Networks, Albedo, Vegetation, Hydrologic data collection, Sahelo-Saharan, Sahel, Soudan, Sahara, Africa.

Evidence is presented from analyses of rainfall fluctuations from the Sahelo-Saharan, Sahel, and Soudan zones from 1901 to 1981 to support the contention that the drought situation in West Africa is continuing and probably intensifying. Rainfall deficits from 1981 through 1984 equal or exceed those of the early 1970's in all three zones. In most cases, rainfall was considerably lower in 1983 than in 1972, the peak drought year of the early 1970's. Rainfall in 1950 was two to three times greater than during the years 1972 and 1983. Although there is yet no sufficient meteorological explanation for the extreme and persistent sub-Saharan droughts, several hypotheses have been offered, mostly based on numerical models. Changes of surface albedo induced by overgrazing may have been a cause of drought conditions in the early 1970's. Other theories suggest that surface changes induced by drought such as depletion of soil moisture or decrease of vegetation cover may feed back upon the atmosphere in such a way as to reinforce the drought. A bimodal cause for sub-Saharan drought involving an atmospheric trigger mechanism and the cause for its persistence has not been ruled out. (Geiger-PTT)
W86-04595

DAILY RAINFALL PROBABILITIES: CONDITIONAL UPON PRIOR OCCURRENCE AND AMOUNT OF RAIN,

Cordoba Univ. (Spain). Escuela Technica Superior de Ingenieros Agronomos.
A. G. Guzman, and W. C. Torrez.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1009-1014, October 1985. 2 fig, 5 tab, 16 ref.

Descriptors: *Rainfall, Stochastic process, *Models, *Markov process, *Monte Carlo method, Probabilistic process, Probable maximum precipitation, Statistical methods, Mathematical studies, Mathematical models, Model studies, Los Angeles, California.

A generalization of the chain-dependent process is proposed to describe daily rainfall. the model utilizes probabilities of rain based on the amount of rain on the preceding day. The model can also accomodate a second order dependence in the Markov chain. the influence of the antecedent amount of rain on the next day occurrence is called feedback. A method for identification of feedback effects in a series of observations is derived and applied to rainfall occurrence at Los Angeles. Performance of the model in reproducing other precipitation patterns, such as maximum daily rainfall or total amount of rainfall in successive day periods, was checked by the Monte Carlo method. Results showed that the stochastic processes coupled with the feedback can give a realistic description of certain meteorological events. (Geiger-PTT)
W86-04623

INFLUENCE OF LOCAL LAND-SURFACE PROCESSES ON THE INDIAN MONSOON: A NUMERICAL STUDY,

National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
Y. C. Sud, and W. E. Smith.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1015-1036, October 1985. 14 fig, 2 tab, 28 ref. Contract No. NAS5-28074.

Descriptors: *Rainfall, *India, *Monsoons, *Albedo, *Evapotranspiration, *Numerical analysis, Vegetation, Models, Coriolis force, Mathematical studies, Model studies, Mathematical models, Goddard Laboratory for Atmospheres General Circulation Model, Charney's hypothesis, Radiation.

Twelve July integrations were made with the GLAS (Goddard Laboratory for Atmospheres) GCM (General Circulation Model) to investigate the influence of changes in the land-surface fluxes over the Indian subcontinent on the monsoon circulation and rainfall. The runs consisted of an ensemble of three integrations for each of four separate: a control, an experiment with increased land-surface albedo, an experiment with increased land-surface albedo and reduced land-surface roughness, and an experiment with increased land-surface albedo, reduced surface roughness and no evapotranspiration. An intercomparison of the ensemble means of monthly fields produced by the experiments with those of the control showed that the Indian Monsoon was significantly weakened by the increase of surface albedo and the

reduction in surface roughness. Higher surface albedo reduced the monsoon rainfall in conformity with Charney's hypothesis; the low surface roughness made the horizontal transport of moisture in the planetary boundary layer (PBL) more westernly, which reduced the cross-isobaric moisture convergence and hence the rainfall over northwestern India while correspondingly increasing it over China. Rainfall was essentially unaltered by the absence of evapotranspiration, because the increased moisture convergence produced by the enhanced sensible heating of the PBL largely compensated for the reduction in evapotranspiration. (Geiger-PTT)
W86-04624

DEDUCING THE MICROPHYSICAL CHARACTER OF PRECIPITATION FROM MULTIPLE-PARAMETER RADAR POLARIZATION MEASUREMENTS,

Applied Research Corp., Landover, MD.
A. R. Jameson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1037-1047, October 1985. 3 fig, 57 ref. NSF Grants NSF ATM-8216847, and NSF ATM-8318355.

Descriptors: *Radar. *Precipitation, *Polarization, *Physical properties, Remote sensing, Meteorological data collection, Rainstorms, Mathematical studies, Micrometeorology, Remote sensing.

Radar polarization measurements are influenced by the distribution of shapes (weighted by the index of refraction) and the fall behaviors of the hydrometeors. In so far as precipitation-sized hydrometeors are symmetric oblates in the Rayleigh-Gans scattering regime, the effects of canting and shapes can in principle, be separated using the co- and cross-polarized backscattered signals at both horizontal and vertical polarizations. These measurements yield estimates of the variance of a two-parameter distribution of canting angles as well as the refractive index weighted estimates of the mean and variance of the shape (axis ratio) distribution. To the extent that hydrometeor asymmetries can be neglected, these quantities provide a possible framework for precipitation identification from radar polarization measurements at long wavelengths. (Author's abstract)
W86-04625

DIURNAL VARIATION OF THUNDERSTORM ACTIVITY IN THE UNITED STATES,

North Carolina Univ. at Chapel Hill. Dept. of Geography.
D. R. Easterling, and P. J. Robinson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1048-1058, October 1985. 7 fig, 3 tab, 21 ref.

Descriptors: *Diurnal distribution, *Thunderstorms, *Theoretical analysis, *Seasonal variation, Storms, Meteorological data collection, Weather patterns, Harmonic analysis techniques.

Starting times of thunderstorms for 450 stations in the conterminous United States for a 25-year period were analyzed using harmonic analysis techniques. Diurnal variations were expressed as both the time of maximum storm occurrence and the concentration of activity around this time. Distinct seasonal and spatial variations in diurnal activity occur. Analysis of these variations indicates that the country can be divided into nine thunderstorm regions. In the central states the majority of storms occur at night, but storms are frequent at any time. In both the east and the west, there is a marked concentration of storms in the afternoon. In the west and northeast winter storms are rare, while along the Pacific Coast summer thunder is uncommon. It is possible to offer tentative explanations of the variations in each of these regions by linking results of the harmonic analysis to the causal mechanisms of the storms. In winter in inland regions, storms associated with depressions and fronts appear to dominate, while along coastlines sea breeze effects are most important. In the other seasons air mass storms seem to dominate in those regions having an afternoon maximum, although they also play a role in the areas where line thunderstorms, giving a nocturnal maximum, are most important. (Geiger-PTT)
W86-04626

HAILSTONE SIZE DISTRIBUTIONS AND THEIR RELATIONSHIP TO STORM THERMODYNAMICS,

Research Council of Alberta, Edmonton. Atmospheric Sciences Dept.
L. Cheng, M. English, and R. Wong.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1059-1067, October 1985. 6 fig, 7 tab, 17 ref.

Descriptors: *Hail, *Thermodynamics, *Storms, *Mathematical studies, *Particle size, Mathematical equations, Meteorological data collection, Weather, Weather forecasting, Alberta.

Hailstone size distributions have been determined from time-resolved hail samples collected from ten storms that occurred in Alberta in the summers of 1980, 1982 and 1983, and an intercept parameter and slope parameter were obtained for each hail sample. The intercept parameters are related to the slope parameters by a power relationship which equates the intercept parameter to the product of a coefficient parameter (A) and the slope parameter to the exponent power (b), where b is constant from storm to storm, and A depends upon the storm thermodynamics. The value of A increases with the cloud base temperature of the storm and the maximum water mass flux. The derived relationships between hailstone size distributions and storm thermodynamics may greatly facilitate the measurement of hailfall by weather radar and help to evaluate hail suppression programs. (Geiger-PTT)
W86-04627

PHYSICAL RESPONSE OF CONVECTIVE CLOUDS OVER THE SIERRA NEVADA TO SEEDING WITH DRY ICE,

Electronics Techniques, Inc., Auburn, CA.
For primary bibliographic entry see Field 3B.
W86-04628

RELATIONSHIP BETWEEN ACID PRECIPITATION AND THREE-DIMENSIONAL TRANSPORT ASSOCIATED WITH SYNOPTIC-SCALE CYCLONES,

National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5B.
W86-04629

DISPOSITION OF SILVER RELEASED FROM SOVIET OBLAKO ROCKETS IN PRECIPITATION DURING THE HAIL SUPPRESSION EXPERIMENT GROSSVERSUCH IV. PART II: CASE STUDIES OF SEEDED CELLS,

Clermont-Ferrand-2 Univ., Aubiere (France).
For primary bibliographic entry see Field 3B.
W86-04630

RELATIONSHIP BETWEEN TIBET-TROPICAL OCEAN THERMAL CONTRAST AND INTERANNUAL VARIABILITY OF INDIAN MONSOON RAINFALL,

Cooperative Inst. for Research in Environmental Science, Boulder, CO.
C. Fu, and J. O. Fletcher.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 8, p 841-847, August 1984. 4 fig, 4 tab, 33 ref.

Descriptors: *Tropical regions, *Monsoons, *Rainfall, *Water temperature, *Soil temperature, Climatology, Albedo, Correlation analysis, Air temperature, Weather patterns, Mathematical studies, Rainfall intensity.

During the northern summer, the Tibetan Plateau is a heat source for the atmosphere, and the Equatorial Pacific Ocean Cold Tongue (ECT) is a heat sink, both contributing to the thermal forcing of large-scale quasi-zonal atmospheric circulation. For the period 1954-1979, there exists a high correlation between the zonal large-scale sea-land thermal contrast and Indian monsoon rainfall. When the thermal contrast between the Tibetan Plateau and the Equatorial Cold Tongue is strong (sea land oscillation > 0), the monsoon rainfall tends to be large, and when it is weak sea-land oscillation (SLO) < 0, the monsoon rainfall tends to be small. The interannual variability of the Tibetan soil temperature and the eastern Pacific sea surface temperature are of comparable magnitude, but their variations appear to be independent of each other. For the entire period the sea surface temperature in ECT which is far removed from the monsoon region shows much higher correlation with Indian monsoon rainfall variability than does temperature of the Tibetan Plateau, which is much nearer the monsoon region. For the anomalous monsoon years, the ground surface temperature of the Tibetan Plateau and the surface temperature of the Equatorial Cold Tongue make nearly equal contributions to the correlation of SLO with monsoon rainfall. These are generally years of strong thermal contrast. When the thermal contrast is strong (SLO > 0), it is a better indicator of Indian monsoon rainfall than when it is weak (SLO < 0). (Geiger-PTT)
W86-04631

PREDICTIONS BY TWO ONE-DIMENSIONAL CLOUD MODELS: A COMPARISON,

Illinois State Water Survey Div., Champaign.
B. Ackerman, and R.-Y. Sun.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 7, p 617-628, July 1985. 5 fig, 5 tab, 41 ref. NSF Grant ENV77-11527 and NOAA Grant COMM-NARAD 05089.

Descriptors: *Clouds, *Models, *Convective precipitation, *Prediction, *Weather modification, Cloud seeding, Simulation analysis, Artificial precipitation, Model studies, Remote sensing, Comparison studies, Radar, Great Plains Cumulus Model, Temporal distribution, Spatial distribution.

Two one-dimensional steady-state models of cumulus convection in common use in weather modification research, the NOAA Experiemental Meteorology Branch model (EMB) and the Great Plains Cumulus Model (GPCM), differ in their formulations in several ways. Some of the differences arise from the conceptualization of the convective phenomenon which is modeled in each and some from the physical parameterizations utilized. Predictions of cloud top and dynamic modification potential (seedability) by the two models for 57 midday radiosondes in the Midwest, differed significantly, with the EMB values consistently higher. GPCM simulations provided a better overall estimate of observed radar echo tops, while EMB consistently overestimated, by largest amounts when tops were below 12 km. Study of the impact of temporal and/or spatial separation between sounding and cloud area emphasizes the need, in the Midwest, to consider factors other than thermodynamic stratification (e.g., forced lifting, convergence) on the synoptic and mesoscale when applying the model for prediction of cloud development. However, it was also found that the average difference in predictions by the two models, for the same sound, was of the same order as the average difference in predictions arising from spatial or temporal separation. (Author's abstract)
W86-04632

AIRBORNE DOPPLER RADAR OBSERVATIONS OF A CONVECTIVE STORM,

National Severe Storms Lab., Norman, OK.
P. S. Ray, D. P. Jorgensen, and S.-L. Wang.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 7, p 687-698, July 1985. 12 fig, 6 ref. NSF Grant ATM-8403452.

Descriptors: *Doppler radar, *Storms, *Meteorologic data collection, *Convective precipitation, *Error analysis, Data collections, Networks, Remote sensing, Mathematical studies, Statistical methods, Statistical analysis, Wind velocity, Radar, Florida.

Airborne Doppler radar can collect data on target storms that are quite widely dispersed. However, the relatively long time required to sample an individual storm in detail, particularly with a single aircraft, and the amplification of the statistical uncertainty in the radial velocity estimates when Cartesian wind components are derived, suggests that errors in wind fields derived from airborne Doppler radar measurements would exceed those from a ground based radar network which was better located to observe the same storm. Error distributions for two analysis methods (termed Overdetermined and Direct methods) are given and discussed for various flight configurations. Both methods are applied to data collected on a sea breeze induced storm that occurred in western Florida on 28 July 1982. Application of the direct solution, which does not use the continuity equation, and the overdetermined dual-solution, which requires the use of the continuity equation, resulted in similar fields. Since the magnitude of all errors are unknown and the response of each method to errors is different, it is difficult to assess overall which analysis performs better, indeed each might be expected to perform best in different parts of the analysis domain. A flexible collection strategy can be followed with different analysis methods to optimize the quality of resulting synthesized wind fields. (Author's abstract)
W86-04633

RETRIEVAL OF PRECIPITABLE WATER FROM BHASKARA-II MICROWAVE MEASUREMENTS AND ITS COMPARISON WITH NOAA-7 AND RADIOSONDE DATA,

Indian Space Research Organization, Ahmedabad. Space Applications Centre.
For primary bibliographic entry see Field 7B.
W86-04653

RAINFALL AND EPIZOOTIC RIFT VALLEY FEVER,

Food and Agriculture Organization of the United Nations, Kabete (Kenya). Veterinary Research Lab.
For primary bibliographic entry see Field 5G.
W86-04663

2C. Snow, Ice, and Frost

SEA ICE DYNAMICS AND REGIONAL METEOROLOGY FOR THE ARCTIC POLYNYA EXPERIMENT (APEX) - BERING SEA 1985,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
C. H. Pease, M. Reynolds, G. A. Galasso, V. L. Long, and S. A. Salo.
NOAA Technical Memorandum ERL PMEL-64, October 1985. 120 p, 18 fig, 20 ref, 4 append.

Descriptors: *Sea ice dynamics, *Sea ice, *Ice, *Meteorological data collection, *Bering Sea, Arctic, Polar regions, St. Lawrence Island.

The physical processes in the atmosphere, sea ice, and ocean in the vicinity of St. Lawrence Island, in the northern Bering Sea, were investigated. The interaction of a wind-created polynya with regional dynamics and thermodynamics were observed. Ice drifted toward the south and west across most of the Bering Sea shelf from mid-February until the beginning of May 1985 due to a prolonged period of northerly winds. The net drift pattern of sea ice from the northern Bering Sea was from the north to the south. This is compared with earlier studies in which the net drift was from the north Bering Sea toward the Chukshi Sea. This contrast points out the enormous interannual variations in ice transport in this area and suggests that it is possible that the winter ice direction may change through the Bering Strait from year to year. (Halterman-PTT)
W86-03903

MONITORING CHANGES IN TOTAL AND UNFROZEN WATER CONTENT IN SEASONALLY FROZEN SOIL USING TIME DOMAIN REFLECTOMETRY AND NEUTRON MODERATION TECHNIQUES,

Department of Agriculture, Ottawa (Ontario).
For primary bibliographic entry see Field 2G.
W86-04305

CLOSED-SYSTEM FREEZING OF SOIL IN EARTH DAMS AND CANALS,

Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
For primary bibliographic entry see Field 8E.
W86-04336

RADIO ECHO-SOUNDING STUDIES OF ENGLACIAL WATER MOVEMENT IN VARIEGATED GLACIER, ALASKA,

Washington Univ., Seattle. Geophysics Program.
R. Jacobel, and C. Raymond.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 22-29, 1984. 6 fig, 1 tab, 6 ref. NSF Grant DPP 8200725.

Descriptors: *Radiosondes, *Englacial water movement, *Glaciers, *Alaska, Variegated Glacier, Radiation, Flow velocity, Flow pattern, Flow rates, Cavitation, Hydraulics.

Radio-echo returns from internal reflectors were monitored for three weeks during surge motion on Variegated Glacier, Alaska in July 1982. A monopulse transmitter with 3 MHz center frequency was fixed on the glacier surface near the equilibrium line. Data were recorded on magnetic tape approximately three times daily and contain both amplitude and phase information. The frequency spectrum of returned radiation from englacial scatters shows peaks in the 12 to 30 MHz range which places constraints on the size and geometry of the scatterers. Timing of variations in the amplitude and frequency of returned radiation were found to coincide with changes in glacier velocity, basal water pressure, and surface melt rate. These changes in the echo pattern are interpreted in terms of the redistribution of water in englacial channels and cavities connected to the bed some distance down-glacier. This connection has large hydraulic resistance compared to a bore hole connected vertically to the bed. The inflow of water to the cavities from surface melt and rain and the drainage are generally in equilibrium except in times of changed surface input and during surge pulses. In the latter case, water may fill these cavities due to increased pressure at the bed associated with the motion pulse. The information obtained is therefore complementary to bore-hole water pressure levels but cannot duplicate it. This is apparently due to fundamental differences in the hydraulics of the natural cavity and conduit system, and a bore hole connected vertically to the bed. (Author's abstract)
W86-04350

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. I. FJALLSJOKULL (SOUTH-EAST ICELAND): BULK MELT WATERS WITH CLOSED-SYSTEM CHARACTERISTICS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
R. Raiswell, and A. G. Thomas.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 35-43, 1984. 7 fig, 3 tab, 24 ref. NERC Grant GR3/3343.

Descriptors: *Glaciohydrology, *Melt waters, *Solute transport, *Fjallsjokull Glacier, *Iceland, Glacial streams, Dissolved cations, Alkalinity, Sulfates, Hydrogen ion concentrations, Closed systems, Solutes, Carbon dioxide.

The glacier at Fjallsjokull, drains through deep valleys cut in the flanking mountains. The width of the glacier ranges from 1.5 km to 4 km. Samples were taken from an area just north of the glacier where the steep ice front is paralleled by the main melt water stream, which is fed by a series of tributaries emerging with force from various portals. Variations in dissolved cations, total alkalinity, sulphate, and field pH are recorded for samples of precipitation, supraglacial melt, and bulk melt waters (those emerging at the portal) from Fjallsjokull (south-east Iceland). The composition of supraglacial melt indicates derivation from precipitation by the acquisition of solutes from the weathering and dissolution of rock debris, in a system open to atmospheric carbon dioxide. Bulk melt waters have variable compositions, approaching saturation with calcite, which can be derived from supraglacial melt water by continued solute acquisition in a system closed to atmospheric carbon dioxide. Solute/discharge relationships at Fjallsjokull are complex. A simple mixing model between dilute englacial water (derived from, and compositionally similar to, supraglacial melt) and more concentrated subglacial water only applied over intermediate discharges (0.5-0.9 m3 s-1), where variations in the composition of either component are small compared to variations in their mixing ratio. Time-dependent chemical reflections occur after mixing and exert significant effects on composition at either discharge extreme. (Lantz-PTT)
W86-04351

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. II. ARGENTIERE (FRENCH ALPS): BULK MELT WATERS WITH OPEN-SYSTEM CHARACTERISTICS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
A. G. Thomas, and R. Raiswell.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 44-48, 1984. 2 fig, 1 tab, 17 ref. NERC Grant GR3/3343.

Descriptors: *Glaciohydrology, *Melt waters, *Solute transport, *Argentina, *France, Open systems, Kinetics, Sediment-water interfaces, Carbon dioxide, Calcium, Bicarbonate, Solutes, Hydrogen ion concentration.

Chemical models for the evolution of glacial melt waters suggest that kinetic factors exert a critical control on the nature and magnitude of sediment-water interactions and thus on the composition of bulk melt waters. Solute acquisition in the glacial system may follow two distinct chemical pathways, where CO2 dissolution is the principal source of the H(+) consumed during the weathering and dissolution of rock minerals. The paper describes the chemical evolution of bulk melt waters with open system characteristics (rates of CO2 consumption by weathering lower than rates of renewal by dissolution. Glacier d'Argentiere is on the south-west side of the Chamonix valley, in the Mont Blanc massif of the French Alps. All the bulk melt waters were collected from a site approximately 150 m down-stream from the glacier snout. The melt waters were sampled at approximately hourly intervals for 10 hr (from 10.00 to 20.00 h) in April 1975, and for 36 h (from 7.00 to 19.00 h) in September 1976. Results indicate that the nature of the dissolved load in bulk melt waters from glacier d'Argentiere is essentially uniform under both autumn high-flow, and spring recession-flow conditions. In both cases, Ca(2+) (70-80%) and HCO3 (80-90%) are the major ions. The bulk melt waters are close to equilibrium with atmospheric CO2 and display the characteristic open-system relationship between solute load and pH. The magnitude of the dissolved load in bulk melt waters is considerably higher under recession-flow conditions. Subglacial melt waters are similar in their total dissolved load to the recession-flow samples, but are comparatively depleted in Ca(2+) and enriched in Na(+) and K(+). The development of open- or closed-system characteristics depends on whether dissolution/weathering reactions occur when chemically aggressive englacial waters are mixed with solute and sediment-rich subglacial melt. Occurrence of dissolution/weathering reactions leads to closed-system conditions; otherwise open systems are observed. Such closed-system characteristics may be modified by re-equilibration with atmospheric CO2 or groundwater mixing to give bulk melt waters with open-system characteristics. (Lantz-PTT)
W86-04352

CHEMICAL MODELS OF SOLUTE ACQUISITION IN GLACIAL MELT WATERS,

University of East Anglia, Norwich (England).

School of Environmental Sciences.
R. Raiswell.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 49-57, 1984. 8 fig, 31 ref.

Descriptors: *Melt waters, *Chemical models, *Solute transport, Earth-water interfaces, Hydrogen ion concentration, Carbonates, Dissolved cations, Carbon dioxide, Closed systems, Open systems, Weathering, Equilibrium.

Relatively little attention has been directed toward identifying the nature and controls of solute acquisition by water-rock interactions in the glacial system. Previous work has suggested that cations are acquired by desorption from suspended sediment, while others have shown that the relative abundance of different cations is determined by their rates of leaching from silicate minerals and replacement by hydrogen ions. It has also been shown that pH exerts a significant influence on water-rock interactions in melt waters, as they do in general on most weathering reactions. In surface waters, pH is principally controlled by carbonate equilibria, which can only be quantified by analysis for cations, dissolved carbonate species and pH. It is the purpose of the paper to present chemical models which define the controls of solute acquisition by glacial melt waters in terms of carbonate equilibria. Chemical models for the evolution of bulk melt waters can be constructed by assuming that rock mineral weathering and solute acquisition are controlled by carbonate equilibria. Different open- and closed-system models are defined by variations in the rates of weathering relative to the rate of hydrogen-ion supply by the dissolution and dissociation of CO2 and can be recognized by characteristic pH and sigma (+) relationships. The observed and inferred compositions of englacial and subglacial melt suggest that mixing is unlikely to be conservative and that closed-system conditions result where post-mixing weathering reactions occur. The final composition of bulk melt waters is determined by the mixing ratio between englacial and subglacial melt, the extent of post-mixing evolution, and opportunity for mixing with ground waters or re-equilibration with the atmosphere. (Lantz-PTT)
W86-04353

INSTRUMENTS AND METHODS. FIELD PH DETERMINATIONS IN GLACIAL MELT WATERS,

Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04355

OPTIMIZATION OF A SNOW NETWORK BY MULTIVARIATE STATISTICAL ANALYSIS,

Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
G. Galeati, G. Rossi, G. Pini, and G. Zilli.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 93-108, March 1986. 7 fig, 2 tab, 15 ref.

Descriptors: *Network design, *Clustering, *Principal component analysis, *Water equivalent, *Snow surveys, Alps, Italy, Cost analysis, Statistical Methods.

Snow cover measurement data in the northeastern Alps (Italy) were analyzed in order to select a reduced number of measurement stations from which to evaluate the water equivalent amount. The selection was based on cluster methods for identification of homogeneous areas and on principal components analysis for individualization of representative stations. This analysis shows clearly that about 30% of the operating stations can be ignored and, if necessary, their values drawn from their more closely associated stations. The results obtained for the years 1983 and 1984, which were not included in the original analysis, were practically identical, confirming the validity of the selection made. The reduction in number of stations allows, with the same results, immediate savings in terms of human and technical resources. The stations not discarded can be more accurately controlled with regard to quantity and quality of measurements and the more significant stations could be used for further analysis or for forecasting. (Rochester-PTT)
W86-04395

SNOW CHEMISTRY OF THE CASCADE-SIERRA NEVADA MOUNTAINS,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-04442

FIELD AND LABORATORY MEASUREMENTS OF SNOW LIQUID WATER BY DILUTION,

California Univ., Santa Barbara. Dept. of Geography.
R. E. Davis, J. Dozier, E. R. LaChapelle, and R. Perla.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1415-1420, September 1985. 3 fig, 2 tab, 15 ref, 2 append. NAS5-27463, NAS5-328, ngt-803.

Descriptors: *Conductivity, *Snowmelt, *Dilution method, *Glaciohydrology, *Water content, Field tests, Physical properties.

Field trials of the dilution technique for measuring snow liquid water content show that the procedure is rapid and simple. Measurements of the liquid water mass fraction with an absolute error of approximately 1.5% can be obtained by one operator at a rate of 10-15 samples per hour, but if the water content is low (0-2%), the relative error can be high. Electrolytic conductivity is the preferred method of measuring concentrations, using a stock solution of 0.01 Normal HCl. The recommended amount of stock solution to add is 0.5-0.8 times the mass of the snow sample. Extraction of the resulting mixture of stock solution and snow liquid water is best done with a screened pipette, instead of by decanting. (Appendixes on error analysis and porosity, liquid water saturation, and volume fraction computations are included.) (Author's abstract)
W86-04540

INTERCEPTION OF SNOW BY THE FOREST CANOPY,

Tennessee Div. of Health Planning, Nashville.
A. F. Kolesov.
Soviet Soil Science SSSCAE, Vol. 17, No. 4, p 123-126, July-August 1985. 2 tab, 5 ref. Translated from Pochvovedniye, No. 8, p 136-138, 1985.

Descriptors: *Snow surveys, *Forests, *Tree crowns, *Water-equivalent, *Hydrologic budget, Square-Meter Plot Method, Spruce, Deciduous Forests, USSR.

Studies at the Istra hydrologic station (USSR) demonstrated that the portion of the snow intercepted by tree crowns and then falling to the soil surface during windy periods and warm spells amounts to 10-15% of the total amount of snow falling in winter. This amount is not accounted for by standard snow-survey methods. A method ('square-meter plot method') is proposed for estimating snowfall. Compared to the square-meter plot method, which accounts for all the snow, including that fallen from the tree crowns, standard instruments underestimate the water equivalent of snow in pure spruce plantations by as much as 15-16% and under deciduous plantations by as much as 5%. This value must be taken into account in water-budget computations. This is not the same as 100% of the snow intercepted by tree crowns, of which 55-60% represents pure losses (evaporation) and 40-45% reaches the soil surface and participates in all hydrologic processes. (Rochester-PTT)
W86-04555

HIGH DENSITIES, WATER EQUIVALENTS, AND MELT RATES OF SNOW IN THE CAIRNGORM MOUNTAINS, SCOTLAND,

Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.
Weather WTHRAL, Vol. 40, No. 9, p 272-277, September 1985. 3 fig, 1 tab, 8 ref.

Descriptors: *Snow depth, *Snow density, *Scotland, Seasonal distribution, Melting, Snowmelt, Snowpack, Cairngorm Mountains.

Depths and densities of snow were measured at several snow courses above Glen Feshie during the winter and spring of 1984. Snow densities were very high by British standards at all sites on all dates. Even fresh-looking powder snow had a density around 0.27 g/cu cm, and mean densities for old snow increased from 0.44 in February to 0.47 in mid-March, 0.51 at the start of April, and 0.63 in late April and mid-May. Estimated water equivalents showed a more complicated spatial and temporal pattern. Differences of up to 250 mm water equivalent were maintained between two sites on opposite sides of the same ridge (N vs S), and the overall range over the season varied considerably among sites. Mean point melt rates were in the range 8-23 mm water equivalent/day during the 3-29 April period and 18-31 mm water equivalent per day during the 29 April-13 May period. The results of this study highlight several features of the Cairngorm snowpack: great spatial variability in accumulation, high densities of old snow, very high water equivalents that do not reach peak values until early April, and sustained high melt rates thereafter. (Rochester-PTT)
W86-04559

2D. Evaporation and Transpiration

POTENTIAL EVAPORATION AND FIELD WATER CONSUMPTION IN THE NORTH CHINA PLAIN,

Academia Sinica, Beijing (China). Inst. of Geography.
C. Weixin.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 271-287, 7 fig, 8 tab, 5 ref.

Descriptors: Water transfer, *Water supply, *Diversion, *China, Water supply development, Evaporation, Water supply development, Irrigation.

Potential evaporation and field water consumption in the North China Plain are estimated as part of the overall assessment of the south-north water transfer project planned for eastern China. The methods for estimating the potential evaporation are provided. The estimates of these values show that at the present state of agricultural technology, natural moisture conditions fail to satisfy agricultural requirements. These findings indicate that the area north of the Huang He should be the key water importing region. (Halterman - PTT)
W86-03937

EVAPOTRANSPIRATION AND SOIL WATER RELATIONSHIPS FOR SPRING WHEAT AND SOYBEAN,

North Dakota State Univ., Fargo. Dept. of Soil Science.
L. J. Brun, L. Prunty, J. K. Larsen, and J. W. Enz.
Soil Science SOSCAK, Vol. 139, No. 6, p 547-552, June 1985. 4 fig, 3 tab, 13 ref.

Descriptors: *Evapotranspiration, *Soil-water-plant relationships, Wheat, Soybeans, Statistical models, Soil water, Lysimeters, Root zone, Plant water.

Nonlinear models to statistically analyze the relationship between evapotranspiration and soil water content at variable levels of potential evapotranspiration were studied. Using precision weighing lysimeters, daily evapotranspiration for spring wheat (Triticum aestivum L.) and soybean (Glycine max (L.) Merrrill) was obtained. Soil water content in the root zone was measured by neutron attenuation. For purposes of analysis, the highest volumetric water content within the root zone was used as the indicator of available water to the plant. Similarly, pan evaporation was used as an index of potential evapotranspiration. Eight models were tested, using pan evaporation, soil water content, or both to predict evapotranspiration. The R-square values obtained were 0.89 for wheat and

0.76 for soybeans. The two simple variables do a good job of predicting evapotranspiration and describing the relationship of soil water content and potential evapotranspiration to actual plant water use. (Lantz-PTT)
W86-04407

WATER-LIMITED EQUILIBRIUM OF SAVANNA VEGETATION SYSTEMS,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2I.
W86-04545

INFLUENCE OF LOCAL LAND-SURFACE PROCESSES ON THE INDIAN MONSOON: A NUMERICAL STUDY,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W86-04634

RELATIONSHIP BETWEEN TIBET-TROPICAL OCEAN THERMAL CONTRAST AND INTERANNUAL VARIABILITY OF INDIAN MONSOON RAINFALL,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2B.
W86-04631

2E. Streamflow and Runoff

MODEL ANALYSIS OF GROUND WATER IN THE SAN LUIS VALLEY, COLORADO, U.S.A.,
Geological Survey, Louisville, KY.
For primary bibliographic entry see Field 2A.
W86-03977

METHODS OF HYDROLOGICAL COMPUTATIONS FOR WATER PROJECTS.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 7A.
W86-04000

CONSIDERATIONS ABOUT WATER MINERALIZATION OF SOME MOZAMBICAN RIVERS,
Direccao Nacional de Aq
J. Suschka.
Aqua AQUAAA, No. 1, p 19-24, 1986. 13 fig. 1 tab.

Descriptors: *Water quality, *Rivers, *Mozambique, *Mineralization, Salinity, Total dissolved solids, Water level fluctuations, Saline water intrusion, Limpopo River.

The salinity of the main Mozambican rivers has been examined. Most of the river waters turned out to have a salinity below 200 mg total dissolved solids (TDS/1), while a few water courses had a salinity below 50 mg TDS/l. Rivers subjected to great fluctuations in flow are affected in the dry season by back flow of saline sea water, sometimes to an extent of 20 to 40 km. Attention is drawn to the direct effects of extensive water use for agriculture and the indirect effects through water storage, on the water mineralization increase. In particular cases like the Limpopo river basin, further water development construction, can affect the water quality adversely and limit the water use for agricultural purposes. (Author's abstract)
W86-04151

TOPOGRAPHIC PARTITION OF WATERSHEDS WITH DIGITAL ELEVATION MODELS,
Hunter Coll., New York. Dept. of Geology and Geography.
For primary bibliographic entry see Field 4A.
W86-04157

PERSISTENCE IN THE SIZE DISTRIBUTION OF SURFICIAL BED MATERIAL DURING AN EXTREME SNOWMELT FLOOD,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W86-04173

STOCHASTIC MODEL OF SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz, and L. M. Watada.
Water Resources Research WRERAO, Vol. 22, No. 3, p 296-302, March 1986. 7 fig, 2 tab, 13 ref, 1 append. NSF Grant No. CEE-8300928.

Descriptors: *Stochastic models, *Seasonal runoff, *Runoff forecasting, Markov Process, Snowmelt, Snake River, Idaho, Bayesian models, Model studies, Actual runoff.

Each year the National Weather Service and the Soil Conservation Service issue a monthly sequence of five (or six) categorical forecasts of the seasonal snowmelt runoff volume to describe uncertainties in these forecasts for the purposes of optimal decision making, a stochastic model is formulated. A Bayesian Markov model of a sequence of categorical forecasts of the seasonal snowmelt runoff volume has been developed. The model provides a formal description of forecast uncertainties for the purposes of optimal decision making. The most likely class of decision problems to benefit from this model are Markov decision processes, which can fit into a discrete-time, finite, continuous-space, nonstationary Markov process. Posterior densities of the actual runoff conditional upon a forecast, and transition densities of forecasts are obtained from a Bayesian information processor. Parametric densities are derived for the process with a normal prior density of the runoff and a linear model of the forecast error. The structure of the model and estimation procedure are motivated by analyses of forecast records from five stations in the Snake River basin, from the period 1971-1983. The advantages of supplementing the current forecasting scheme with a Bayesian analysis are discussed. They are: (1) The format of the current forecasts, to which users have become accustomed, is preserved; (2) The credible interval has attached to it an explicit probability which can be set at any desired level; (3) The information contained in the forecast specifies completely the posterior density; and (4) The posterior density provides necessary information for optimal decision making and economic evaluation of forecasts. (Lantz-PTT)
W86-04192

OPTIMAL WATER SUPPLY PLANNING BASED ON SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 6B.
W86-04194

LOW-COST SYSTEM TO REMOTELY MEASURE PIEZOMETRIC HEAD,
M. E. Schaefer, and H. F. Hemond.
Ground Water Monitoring Review, Vol. 6, No. 2, p 87-91, Spring 1986. 3 fig, 1 ref.

Descriptors: *Piezometric head, *Remote control, *Cost analysis, Piezometers, Measuring instruments, Computers, Temperature effect, Data transmission, Salt marshes, Radios, Data acquisition.

A low-cost rapid response system to remotely collect piezometric head data in compressible porous media has been constructed. The system is based on low-cost temperature compensated pressure transducers, standard low-cost CMOS logic devices, low-cost commercially available two-way radios and a portable microcomputer. The basic system operation involves encoding a pressure transducer output, which is then transmitted on command via two-way FM radios to a base station located up to one-half mile away. The base station includes a TRS-80 Model 100 microcomputer which controls the network of remote stations and decodes and stores the information. The system has been field-tested using one nest of four piezometers. The system range in the marsh was about 1/2 mile for line-of-sight transmission and 1/4 mile when trees and shrubs interfered. One of the four piezometers was used as a control by opening both ports of the transducer to the atmosphere. In all field tests, there is a slight dip in the data for the control piezometer, which seems to result from temperature changes over the period of the test. This data collection system can also be used to monitor any set of environmental instruments that have a voltage output that can be scaled to 1 to 6 volts. This allows measurements of salinity, wind speed and direction, tide, or other environmental parameters to be made. As many as 16 nest of four instruments each can be sampled with the current setup. It is also possible to modify the system for long-term measurements by turning the non-essential circuitry off and on as needed. Because the Model 100 has a built-in modem, it could be connected to a telephone line in the field and operated remotely. Other modifications may be envisioned that further expand the realm of applicability of this system. (Lantz-PTT)
W86-04214

DIAGNOSTIC HYDROLOGY,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-04277

MIXING OF A STRATIFIED RIVER BY BARGE TOWS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5G.
W86-04306

SOLUTION TO THE KINEMATIC WAVE APPROACH TO OVERLAND FLOW ROUTING WITH RAINFALL EXCESS GIVEN BY PHILIP'S EQUATION,
Washington Univ., Seattle. Coll. of Forest Resources.
T. W. Cundy, and S. W. Tento.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1132-1140, August 1985. 9 fig, 4 tab, 14 ref, 1 append.

Descriptors: *Kinematic wave theory, *Overland flow, *Rainfall, *Mathematical models, Flow pattern, Mathematical studies, Algorithms, Models, Mathematical equations, Rainfall-runoff relationships, Infiltration.

A solution to the kinematic wave equations for overland flow routing where the lateral inflow term is determined from a constant rainfall rate and the infiltration model of Philip is presented. The solution uses the methdo of characteristics, and while it is not completely analystical, it reduces to a simple numerical procedure requiring only a Newton method or similar algorithm. The analysis presented deals with both the rising and falling stages. Example calculations, water surface profiles, and hydrographs are illustrated. The method may also serve as a test for finite difference schemes designed to solve the more difficult problem of unsteady, nonuniform lateral inflow, since at least parts of the solution are known analytically. (Geiger-PTT)
W86-04310

MOMENTS OF CATCHMENT STORM AREA,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-04316

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 1. THEORY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2A.
W86-04317

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 2. CASE STUDY,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2A.
W86-04318

EVALUATION OF THORNTHWAITE'S WATER BALANCE TECHNIQUE IN PREDICTING STREAM RUNOFF IN COSTA RICA,

Instituto Tecnologico de Costa Rica, Cartago. Dept. de Ingenieria Forestal.
J. C. Calvo.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 51-60, March 1986. 2 fig, 2 tab, 15 ref.

Descriptors: *Hydrologic budget, *Thornthwaite water balance method, *Stream discharge, *Statistical analysis, *Rio Macho, *Costa Rica, Confidence intervals, Runoff.

The Thornthwaite water balance technique was used to predict monthly stream runoff from the Rio Macho basin in Costa Rica. The method was tested by comparing observed and predicted runoff over a 15 water-year period. The study shows that this method provides mean annual and monthly estimates in close agreement with measured values. Generally these mean estimated values fall between the 90% confidence intervals for the measured runoff. These results indicate that the Thornthwaite method can be satisfactorily applied to estimate mean monthly streamflow in the uplands of Costa Rica. (Author's Abstract)
W86-04393

PERIODIC AUTOREGRESSIVE-MOVING AVERAGE (PARMA) MODELING WITH APPLICATIONS TO WATER RESOURCES,

Geological Survey, Denver, CO.
A. V. Vecchia.
Water Resources Bulletin WARBAQ, 21, No. 5, p 721-730, October 1985. 2 fig, 4 tab, 16 ref.

Descriptors: *Streamflow time series, *Model studies, *Model selection criteria, *Multivariate analysis, *Fourier analysis, Mathematical models.

Results involving correlation properties and parameter estimation for autoregressive-moving average models with periodic parameters are presented. A multivariate representation of the PARMA model is use to derive parameter space restrictions and difference equations for the periodic autocorrelations. Close approximation to the likelihood function for Gaussian PARMA processes results in efficient maximum-likelihood estimation procedures. Terms in the Fourier expansion of the parameters are sequentially included, and a selection criterion is given for determining the optimal number of harmonics to be included. Application of the techniques is demonstrated through analysis of a monthly streamflow time series. The PARMA model provides a powerful tool for modeling hydrologic time series that are observed at time resolutions smaller than one year. Maximum-likelihood estimation of PARMA models through the procedure set forth here involves little more computational difficulty than estimation with standard PARMA models. (Rochester-PTT)
W86-04529

PARAMETRIC/NONPARAMETRIC MIXTURE DENSITY ESTIMATION WITH APPLICATION TO FLOOD-FREQUENCY ANALYSIS,

Texas Univ. at El Paso. Dept. of Mathematics.
E. Schuster, and S. Yakowitz.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 797-804, October 1985. 4 fig, 3 tab, 31 ref. NSF CEE-81-10889, DPP-82-19439.

Descriptors: *Mathematical models, *Statistical methods, *Flood peak, *Flood frequency, Simulation analysis, Hypothesis testing.

Nonparametric density estimation methodology is suggested as a means of sidestepping the dilemma of choosing a model in analysis of peak annual flows in the context of flood frequency analysis. Simultaneously, the authors recognize that the standard nonparametric estimators preclude the use of prior information and related data and, furthermore, have virtually no tail at all. They offer a remedy for these inadequacies by introducing an estimator that mixes parametric and nonparametric density estimates. The procedure allows incorporation of prior information, experience, and regional data information, but provides a safeguard against incorrect model choice. Pointers are offered on implementation of the suggested procedures and the results of a simulation study are described. Application to the regionalization problem is outlined and some connections with hypothesis testing are discussed. (Rochester-PTT)
W86-04531

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: I. REVIEW, ALGORITHM, AND SIMULATION EXPERIMENTS,

Halff (Albert H.) Associates, Inc., Dallas, TX.
M. J. Bergman, and J. W. Delleur.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 815-826, October 1985. 4 fig, 4 tab, 31 ref.

Descriptors: *Streamflow forecasting, *Mathematical models, *Forecasting, Simulation analysis, Hydrologic models, Statistical methods.

State space techniques and Kalman filtering are applied to the class of autoregressive (AR) models for real-time flow forecasting. State-space formulation is reviewed and an adaptive algorithm is discussed that estimates model parameters, system noise statistics, and measurement noise statistics simultaneously with the state variables (stream flows). To estimate the parameters, the filter operates alternately in the state space and the parameter space. Estimation of the noise statistics involved linearization of the measurement equation. The procedures made explicit use of the optimality properties of the Kalman filter. The several cases presented showed good estimation and forecasting capabilities. This was confirmed by analysis of an innovation sequence, which indicated near optimal filter behavior. Model parameter estimates were improved compared to others commonly used in hydrology, such as least squares and maximum likelihood estimators. This was due to noise in the observations. (see also W86-04534)(Rochester-PTT)
W86-04533

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: II APPLICATION TO THE POTOMAC RIVER,

Halff (Albert H.) Associates, Inc., Dallas, TX.
M. J. Bergman, and J. W. Delleur.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 827-832, October 1985. 4 fig, 3 tab, 11 ref.

Descriptors: *Forecasting, *Streamflow forecasting, *Mathematical models, Statistical method, Simulation analysis, Potomac River, Hydrologic models.

State space formulation and Kalman Filtering were applied to the general class of autoregressive models. Methodologies pertaining to the estimation of parameters and noise statistics were applied to the daily flows of the Potomac River. The results from the implementation of the model to the forecasting of daily river flows up to four days ahead are reported. The use of Kalman filtering techniques could result in an overall reduction of mean square forecast error compared to non-filtering techniques (maximum likelihood method). This trend was not always consistent for all forecast periods investigated, however. (see also W86-04533)(Rochester-PTT)
W86-04534

2F. Groundwater

SHALLOW GROUNDWATER RESOURCES OF THE HUANG-HUAI-HAI PLAIN,

Z. Yanhua, and Z. Xianglin.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 257-270, 3 fig, 2 tab.

Descriptors: *Diversion, *Water transfer, *China, Agriculture, Industrial water, Water use, Water supply, Water supply development, Basins.

As part of the assessment of the proposed south-north water transfer project in eastern China, the shallow groundwater resources of the Huang-Huai-Hai Plain is described, and the hydrogeological problems along one of the proposed routes of the project is discussed. Although the shallow groundwater resources of the basin are not excessive, a tremendous potential remains. It is suggested that this could satisfy the requirements of agriculture and industry in the near future. (Halterman - PTT)
W86-03936

CONTRIBUTION OF ISOTOPE TECHNIQUES IN THE DETERMINATION OF THE RELATIONSHIP SURFACE WATER/GROUNDWATER IN BANGLADESH (GANGES AND BRAHMAPUTRA AREAS),

International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 2A.
W86-03969

GROUND-WATER MODELS, VOLUME I: CONCEPTS, PROBLEMS, AND METHODS OF ANALYSIS WITH EXAMPLES OF THEIR APPLICATION.

United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
The UNESCO Press: Paris, France, 1982. 235 p.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, Aquifers, Mathematical models, Alluvial fans, Karst, Artesian basins, Recharge.

The use of models for studying groundwater is explored. General information includes human activities which influence groundwater, the mathematical framework of models, types of groundwater models, methods of solution (analytical, stochastic, discretized, analog), management models, and adaptability of models for developing countries. Twenty-one case histories of model applications are presented. These are grouped into several categories: alluvial valleys, mountain valleys, alluvial fans, large phreatic aquifer fans, fractured rock, karst, and small artesian basins. (Caser - PTT)
W86-03974

APPLICABILITY OF MODELS TO ALLUVIAL VALLEYS: ARKANSAS RIVER VALLEY, COLORADO, U.S.A.,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2A.
W86-03975

MODEL OF THE AQUIFERS IN THE LLOBREGAT DELTA (CATALONIA, SPAIN),

Curso Internacional de Hidrolgia Subterranea, Barcelona (Spain).
E. Custodio.
IN: Groundwater-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 39-51, 5 fig, 11 ref.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, *Rivers, Llobregat River, Spain, Aquifers, Coastal aquifers, Saline water intrusion, Groundwater depletion, Water supply.

A model was developed to study the aquifers of the Llobregat Delta near Barcelona, Spain. The two-layer system has a semipermeable layer which isolates the two aquifers in the central coastal area of the delta. There is only a single aquifer in the sides and lower end of the valley. The system is surrounded by impermeable material, which limits the flow of water from the alluvial deposits up-

stream. Both aquifers contact the seabed in places. The water supply in this region of high population and extensive groundwater withdrawal is believed to be near its limit. Modeling results indicated that with the present withdrawal situation, a period of three consecutive dry years would make it impossible to maintain withdrawals for more than two years. However, at the end of a sequence of three consecutive dry years followed by two wet years, the groundwater levels would recover. Human interventions such as channeling and increased regulation of upriver dams would produce the same result. The aquifer system could not support an increase in pumping rate of 15 cu hm/yr. (Cassar - PTT)
W86-03976

AQUIFER OF ULLUM-ZONDA VALLEY (ARGENTINA),

United Nations, New York.
A. A. Navarro, and J. A. Parca.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 67-72, 2 fig, 2 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, Aquifers, Recharge, Reservoirs, Ullum Valley, San Juan Valley, Argentina, Groundwater recharge, Dams, Reservoirs.

Three digital models were used to simulate the groundwater regime of the uninhabited Ullum-Zonda Valley, Argentina. This region is upstream from the agricultural San Juan Valley, which requires additional irrigation water. A dam is planned to transfer water from the Ullum Valley to San Juan Valley. Results indicated that the reservoir, inundating 13 sq km of land, was necessary if water is pumped continuously from the Ullum well field. This would create additional recharge in the complex hydraulic system, river-reservoir-aquifer-wells. (Cassar - PTT)
W86-03978

SAN JOSE DEL CABO, BAJA CALIFORNIA, NARROW VALLEY AQUIFER,

Universidad Nacional Autonoma de Mexico, Mexico City.
C. V. Cruickshank.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 73-78, 3 fig, 3 ref.

Descriptors: *Groundwater *Model studies, Aquifers, Coastal aquifers, Saline water intrusion, San Jose del Cabo, Mexico.

Aquifer behavior was modeled in the semiarid San Jose del Cabo Valley, Baja California, to study pumping rates and well locations. Salt water intrusion was prevented with an alternative which extracted up to 20 million cu m/yr with wells located in the downstream end of the valley, but not too close to the sea (the closest well was 4 km from the coast). Larger extractions could have been obtained by locating the wells further upstream; however, pumping levels would then have been too low and the water volume exploited far in excess of the estimated recharge. (Cassar - PTT)
W86-03979

ASSESSMENT OF EXPLOITABLE GROUNDWATER RESOURCES OF THE SOKH DEBRIS CONES,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenernoi Geologii, Moscow (USSR).
I. V. Garmonov.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 79-83, 1 fig, 3 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, *Alluvial fans, *Debris cones, Aquifers, Infiltration, Recharge, Sokh debris cone, USSR.

Debris cones (alluvial fans) are found where mountain streams emerge upon a plain or intermountain area. The Sokh debris cone in the Soviet Union was studied by a mathematical model to provide information on groundwater exploitation. Located in an old irrigated agricultural area, the cone consists of several zones: (1) a zone of surface runoff infiltration and groundwater transit, (2) a zone in which permeable deposits wedge out, (3) a zone of poor unconfined groundwater, (4) a zone of shallow unconfined groundwater. The main source of recharge is infiltration. Several aquifers, some artesian, are present in the lower part of the cone. Patterns of groundwater movement and recharge are complex, with confined and unconfined conditions. The hydrogeological conditions vary not only down the slope but also laterally across the slope. Model results showed that the seasonal and perennial groundwater regime in the confined aquifers is determined by the surface water discharge. Calculations of data from the Sokh debris cone established that the average discharge of the groundwater flow formed in the zone of the surface runoff infiltration for the period 1955-1956 averaged 27 cu m/sec, of which 18 cu m/sec returned to the surface in the zone of pinch out. Later, in the 1960's, after many irrigation canals were concrete-lined in the zone of surface infiltration, the average annual discharge of the groundwater flow was reduced by 4 cu m/sec and the groundwater discharge in the zone of pinch out by 7 cu m/sec. (Cassar - PTT)
W86-03980

APPLICABILITY OF MODELS TO A LARGE AQUIFER: THE OGALLALA FORMATION OF COLORADO,

Geological Survey, Denver, CO.
R. R. Luckey.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 85-91, 2 fig, 10 ref.

Descriptors: *Groundwater mining, *Model studies, *Hydrologic models, Ogallala Aquifer, Colorado.

Modeling of the Ogallala formation in Colorado predicted water level declines to the year 2000 under several pumping regimes. Projected water level declines ranged from nearly zero in areas of little or no development to nearly 40 m in areas of maximum projected development. Maps were drawn to indicate those areas in which irrigation would soon no longer be practical. These coincided with the areas which were heavily developed prior to regulation of the groundwater system. Large areas will have less than 30 m of saturated thickness remaining by the year 2000. This is the minimum amount required for irrigation development. (Cassar - PTT)
W86-03981

PREDICATION OF CHANGES IN NATURAL GROUND-WATER RESOURCES OF A LARGE REGION (KAZAKH SSR),

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenernoi Geologii, Moscow (USSR).
A. A. Konoplyantsev, and S. M. Semenov.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 93-96, 1 fig, 2 ref.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, Recharge, Groundwater recharge, Kazakh, SSR, USSR.

A model was applied to the groundwater resources of the steppe-desert of the Kazakh SSR, where cities, industry, irrigated agriculture, and stock breeding are the principal water users. A map shows predicted changes in natural unconfined groundwater resources over the 2.8 million sq km area. (Cassar - PTT)
W86-03982

RADIOACTIVE AND CHEMICAL WASTE MIGRATION IN THE SNAKE RIVER PLAIN AQUIFER, IDAHO NATIONAL ENGINEERING LABORATORY,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W86-03983

CHANGES IN GROUND-WATER RESOURCES AS A RESULTS OF MINE DRAINAGE IN THE SEVEROURALSK BAUXITE AREA,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenernoi Geologii, Moscow (USSR).
Z. P. Lebedyanskaya.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 123-130, 5 fig, 5 ref.

Descriptors: *Groundwater movement, *Mine drainage, *Model studies, *Hydrologic models, Severouralsk mine, Drainage, Geohydrology, Karst, Aquifers, USSR.

Integrated application of a stochastic model of a karstic basin and a network analog model permitted the solution of a number of practical problems associated with bauxite mining in the Severouralsk area (USSR), namely: (1) to evaluate a change in the groundwater regime due to mine drainage and to predict changes in the water resources in the region caused by future mining; (2) to predict the changes in the groundwater balance at different stages of mining; (3) to evaluate possible general mean inflow into the system of mine works at design depths to 1000 m; (4) to show the expediency of diverting a river in a karst area, thereby to evaluate the hydrogeological efficiency of this measure and to identify the river bed sections to be isolated; and (5) to recommend a rational scheme for draining deep aquifers providing outflow through drainage systems, galleries, and pumping wells. (Author's abstract)
W86-03984

ASSESSMENT OF EXPLOITABLE GROUND-WATER RESOURCES ON THE BASIS OF MEASUREMENTS OF SPRING FLOW,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenernoi Geologii, Moscow (USSR).
M. A. Khordikainen.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 131-136, 3 fig, 1 ref.

Descriptors: *Groundwater, *Springs, *Karst, Crimea, Filtration springs, Perennial springs, Fluation springs, Karst hydrologu, USSR.

The springs of the southern coast of Crimea serve as a water supply for the population. Discharge measurements involved 85 springs. The area is composed of Jurassic karstic limestones. One series measured discharges 10 times a month for 3 to 24 years. The other statistics were obtained once during the low water period, both for high and low water years. Mathematical analysis revealed the reliable resources from filtration-type springs, mixed-type springs, and floation-type springs. Filtration-type springs have very small variations in the amplitude of discharge. They are perennial. Floation-type springs have a much greater variability in discharge. They react quickly to precipitation, usually 1-3 days, sometimes 5-10 days. Mixed-type springs have discharges more like filtration springs but with greater amplitude. Both filtration- and mixed-type springs have a peak discharge in February-March, then a smooth decrease in discharge takes place. In karstic regions the exploitable groundwater resources are much less than the mean perennial discharges. For the filtration-type springs this difference is not more than 2-10 fold; for mixed-type springs, 4-20 fold; and for floation-type springs, 40-50 fold. (Cassar - PTT)
W86-03985

MODELING OF THE SUBSIDENCE OF VENICE,

Centro di Ricerca IBM di Venezia (Italy).
For primary bibliographic entry see Field 6G.
W86-03987

SIMULATED OIL-SHALE MINE DEWATERING USING A CONFINED MULTIAQUIFER MODEL, PICEANCE BASIN, COLORADO, U.S.A.,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 4C.
W86-03988

MODELING OF GROUND-WATER HYDROLOGY IN THE HOUSTON DISTRICT, TEXAS,

Kansas State Geological Survey, Lawrence.
D. G. Jorgensen.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 167-176, 4 fig, 1 tab, 10 ref.

Descriptors: *Groundwater, *Environmental effects, *Subsidence, *Hydrologic models, *Model studies, Soil compaction, Compaction, Houston, Texas, Aquifers.

Groundwater withdrawal and its effect on hydrology in the Houston, Texas, area were modeled, using two analog models and a digital model. Problems encountered in this region are water level decline, land subsidence, and salt water intrusion. Three aquifers are present: Chicot (upper), Evangeline (underlying Chicot and the most important water source), and the Burkeville confining layer. The second, more refined analog model simulated water level declines and quantity of water resulting from clay compaction with a high degree of accuracy. It also simulated, to a reasonable degree, the total amount of water derived from clay compaction. The digital model correctly simulated head in both aquifers, the quantity of water resulting from clay compaction, and the correct spatial distribution of the compaction (subsidence). Figures illustrate the groundwater withdrawals from 1890 to 1976 and predicted withdrawals to 1981, decline in the altitude of the potentiometric surface in the Evangeline aquifer (up to 120 cm), and land subsidence (up to 210 cm). A table lists the volume of water derived from clay compaction and the total groundwater pumped during several periods between 1980 and 1964. The compaction ratios (compaction divided by water pumped) are 0.17 to 0.22. (Cassar - PTT)
W86-03989

ANALOGUE MODEL OF THE CHAD BASIN,

Kwara State Water Corp., Ilorin (Nigeria).
J. U. Uzoma.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 183-192, 2 fig, 1 tab, 3 ref.

Descriptors: *Groundwater, *Model studies, *Surface-groundwater relationships, Chad, Africa, Artesian basins, Hydrographs, Confined aquifers, Analog models, Aquifers.

An electric analog model of the Chad Basin aquifer (chiefly Pleistocene deposits) was constructed in 1968 to help in the operation and management of the groundwater resources of the basin. Confined groundwater exists in the sand bodies within the quaternary argillaceous sequence. Flowing artesian wells are common here. Drilling of boreholes and other field exploration tests identify three aquifer zones: the upper or shallow, largely unconfined aquifer; the middle zone, which has the most important yield; and the lower zone, which has a lesser yield than the middle zone. No hydraulic intercommunication exists between the confined aquifer and Lake Chad. However, the shallow aquifer receives seasonal recharge from surface waters. The analog model of the Chad Basin artesian aquifer has been described as hypothetical and best suited for demonstration. Problems with the model are lack of sufficient data. The model could have greater use if the enormous amount of data that have accrued is incorporated. (Cassar - PTT)
W86-03991

MODEL OF THE TERMINAL COMPLEX OF THE OUED R'HIR (ALGERIA),

Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
A. Levassor.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 193-204, 4 fig, 3 tab, 4 ref.

Descriptors: *Groundwater *Model studies, *Hydrologic models, *Irrigation requirements, Oued R'hir Valley, Algeria, Date palms.

Model studies of the Oued R'hir region of Algeria were conducted to assess the groundwater reserves, considering that slow depletion in this date-growing region appears inevitable. A four-year plan to plant and irrigate 10,000 additional hectares of palm groves and to improve irrigation practices cannot be achieved with the water resources in this region alone. For the year 2000 the projected maximum withdrawals are less than half of the projected requirements. Since dates require a large amount of water (4000 to 6000 cu m) to produce 1 ton of dates, it is suggested that development deemphasize agriculture. (Cassar - PTT)
W86-03992

GROUND-WATER BALANCE IN THE AQUITAINE BASIN,

Ecole Nationale des Ingenieurs de Tunis (Tunisia).
M. Besbes, G. de Marsily, and M. Plaud.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 205-217, 4 fig, 8 tab, 8 ref.

Descriptors: *Groundwater, *Model studies, *Hydrologic models, Aquitaine basin, France.

Aquitaine, the largest sedimentary basin in France and the most abundant source of groundwater, has been exploited for more than a century. This report summarises the past ten years' efforts to forecast groundwater flow patterns using digital models. Modeling has added considerably to the knowledge of basin hydrology. One figure illustrates the computed head for 1965 in the Eocene level (layer 4). Another figure diagrams the steady-state gains and losses corresponding to groundwater layers in 1965. (Cassar - PTT)
W86-03993

ASSESSMENT OF EXPLOITABLE RESOURCES OF FRESH WATER LENSES IN ARID REGIONS,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenernoi Geologii, Moscow (USSR).
V. A. Babushkin.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 229-234, 3 fig, 6 ref.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, *Lenses, Yashkanian Lens, Turmenian, USSR, Wells, Injection wells, Aquifers.

An electric analog model was used to study the groundwater resource of the fresh water lenses in arid regions of the USSR, specifically the Yashkanian lens in Turkmenia. Paired wells, used to prevent salt water intrusion, have been operated in the Yashkanian water system for 15 years at a rate computed to be about 20% of the total exploitable resources. During operation the fresh-salt water interface was practically stable. Around the discharging wells a cone of depression with a drawdown of 3-4 m was formed. The size of the cone did not exceed 4-5 km. Model results confirmed these data. (Cassar - PTT)
W86-03995

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH: PROCEEDINGS,

Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
National Center for Ground Water Research, Houston, Texas. (1985). Edited by Norman N. Durham and Ann E. Redelfs. 222 p.

Descriptors: *Groundwater quality, *Groundwater contamination, *Path of contamination, *Water quality control, *Groundwater protection, Water quality, Water chemistry, Fate of pollutants.

This conference addresses many groundwater quality issues which have become of public concern, with the recent increase in public awareness of the potential problems of groundwater pollutants and contaminants. The conference emphasized physical, chemical and biological processes that control the movement and fate of contaminants in the subsurface. New and improved processes and methodologies were discussed and coordinated with biotic and abiotic molecular transformation processes. Transport processes and sorption procedures exhibited new concepts and philosophies. Information presented should be an aid to water quality research programs, where the techniques and methodologies discussed may be put to practice. (Lantz - PTT)
W86-04042

MICROBIOLOGICAL PARAMETERS CONTROLLING PLUGGING OF WELLS AND GROUNDWATER SYSTEMS,

Regina Water Research Inst. (Saskatchewan).
D. R. Cullimore.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 12-14, 16 ref.

Descriptors: *Water well plugging, *Clogging, *Obstruction to flow, *Groundwater movement, *Wells, Biofilm, Groundwater barriers, Gallionella, Bacteria, Heterotrophic bacteria, Biochemical tests.

The plugging of well screens and the neighboring interstitial zones of the aquifer can be microbiological in origin. In Saskatchewan, most microbial plugging is a direct result of biofilm generation. Microbiological examination of the wells revealed a diverse group of bacteria involved. These have been differentiated into three groups: (1) Gallionella, (2) other bacteria able to deposit iron or manganese oxides or hydroxides in or around the cell, and (3) heterotrophic bacteria able to grow in a biofilm. The major factors which are involved in developing a predictive formula for the risk of plugging are organic carbon, total iron, total manganese, total Kjeldahl nitrogen, pH, temperature and bacterial loading. A Plugging Risk Factor (P.R.F.) is under development. (Author's abstract)
W86-04045

ISOLATION AND GROWTH OF 'NATURALLY OCCURRING' BACTERIA FROM GROUND WATER,

Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
L. D. Stetzenbach, N. A. Sinclair, and L. M. Kelley.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 28-29, 2 fig, 1 tab, 13 ref.

Descriptors: *Groundwater, *Bacteria, *Microbiological studies, Aquifers, Acinetobacter, Flavobacterium.

Ground water is an increasingly significant source of potable water and is one of the least studied ecosystems. Assessment of man's impact on this resource requires knowledge of the 'naturally occurring' microbial populations. Since ground water from deep protected aquifers is generally assumed to be oligotrophic, a low nutrient medium (R2A) was selected for the primary isolation and enumeration of bacteria from well water. Of the 500 isolates recovered, >80% were Gram negative, non-motile, rod shaped bacteria. These organisms were identified according to the three tube method

of Lassen. Acinetobacter spp. predominated and comprised 59% of the total isolates. Moraxella spp., Flavobacterium sspp., and an unidentified, oxidase negative, pigmented bacterium (PO) were also present. Direct counts using epifluorescent microscopy revealed that representative isolates grew significantly (4 orders of magnitude) in filtered well water. Enrichment of well water with low concentrations (100 microgm carbon/liter or 1000 microgm carbon/liter) of glucose, acetate, succinate or pyruvate enhanced the growth of the PO and Acinetobacter isolates. (Author's abstract)
W86-04049

GROUNDWATER CONTAMINATION AT CONROE WASTE DISPOSAL SITE,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-04054

IRREVERSIBLE SORPTION OF TRACE LEVEL ORGANICS BY GROUND WATER HUMIC SUBSTANCES: A NEW MECHANISM OF TRANSPORT,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-04055

ORGANIC SOLUTE TRANSPORT IN GROUNDWATER DISCHARGE ENVIRONMENTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04056

CHEMICAL TRANSFORMATIONS IN GROUNDWATER,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
For primary bibliographic entry see Field 2B.
W86-04057

GEOCHEMICAL INVESTIGATIONS INTO GROUNDWATER POTENTIAL CONTAMINANTS RESULTING FROM UNDERGROUND COAL GASIFICATION (UCG),
Ground Water Sampling, Inc., Englewood, CA.
For primary bibliographic entry see Field 5B.
W86-04058

DISTRIBUTION OF SELECTED TRACE ORGANICS IN THE LEACHATE PLUME OF A MUNICIPAL LANDFILL,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04059

FACTORS INFLUENCING THE SURVIVAL OF VIRUSES IN GROUND WATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5B.
W86-04060

REMOVAL OF IRON AND MANGANESE FROM GROUND WATER WITH THE VYREDOX METHOD,
Ground Water Associates, Inc., Arlington, MA.
For primary bibliographic entry see Field 5G.
W86-04061

SALINE CONTAMINANTS IN THE GROUNDWATERS OF EASTERN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04062

MODELING GROUND WATER TRANSPORT AT CONROE CREOSOTE WASTE SITE,
National Center for Ground Water Research, Norman, OK.
For primary bibliographic entry see Field 5B.
W86-04063

GEOHYDROLOGY SURROUNDING A POTENTIAL HIGH LEVEL NUCLEAR WASTE REPOSITORY IN THE PALO DURO BASIN, TX,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
M. A. Deyling, P. G. Smith, and L. Picking.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 91-94, 6 fig, 1 tab, 6 ref.

Descriptors: *Groundwater pollution, *Radioactive wastes, *Groundwater movement, *Geohydrology, Aquifers, Radionuclides, Waste storage, Palo Duro Basin, TX.

The Palo Duro Basin of the Texas Panhandle is being investigated as a potential high level nuclear waste repository site. As groundwater is the most likely mechanism for radionuclide movement, it is desirable to locate a repository in a hydrologic regime which is favorable for waste isolation and containment. The Palo Duro Basin consists of deep brine aquifers of low regional permeability underlying a thick Permian age evaporite section. Overlying the Permian age evaporites are the Dockum and Ogallala fresh water aquifers. Observed potentiometric data in the principal aquifers indicate a potential for downward flow from the surficial aquifers to the deep brine aquifers. Groundwater movement in these deep aquifers is very slow. Modeling efforts indicate flow times of hundreds of thousands to over a million years for groundwater to reach the basin margins. Investigative methods have included drill-stem testing similar to oil field methodology, modified drill-stem testing with tools developed for low-permeability formations and long term production tests similar to conventional water well pumping tests. Testing has generally indicated permeability of .1-10 millidarcies in the water transmitting units. (Author's abstract)
W86-04064

ADVECTION AND RETARDATION IN AN EXPERIMENTAL PLUME OF SORBING AND NON-SORBING SOLUTES,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04065

CONTRIBUTIONS TO THE FATE OF UNDERGROUND ORGANIC CONTAMINANTS DURING UNDERGROUND PASSAGE,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W86-04066

ASSESSING THE QUALITY OF GROUNDWATER NEAR A COASTAL PLAIN USED FOR AGRICULTURE AND DISCHARGE OF SEWAGE,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5D.
W86-04067

ONE-DIMENSIONAL MATHEMATICAL MODEL OF VIRUS TRANSPORT,
Holzmacher, McLendon and Murrell, Melville, NY.
For primary bibliographic entry see Field 5B.
W86-04068

TRANSPORT OF HALOGENATED ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04071

MODEL TO EVALUATE SALT WATER INTRUSION DUE TO DIFFERENT CONJUNCTIVE USE STRATEGIES IN COASTAL AQUIFERS IN SAUDI ARABIA,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04072

IMPROVED NUMERICAL MODELLING OF CONTAMINANT TRANSPORT IN SATURATED AQUIFERS,
North Carolina Univ. at Charlotte.
For primary bibliographic entry see Field 5B.
W86-04073

GROUNDWATER POLLUTION IN NORTHWEST ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04074

PHYSICAL TRANSPORT PROCESS FOR HYDROCARBONS IN THE SUBSURFACE,
Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W86-04075

DELINEATING GROUNDWATER CONTAMINATION BY HOUSEHOLD WASTEWATER,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W86-04076

VIRAL AND BACTERIAL CONTAMINATION OF GROUNDWATER BY ON-SITE WASTEWATER TREATMENT SYSTEMS IN SANDY COASTAL SOILS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W86-04077

FINITE ANALYTIC METHOD FOR SOLUTION OF ONE-DIMENSIONAL TRANSIENT TRANSPORT EQUATIONS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04079

DEVELOPING INFORMATION ON ALDICARB LEVELS IN LONG ISLAND GROUNDWATER,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W86-04080

SPRINGS ARE MORE EFFICIENT AND RELIABLE THAN WELLS FOR MONITORING GROUND WATER QUALITY IN MOST LIMESTONE TERRAINS - A CONSEQUENCE OF TRANSPORT PROCESSES OCCURRING IN CONDUITS,
National Park Service, Mammoth Cave, KY.
For primary bibliographic entry see Field 5B.
W86-04081

SEAWATER INTRUSION IN THE SAN JUAN ISLANDS,
San Diego State Univ., CA. Dept. of Natural Science.
For primary bibliographic entry see Field 5B.
W86-04083

SUBSURFACE TRANSPORT OF URBAN RUNOFF POLLUTANTS,
Arizona Univ., Tucson.

For primary bibliographic entry see Field 5B.
W86-04084

FINITE ELEMENT METHOD WITH REGION WISE ITERATION SCHEME FOR SOLVING GROUNDWATER SOLUTE TRANSPORT EQUATION,

Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-04085

SOME CONCEPTS PERTAINING TO INVESTIGATIVE METHODOLOGY FOR SUBSURFACE PROCESS RESEARCH,

Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W86-04086

STATISTICAL EXAMINATION OF SMALL-SCALE SPATIAL VARIABILITY OF VOLATILE ORGANIC COMPOUNDS AND INORGANIC ANIONS IN GROUNDWATER,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04089

SAMPLING ANALYTICAL CONCERNS IN VOLATILE ORGANIC CONTAMINANT STUDIES,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5A.
W86-04090

IN-SITU DETERMINATION OF DISPERSION COEFFICIENTS AND ADSORPTION PARAMETERS FOR CONTAMINANTS USING A PUSH-PULL TEST,

Insitu Consulting, Laramie, WY.
For primary bibliographic entry see Field 5B.
W86-04092

IDENTIFICATION OF SUBSURFACE BRINES USING STATISTICAL TECHNIQUE,

National Inst. of Hydrology, Roorkee (India).
For primary bibliographic entry see Field 5A.
W86-04093

MINIMIZING PROBLEMS CAUSED BY UNEQUAL DEVELOPMENT OF BIOLOGICAL ACTIVITY WITHIN COLUMN MICROCOSMS USED TO PREDICT THE FATE OF POLLUTANTS IN SUBSURFACE MATERIALS,

Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5A.
W86-04095

QUANTIFYING GROUNDWATER STORAGE AND INTERACTION IN A MULTI-LAYERED ALLUVIAL AQUIFER,

Agricultural Research Service, Durant, OK.
J. W. Naney, D. C. Kent, M. R. Hemann, and R. Neafus.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 199-202, 4 fig, 2 tab, 6 ref.

Descriptors: *Groundwater storage, *Alluvial aquifers, *Hydraulic properties, Hydrology, Wells, Irrigation wells, Aquifers, Pumping tests, Washita River, Anadarko, Oklahoma.

Comparisons are made between total penetration wells and those completed in selected layers of the Washita River alluvium near Anadarko, Oklahoma in order to determine the effects of layered lithology on aquifer yield. The hydraulic characteristics developed from analysis of core samples from individual sand and silt layers within the alluvium are used to estimate groundwater storage and movement within the alluvium. Pumping tests of a nearby total penetration irrigation well and those from research test wells are compared in order to relate yield determined by analytical techniques to that of a producing well. Aquifer test results are presented for wells in specific layers. A unique relationship between the D50 grain size and the permeability within each layer is demonstrated which makes it feasible to use the laboratory test, rather than the more expensive pumping test to determine permeability. The results of the multilayered and homogeneous cases are compared using a map of transmissivity residuals which indicates areas of reduced storage within nearly 70,000 acres of aquifer during a 20 year period of simulated pumping in the Washita River alluvium. (Author's abstract)
W86-04096

USE OF ELECTRICAL RESISTIVITY METHOD TO STUDY VERTICAL HYDROLOGIC BOUNDARIES IN WADI SUDR, SINAI PENINSULA, EGYPT,

King Faisal Univ., Al-Hasa (Saudi Arabia). Coll. of Agriculture.
M. A. A. Sayed.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 203-207, 4 fig, 2 tab, 4 ref.

Descriptors: *Electrical properties, *Resistivity, *Vertical flow, *Geohydrologic boundaries, Hydrology, Saline water, Groundwater, Boundary layers, Wells, Wadi Sudr, Sinai Peninsula, Egypt.

The method of electrical resistivity sounding was applied to the Delta of Wadi Sudr in Sinai Peninsula to study, within the upper 25-35 m of Pliocene and Quaternary strata, the relation between the lithologic succession and the presence of both fresh and saline water bearing formations at different depths. Interpretation of the sounding curves indicates that the geoelectric succession in the area corresponds to hydrologic rather than lithologic boundaries. The results indicate that: (1) Four geoelectric layers are recognized which represent the soil zone, aeration zone, fresh water zone and sea water zone. (2) Depths of the boundaries between these zones are 1-2.5 m, 4-10.5 m and 21-17 m respectively from ground surface. (3) Resistivities of the four geoelectric layers are 53-1000 ohm.m, 25-343 ohm.m, 18-120 ohm.m and 5-16 ohm.m respectively. The results obtained show good agreement with the known geologic and hydrologic settings of the area and the method used has proved to be useful in locating vertical hydrologic successions. The results show also that water wells to be drilled in the future in the area should not exceed a depth of 25 m and that pumping rates and periods should be under accurate control as to the change in water quality due to overpumping. (Author's abstract)
W86-04097

SIMPLIFIED GROUNDWATER SAMPLING TECHNIQUES AT LANDFILLS,

Beling Consultants, Inc., Moline, IL.
For primary bibliographic entry see Field 5B.
W86-04098

POROUS FLOW MODEL FOR STEADY STATE TRANSPORT OF RADIUM IN GROUNDWATER,

Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics.
For primary bibliographic entry see Field 5B.
W86-04159

ORIGIN AND DISTRIBUTION OF SULFATE IN A FRACTURED TILL IN SOUTHERN ALBERTA, CANADA,

Department of Agriculture, Lethbridge (Alberta). Groundwater Section.
For primary bibliographic entry see Field 2K.
W86-04160

REVIEW OF PARAMETER IDENTIFICATION PROCEDURES IN GROUNDWATER HYDROLOGY: THE INVERSE PROBLEM,

California Univ., Los Angeles. Dept. of Civil Engineering.
W. W.-G. Yeh.
Water Resources Research WRERAO, Vol. 22, No. 2, p 95-108, February 1986. 2 tab, 118 ref. NSF Grant Nos. CEE 8118500 and CEE 8301230.

Descriptors: *Geohydrology, *Parametric hydrology, *Inverse problem, *Reviews, Mathematical studies, Evaluation.

The purpose of this survey is to review parameter identification procedures in groundwater hydrology and to examine computational techniques which have been developed to solve the inverse problem. Parameter identification methods are classified under the error criterion used in the formation of the inverse problem. The problem of ill-posedness in connection with the inverse problem is addressed. Typical inverse solution techniques are highlighted; specifically, the (1) generalized matrix method based upon the equation error criterion method, and the (2) Gauss-Newton minimization based upon the output error criterion method. The review also includes the evaluation of methods used for computing the sensitivity matrix (influence coefficient method, sensitivity equation method). Statistics which can be used to estimate the parameter uncertainty are outlined. Attempts have been made to compare and contrast representative inverse procedures, and direction for future research is suggested. (Lantz-PTT)
W86-04164

ESTIMATION OF AQUIFER PARAMETERS UNDER TRANSIENT AND STEADY STATE CONDITIONS: 1. MAXIMUM LIKELIHOOD METHOD INCORPORATING PRIOR INFORMATION,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, and S. P. Neuman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 199-210, February 1986. 3 fig, 80 ref. Research Grant T3770171.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Transient conditions, *Steady-state conditions, *Maximum liklihood method, *Statistical analysis, Inverse problem, Hydraulic properties, Regression analysis.

Some of the advantages in treating the inverse problem in groundwater flow analysis statistically and in regularizing its solution by means of penalty criteria are discussed based on use of prior estimates of the parameters. The inverse problem is posed in the framework of maximum likelihood theory cast in a manner that accounts for prior information about the parameters. Since not all the factors which contribute to the prior errors can be quantified statistically at the outset, the covariance matrices of these errors are expressed in terms of several parameters which, if unknown, can be estimated jointly with the hydraulic parameters by a stagewise optimization process. When transient head data are separated by a fixed time interval, the temporal structure of these data is approximated by a lag-one autoregressive model with a correlation coefficient that can be treated as another unknown parameter. Estimation errors are analyzed by examining the lower bound of their covariance matrix in the eigenspace. Conclusions are drawn which suggest that certain model identification criteria developed in the time series literature, all of which are based on the maximum likelihood concept, might be useful for selecting the best groundwater model (or the best method of parameterizing a particular model) among a number of given alternatives. (see also W86-04175 and W86-04176) (Lantz-PTT)
W86-04174

ESTIMATION OF AQUIFER PARAMETERS UNDER TRANSIENT AND STEADY STATE CONDITIONS: 2. UNIQUENESS, STABILITY, AND SOLUTION ALGORITHMS,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, and S. P. Neuman.

Water Resources Research WRERAO, Vol. 22, No. 2, p 211-227, February 1986. 10 fig, 1tab, 32 ref. Research Grant T3770171.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Transient conditions, *Steady-state conditions, Algorithms, Uniqueness, Stability, Solutions, Ill-posed problems, Conjugate gradient algorithms.

After defining the terms uniqueness, identifiability, and stability, theoretical considerations and synthetic examples are used to demonstrate that ill-posedness of the aquifer inverse problem can be mitigated by including prior information about the parameters in the estimation criterion to be minimized. At the same time, the inclusion of such information is shown to be insufficient to guarantee uniqueness and stability in all cases. Several test problems in the recent literature, which have resulted in pessimistic conclusions about the solvability of the aquifer inverse problem, are shown to be ill-posed; a question is thus raised about the validity of these conclusions in the general case. Various conjugate gradient algorithms, coupled with the adjoint state finite element method for computing the gradient of the estimation criterion, and with Newton's method for determining the optimum step size downgradient, are compared. A marked improvement in the rate at which these algorithms converge is shown to be achieved by switching from one method to another when the former slows down or fails to converge. (see also W86-04174 and W86-04176) (Lantz-PTT)
W86-04175

ESTIMATION OF AQUIFER PARAMETERS UNDER TRANSIENT AND STEADY STATE CONDITIONS: 3. APPLICATION TO SYNTHETIC AND FIELD DATA,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, and S. P. Neuman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 228-242, February 1986. 16 fig, 18 tab, 14 ref. Research Grant T3770171.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Transient conditions, *Steady-state conditions, *Field tests, *Synthetic data, Model studies, Model testing, Autocorrelation, Eigenspace.

Illustrated and explored are various features of a methodology for solving the inverse problem of aquifer hydrology, by applying it to a synthetic test case and to a set of field data from the southwestern United States. In addition to demonstrating the ability of the method to estimate model parameters under a variety of conditions, the synthetic example is used to investigate the relative worth of transient and steady state data in terms of their ability to bring about an improvement in the quality of the estimates. A similar investigation is performed with regard to the role that prior information may play in reducing the variance of the estimation errors. The paper demonstrates the potential utility of the author's inverse methodology to the optimum design of observation and measurement networks in space and time. Based on a synthetic example, it is shown that the model structure identification criteria previously introduced can be used successfully to choose the best parameter zonation pattern among a number of given alternatives. The field example illustrates a case where one must account for temporal autocorrelation between water level data at a given observation point. By validating the model against data which have not been used for parameter estimation, one finds that the validation results improve when the temporal error structure of the water level data is represented by a lag-one autocorrelation model. Both the synthetic and the field examples are used to obviate the advantages of performing the analysis of the estimation errors in the eigenspace instead of the original parameter space and to relate the results of this analysis to the fundamental questions of identifiability, uniqueness, and stability where appropriate. (see also W86-04174 and W86-04175) (Lantz-PTT)
W86-04176

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: MODEL DEVELOPMENT AND PARAMETER SENSITIVITY,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04190

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: EXPERIMENTAL RESULTS,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04191

FINITE ELEMENT ALGORITHMS FOR SIMULATING THREE-DIMENSIONAL GROUNDWATER FLOW AND SOLUTE TRANSPORT IN MULTILAYER SYSTEMS,

GeoTrans, Inc., Herndon, VA.
P. S. Huyakorn, B. G. Jones, and P. F. Andersen.
Water Resources Research WRERAO, Vol. 22, No. 3, p 361-374, March 1986. 16 fig, 2 tab, 24 ref. E.I. duPont deNemours Contract AX-654761.

Descriptors: *Groundwater movement, *Finite element method, *Algorithms, Aquifers, Flow system, Mathematical analysis, Simulation analysis, Mathematical studies.

A finite element formulation is developed for the simulation of groundwater flow and solute transport in multilayer systems of several aquifers and aquitards. This formulation is general, flexible, and capable of taking full advantage of the nature of flow in such multilayer systems. A fully three-dimensional spatial representation can be performed for certain aquifers or for the entire flow system if needed. Those parts of the system that require three-dimensional spatial discretization are handled effectively by combining two-dimensional basis functions in the x-y space and one-dimensional basis functions in the z space. Furthermore, the formulation has a desirable option to perform one-dimensional representation of flow and transport in aquitards and areal representation of flow and transport in certain aquifers that do not require the fully three-dimensional discretization. When the one-dimensional representation of an aquitard is used, coupling of adjacent aquifer and aquitard layers is handled using a convolution integral approach. A general solution strategy is also developed to allow systematic time stepping and cost-effective matrix handling schemes. For those parts of the system that require three-dimensional discretization, an algorithm referred to as the alternate sublayer and line sweep procedure is presented for decomposing three-dimensional matrix equations. This algorithm can accomodate several thousand nodal unknowns without requiring excessive core storage and CPU time. Four examples of transient flow and transport problems are provided. These examples show verification of numerical results and demonstrate that the present finite element models are far more cost-effective than earlier three-dimensional models that are based on the conventional Galerkin approach and direct matrix solution algorithms. (Author's abstract)
W86-04200

MODELING CONTAMINATION OF SHALLOW UNCONFINED AQUIFERS THROUGH INFILTRATION BEDS,

Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04201

INTERPRETATION OF AN UNCONFINED GROUNDWATER FLOW EXPERIMENT,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. Brutsaert, and A. I. el Kadi.
Water Resources Research WRERAO, Vol. 22, No. 3, p 419-422, March 1986. 4 fig, 8 ref. NSF Grant INT-8213639.

Descriptors: *Groundwater movement, *Unconfined groundwater, *Data interpretation, Experimental data, Water table profiles, Aquifers, Saturation.

A laboratory experiment is considered that was carried out on a sand tank to study the problem of water table geometry during flow to an adjacent stream. The purpose of the analysis is to determine whether the effects of partial saturation and of compressibility are likely to be important in this type of problem. Through numerical simulations and other considerations, it is concluded that compressibility alone, however large, cannot reproduce these experimental results. The results can only be simulated if proper account is taken of the partly saturated flow above the water table. Compressibility effects of aquifer material and of the water may be safely neglected. (Lantz-PTT)
W86-04205

ADAPTATION OF THE CARTER-TRACY WATER INFLUX CALCULATION TO GROUNDWATER FLOW SIMULATION,

Geological Survey, Denver, CO.
K. L. Kipp.
Water Resources Research WRERAO, Vol. 22, No. 3, p 423-428, March 1986. 2 fig, 1 tab, 16 ref.

Descriptors: *Carter-Tracy equation, *Groundwater movement, *Mathematical analysis, Aquifers, Computer models, Boundary processes, Boundary conditions, Flow rates.

The Carter-Tracy calculation for water influx is adapted to groundwater flow simulation with clarifying explanations. The Van Everdingen and Hurst aquifer-influence functions for radial flow from an outer aquifer region are employed. This technique, based on convolution of unit-step response functions, offers a simple but approximate method for embedding an inner region of groundwater flow simulation within a much larger aquifer region where flow can be treated in an approximate fashion. The use of aquifer-influence functions in groundwater flow modeling reduces the size of the computational grid with a corresponding reduction in computer storage and execution time. The Carter-Tracy approximation to the convolution integral enables the aquifer influence function calculation to be made with an additional storage requirement of only two times the number of boundary nodes more than that required for the inner region simulation. It is a good approximation for constant flow rates but is poor for time-varying flow rates where the variation is largely-relative to the mean. A variety of outer aquifer region geometries, exterior boundary conditions, and flow rate versus potentiometric head relations can be used. The radial, transient-flow case presented is representative. An analytical approximation to the function of Van Everdingen and Hurst for the dimensionless potentiometric head versus dimensionless time is given. (Author's abstract)
W86-04206

EFFECTIVE AND INEXPENSIVE GAS-DRIVE GROUND WATER SAMPLER,

GHR Environmental, Inc., New Bedford, MA.
For primary bibliographic entry see Field 5B.
W86-04208

FACTORS WHICH AFFECT SOIL-PORE LIQUID: A COMPARISON OF CURRENTLY AVAILABLE SAMPLERS WITH TWO NEW DESIGNS,

For primary bibliographic entry see Field 5B.
W86-04209

SAMPLING FOR TOXIC CONTAMINANTS IN GROUND WATER,

Kennedy/Jenks Engineers, San Francisco, CA.
For primary bibliographic entry see Field 5B.
W86-04210

LOW-COST APPARATUS FOR ON-SITE MONITORING OF METHANE IN GROUND WATER,

Allegheny Coll., Meadville, PA. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W86-04211

NEW VALVED AND AIR-VENTED SURGE PLUNGER FOR DEVELOPING SMALL-DIAMETER MONITOR WELLS,

Battelle Project Management Div., Richland, WA. Office of Hazardous Waste Management.
For primary bibliographic entry see Field 5B.
W86-04212

USE OF A GEO FLOWMETER FOR THE DETERMINATION OF GROUND WATER FLOW DIRECTION,

ARCO Petroleum Products Co., Houston, TX.
M. Guthrie.
Groundwater Monitoring Review, Vol. 6, No. 2, p 81-86, Spring 1986. 10 fig, 1 ref.

Descriptors: *Flowmeters, *Groundwater movement, *Geo Flowmeter, Landfills, Geohydrology, Water level, Channels, Flow velocity, Flow pattern, Drilling.

This paper is a case history of the use of the Geo Flowmeter (which is used to determine groundwater flow direction and velocity in monitoring wells or open boreholes) in a complex hydrogeologic setting consisting of a partially above grade landfill located between a navigable waterway and a large storm water impoundment basin. Mounding effects of the landfill, tidal changes in the channel, varying water levels in the impoundment basin and a complex substrate (alternating layers of sand, silt and clay) presented a challenge for groundwater interpretation and analysis. The Geo Flowmeter was lowered into existing monitoring wells surrounding the landfill to determine groundwater flow direction and rate. Sensitivity of the meter was sufficient to distinguish two separate flow directions in a single well screen. Later investigation involving installation of piezometers, long-term groundwater level monitoring and plotting of groundwater contours verified initial findings of the meter. When compared to an extensive drilling program, it is relatively inexpensive. In addition, much information can be derived by using the instrument and only a few wells. Disadvantages would include the time and effort it takes to understand and use the instrument properly. The operating manual certainly needs to be more explicit. It must be remembered that in many cases the meter will indicate a very local situation that could be subject to change. For example, the flow in some wells actually reversed because of tidal situations. Not all readings taken during the testing of this instrument were 100% convincing, particularly those taken in open boreholes. In a deep boring, it was very difficult to determine if the instrument was placed in the soil correctly. (Lantz-PTT)
W86-04213

LOW-COST SYSTEM TO REMOTELY MEASURE PIEZOMETRIC HEAD,

For primary bibliographic entry see Field 2E.
W86-04214

DETERMINING HEAD AND PRESSURE DISTRIBUTION IN LOW TRANSMISSIVITY FORMATIONS AND SOILS,

Gartner Lee Associates Ltd., Markham (Ontario).
K. G. Kennedy, S. C. Hollingshead, and R. E. J. Leech.
Ground Water Monitoring Review, Vol. 6, No. 2, p 92-98, Spring 1986. 6 fig, 1 tab, 3 ref.

Descriptors: *Soil water, *Pressure distribution, *Pressure head, Transmissivity, Model studies, Groundwater movement, Permeability coefficient, Drilling, Monitoring, Flow velocity, Data interpretation.

The prediction of groundwater flow system behavior relies on defining the transmissivity and potentials within the individual hydrostratigraphic units that are part of the system. Testing can be done to quantify the transmissivity, generally within a relatively short period of time after drilling or monitoring devices have been installed. However, the ability to determine the heads or pressures in the individual units can take longer periods of time. This is particularly true when the hydraulic conductivity of units is less than about 10 to the -8 m/s. These are commonly the most sought after types of deposits for waste management sites. Two application models were developed to determine the potentials in low transmissivity units. The first model, called headrop, was applied to shallow groundwater flow systems where hydraulic head and average linear velocities were typically of interest in relatively flat-lying layered sequences of low permeability soils. Water levels were measured in the more permeable hydrostratigraphic formations but no such data could be reliably obtained from the tighter clays and clayey till units. A second model, called presdrop, was applied to deeper groundwater investigations where pressures and fluid densities were measured but no useful fluid level information could be obtained. The following conclusions can be made from the studies done to date with the two models: 1) Long periods of time are required to obtain samples from and measure water levels in tight formations; 2) The head distribution within any flow system can be extrapolated knowing the transmissivity of individual units and the total head drop across the system or between higher permeability formations within the system; 3) The head profile can be used to determine the average linear groundwater velocities and total flux through the system; 4) The pressure profile in any deep groundwater flow system can also be determined knowing the transmissivity of individual units and the total pressure change and density differences in the system; and, 5) The application of these principles to both shallow and deep flow systems analysis has led to a better understanding of the systems and how they may potentially respond to external influences. (Lantz-PTT)
W86-04215

ELECTRONIC SENSING DEVICES USED FOR IN SITU GROUND WATER MONITORING,

Woodward-Clyde Consultants, Overland Park, KS.
For primary bibliographic entry see Field 7B.
W86-04217

FM RADIOTELEMETRY COUPLED WITH SONIC TRANSDUCERS FOR REMOTE MONITORING OF WATER LEVELS IN DEEP AQUIFERS,

Corps of Engineers, Winchester, VA. Middle East Div.
For primary bibliographic entry see Field 7B.
W86-04218

ANALYSIS OF A CONTAMINATED BEDROCK AQUIFER BY MEANS OF A PACKER AND ATTEMPTS AT REMEDIATION USING A PACKER,

Olin Chemical Group, Charleston, TN.
For primary bibliographic entry see Field 5B.
W86-04220

MICRO COMPUTERS APPLIED TO GROUND WATER MONITORING AND TESTING,

Dames and Moore, Baldwinsville, NY.
L. K. Branneka, and L. R. Keefe.
Ground Water Monitoring Review, Vol. 6, No. 2, p 135-139, Spring 1986. 3 fig.

Descriptors: *Computers, *Groundwater monitoring, *Aquifers, Piezometry, Data acquisition, Data storage, Pump testing, Porosity.

Documented are systems which have been developed and used for simultaneous monitoring of several wells during aquifer tests, and systems installed for long-term monitoring of piezometric surface fluctuations. Both systems can be contained in a small suitcase or insulated cooler. Specific features of the systems include multiple channel capacity, one-month maintenance period, variable computer controlled reading intervals, magnetic tape data storage, data reduction and analysis capabilities while maintaining monitoring, graphic display of time and measurements, hard copy capability and barometric pressure change corrections. Other applications are examined for the complete control of pumping tests, including pumping rate; in situ permeability tests; monitoring changes; and even strain. The pressure transducer system may also be applied for river gauging and current measurement. (Lantz-PTT)
W86-04222

RELATIONSHIP OF GEOLOGY, PHYSIOGRAPHY, AGRICULTURAL LAND USE, AND GROUND-WATER QUALITY IN SOUTHWEST GEORGIA,

Florida Sinkhole Research Inst., Orlando.
For primary bibliographic entry see Field 5B.
W86-04240

PROGRAM TO CALCULATE AQUIFER TRANSMISSIVITY FROM SPECIFIC-CAPACITY DATA FOR PROGRAMMABLE CALCULATORS,

Geological Survey, Denver, CO. Nuclear Hydrology Program.
For primary bibliographic entry see Field 7C.
W86-04243

SOLUTE-TRANSPORT SIMULATION OF BRACKISH-WATER INTRUSION NEAR BALTIMORE, MARYLAND,

For primary bibliographic entry see Field 5B.
W86-04274

RADIAL INJECTION TRACER EXPERIMENT IN A CONFINED AQUIFER, SCARBOROUGH, ONTARIO, CANADA,

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
C. D. Palmer, and R. L. Nadon.
Ground Water GRWAAP, Vol. 24, No. 3, p 322-331, May-June 1986. 16 fig, 2 tab, 13 ref.

Descriptors: *Radial injection, *Tracers, *Confined aquifers, *Scarborough, Ontario, Water storage, Thermal water, Injection wells, Monitoring wells, Mathematical analysis, Resistivity, Chlorides.

A radial injection tracer experiment was conducted to evaluate the feasibility of using a confined aquifer for the storage of chilled and/or heated water for a seasonal thermal energy storage system. Water was injected into the aquifer over a period of four hours at a rate of 22.7 l/s. Injection of the water into the aquifer continued for an additional 15 hours following injection of the salt solution. Samples were collected from a monitoring well located 6.54 m from the injection well. A sampling device was installed prior to the injection experiment to permit the collection of water samples at different elevations within the screened portion of the monitoring well. The samples which were collected at five different elevations at various times, both during and following the salt injection, were analyzed for specific conductance and chloride concentration. The data suggest that the aquifer is inhomogeneous and that the ratio of the hydraulic conductivity to porosity increases from the lowest sampling port to the highest sampling port near the top of the aquifer. A linear relationship was obtained between the time of arrival of the tracer and the apparent resistivity of the formation. This linear relationship was used to calibrate the apparent resistivity log of the injection well to provide a continuous characterization of the vertical variation in the hydraulic conductivity/porosity ratio across the full thickness of the aquifer. Data analysis also suggests that the dispersivity parameter varies linearly with the time of arrival of the tracer. The combination of geophysical logs with tracer experiments may permit detailed characterization of the hydraulic properties of aquifers. (Lantz-PTT)
W86-04276

DIAGNOSTIC HYDROLOGY,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-04277

CONTAMINANT MOVEMENT UNDER PUMPAGE-RECHARGE CONDITION IN STEADY GROUNDWATER FLOW SYSTEM,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-04278

EVALUATION OF TRANSIENT ELECTROMAGNETIC SOUNDINGS FOR DEEP DETECTION OF CONDUCTIVE FLUIDS,
University of South Florida, Tampa. Dept. of Geology.
M. Stewart, and M. C. Gay.
Ground Water GRWAAP, Vol. 24, No. 3, p 351-356, May-June 1986. 7 fig, 5 ref.

Descriptors: *Electromagnetic waves, *Geophysics, *Aquifer characteristics, *Sounding, *Saline-freshwater interfaces, *Conductivity, Resistivity, Unconfined aquifers, Saline-freshwater interfaces, Karst, Aquifers, Porosity, Chloride, Geohydrology.

Transient electromagnetic sounding methods (TEM) have several advantages over DC resistivity soundings. The primary advantage is that sounding depths several times the receiver-transmitter spacing can be achieved, resulting in less cumbersome field work and more flexible sounding site selection. The TEM method was tested using a commercially available instrument (Geonics EM-37) in the Gulf Springs region of west-central Florida to locate the salt-water interface in the Floridan Aquifer. The Floridan is a thick (200 m), unconfined, karstic, carbonate aquifer within the study area. High annual rainfall and internal drainage create a deep and dynamic interface. Eighty transient soundings were completed in 18 field days. Seventy-one soundings used a square 80 m x 80 m transmitter loop, and the other nine used a 160 m x 160 m coil. The interface was easily detected from a minimum depth of 60 m to its maximum depth of about 140 m. Also a high-resistivity, low-porosity zone was detected at depths ranging from 180 - 250 m. The TEM data compare well with available chloride concentration data. The TEM interface corresponds to chloride values in excess of 200 - 400 mg/l. The sounding curves obtained suggest that with presently available instruments the TEM method is not well-suited for shallow soundings (less than 40 - 50 m). (Lantz-PTT)
W86-04279

SATURATED THICKNESS FOR DROUGHT AND LITIGATION PROTECTION,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W86-04280

GROUND-WATER PROBLEMS IN THE MESOZOIC PAX MOUNTAIN FAULT ZONE,
Clemson Univ., SC. Dept. of Chemistry and Geology.
d. S. Snipes, P. R. Manoogian, M. W. Davis, L. L. Burnett, and J. A. Wylie.
Ground Water GRWAAP, Vol. 24, No. 3, p 375-381, May-June 1986. 3 fig, 3 tab, 16 ref.

Descriptors: *Groundwater potential, *Geohydrology, *Pax Mountain, *Geologic fractures, Igneous rocks, Metamorphic rocks, Boreholes, South Carolina, Wells, Clay, Potable water, Turbidity.

The present investigation deals with the hydrological problems encountered in exploring for groundwater in the Pax Mountain Fault zone, which is cut across by Paleozoic igneous and metamorphic rocks. This is the largest known Mesozoic fault in the Carolinas, having a length of more than 75 km and attaining a width of 1 km in places. Subsurface studies of seven wells, which were drilled along the axis of Pax Mountain, South Carolina, show that the composition of the fault rocks is much more complicated than was known before. These rocks consist of angular particles of quartz and feldspar fault breccia enclosed in a kaolinitic clay gouge. They vary greatly in degrees of consolidation and permeability, and these variations were the cause of some serious groundwater problems. Two wells were dry holes because the intergranular spaces of the breccia were clogged with clay and also because most of the joints were filled with secondary minerals. Three wells, which were drilled in more permeable, but poorly consolidated fault rocks, caved in at a depth of about 80 m just when they had encountered large volumes of water. Two of the seven wells produce potable water, but chemical analyses of the groundwater showed that their turbidity values were 6.0 turbidity units (t.u.) and 2.0 t.u., which exceed the limit of 1.0 recommended by the South Carolina Department of Health and Environmental Control. (Lantz-PTT)
W86-04282

ANALYTICAL AND APPROXIMATE SOLUTIONS TO RADIAL DISPERSION FROM AN INJECTION WELL TO A GEOLOGICAL UNIT WITH SIMULTANEOUS DIFFUSION INTO ADJACENT STRATA,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04304

GROUNDWATER MASS TRANSPORT AND EQUILIBRIUM CHEMISTRY MODEL FOR MULTICOMPONENT SYSTEMS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04307

MACROSCOPIC BALANCE EQUATIONS IN SOILS AND AQUIFERS: THE CASE OF SPACE- AND TIME-DEPENDENT INSTRUMENTAL RESPONSE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2G.
W86-04308

TRANSIENT FLOW TO A LARGE-DIAMETER WELL IN AN AQUIFER WITH STORATIVE SEMICONFINING LAYERS,
Geological Survey, Menlo Park, CA.
A. F. Moench.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1121-1131, August 1985. 8 fig, 38 ref, 1 append.

Descriptors: *Mathematical studies, *Aquifers, *Leaky aquifers, *Pumped storage, *Observation wells, Pump wells, Test wells, Transition flow, Aquifer testing, Theoretical analysis.

The Hantush theory of leaky aquifers with storage in the semiconfining layers is combined with large-diameter well theory to produce equations that can be used to analyze pumped-well and observation well data for stratified formations. The equations take into account pumped well storage and a linear resistance to flow at the sand face or well bore skin. Three cases proposed by Hantush are considered. These depend upon whether the upper boundary of the overlying semiconfining layer or the lower boundary of the underlying semiconfining layer are constant head or no-flow boundaries. Laplace transform solutions valid for the complete time domain, are given for each of the three cases for the hydraulic head in the pumped well, the aquifer, and each of the semiconfining layers. Type cures obtained by numerical inversion are used to show the effects of well bore storage, well bore skin, and leakage. Although several dimensionless parameters are involved, these parameters tend to influence the character of different portions of the type curves, suggesting that unique matches are possible. The type curves illustrate that well bore storage in a large-diameter well may completely obliterate effects of leakage derived from compressible storage in semiconfining layers. For the purposes of aquifer testing, it may be possible to reduce the magnitude of well bore storage in a large-diameter well and reveal the presence of leaky semiconfining layers, thus preventing erroneous interpretation of the well test data and incorrect evaluation of the aquifer parameters. (Geiger-PTT)
W86-04309

DISCRIMINATION OF GROUNDWATER SOURCES USING CLUSTER ANALYSIS, MANOVA, CANONICAL ANALYSIS AND DISCRIMINANT ANALYSIS,
Idaho Univ., Moscow. Dept. of Mathematics and Applied Statistics.
R. K. Steinhorst, and R. E. Williams.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1149-1156, August 1985. 5 fig, 3 tab, 12 ref. NRC 02 82 044.

Descriptors: *Multivariate analysis, *Statistical methods, *Groundwater recharge, *Mathematical studies, Mathematical models, Aquifers, Water quality, Chemical properties.

Multivariate statistical analysis of water chemistry variables provides an empirical method of establishing relationships and/or differences among groundwater samples taken spatially or temporally. Careful application of cluster analysis, multivariate analysis of variance, canonical analysis, and discriminant analysis provides insight into possible segregation among groundwater sources or mixing among aquifers and a subsequent test of that conjecture. The present method has been used successfully in an analysis of water sample data from the area of a proposed molybdenum mine in western Colorado, and in differentiating water quality among aquifers in basalt flows and interbeds on the Hanford Reservation in south central Washington. The statistically distinct groups of samples identified by the above methods are supported by structural and geochemical stratification mapping. (Geiger-PTT)
W86-04312

COMPARATIVE STUDY OF GREEN AND AMPT ANALYSIS FOR A FALLING WATER TABLE IN A HOMOGENEOUS SAND PROFILE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2G.
W86-04313

FIELD EXAMPLE OF MEASURING HYDRODYNAMIC DISPERSION IN A SINGLE FRACTURE,
Atomic Energy of Canada Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W86-04314

FREQUENCY DOMAIN APPROACH TO WATER QUALITY MODELING IN GROUNDWATER: THEORY,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W86-04315

IDENTIFYING HYDRAULICALLY CONDUCTIVE FRACTURES WITH A SLOW- VELOCITY BOREHOLE FLOWMETER,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-04337

EMPIRICAL EQUATIONS OF GROUNDWATER RECHARGE PATTERNS,
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 1-11,

March 1986. 4 fig, 3 tab, 18 ref.

Descriptors: *Regolith aquifers, *Groundwater recharge, *Temporal pattern, *Spatial pattern, *Saturated zone, *Rainfall-recharge relationship, *Least Squares method, Nigeria, Middle Osun Valley.

The paper resulted from attempts at fitting empirical equations to describe the patterns of groundwater recharge in the regolith of the Middle Osun Valley in the Nigerian Basement Complex. Equations of both the temporal and spatial patterns were derived empirically by analyzing sample data on saturated zone thickness using a least-squares curvilinear regression technique. The temporal pattern for the study period conforms with the prevailing rainfall regime and is optimally described by fourth-degree polynomial regression equations. the spatial pattern is optimally described by quadratic equations and suggests that an almost uniformly thick annual groundwater recharge zone of about 2.4 m overlies the gross spatial distribution of the saturated zone thickness from the major river channel to the major water divide. The quantitative methodology of this study is universally applicable and could greatly facilitate direct calculation of groundwater recharge and rainfall-recharge correlation if reliable information about relevant parameters of Basement Complex regolith aquifers is available. (Author's Abstract)
W86-04390

CHARACTERIZATION OF DYE TRACER PLUMES: IN SITU FIELD EXPERIMENTS,

Battelle Memorial Inst., Columbus, OH.
T. G. Naymik, and M. E. Sievers.
Ground Water GRWAAP, Vol. 23, No. 6, p 746-752, November-December 1985. 6 fig, 2 tab, 8 ref. EPA Contract No. 806391.

Descriptors: *Dye dispersion, *Dye releases, *Tracers, *Groundwater movement, *In situ tests, Fluorescent dyes, Aquifers, Hydraulic gradient, Wells, Solute transport, Plumes.

In the Spring of 1984, the second in a series of groundwater dye tracer experiments at Sand Ridge State Forest, Illinois, was conducted. Slugs of three different fluorescent dyes (Rhodamine Wt, Amino G Acid, and Lissamine FF) were allowed to migrate under natural hydraulic gradient conditions through a water table aquifer composed of windblown sand overlaying glacial outwash sand and gravel. The plumes in the outwash deposit and in the dune sand were monitored first by a line of sand point wells placed perpendicular to flow at a distance of 10 ft and 5 ft, respectively, from the source wells. A trilevel nest of sand points was then placed in the path of each plume at a greater distance (50 feet from the sources of the deep plumes). The field data suggest that the plume geometry varied with distance from the source. A solute transport model, calibrated to the field data, provided estimates of longitudinal dispersivity (0.10 ft and 0.17 ft for the plumes in the lower unit). The model was then used as a mass accounting system to relate the tracer concentrations detected in monitoring wells to the mass within the plumes. (Lantz-PTT)
W86-04468

ESTIMATING AQUIFER PERMEABILITY FROM FORMATION RESISTIVITY FACTORS,

Woodward-Clyde Consultants, Tallahassee, FL.
T. Kwader.
Ground Water GRWAAP, Vol. 23, No. 6, p 762-766, November-December 1985. 3 fig, 1 tab, 8 ref.

Descriptors: *Aquifer characteristics, *Resistivity, *Permeability, Pumping tests, Flow movement, Saturated soils, Conductance, Boreholes, Aquifers.

A comparison of permeability results for individual producing zones obtained from pumping tests and flowmeter logs showed a good correlation to calculated corresponding formation resistivity factors (F). Unlike formations containing saline water, where the electrical current is conducted through the pore fluid, in fresh water aquifers, the electrical current appears to be conducted along the grain-aqueous interface by surface conductance rather than through the grain or pore fluid. Surface conductance of the current serves to increase the current path length which is recorded as an increase in the measured saturated resistivity. The current path direction and length through the formation is directly related to the shape, diameter, and sorting of the grains, geometric packing arrangement, and degree of matrix cementation. Fortunately, all of these factors that serve to increase the current path also are factors that increase formation permeability. Relative changes in F values can be matched with known permeabilities from aquifer tests and flowmeter logs to quantify the relative productivity of the various zones analyzed. Once this relationship is established, F values can be used to assign relative permeabilities within a single borehole or from borehole to borehole for a given geographical area. This method has been successfully used to estimate permeability in both unconsolidated sands and Tertiary carbonate aquifers in the southeastern Coastal Plain of the United States. (Lantz-PTT)
W86-04469

ENVIRONMENTAL ANALYSIS OF IRON-PRECIPITATING BACTERIA IN GROUND WATER AND WELLS,

Smith (S.A.) Consulting Services, Columbus, OH.
For primary bibliographic entry see Field 5C.
W86-04470

GEOPHYSICAL TECHNIQUES TO DELINEATE SATURATED ALLUVIAL ZONES FOR THE SITING OF HVDC POWER TRANSMISSION RETURN ELECTRODES,

Ertec Western, Inc., Long Beach, CA.
K. Hennon.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 53-57, Fall 1985. 4 7 ref.

Descriptors: *Geophysics, *Saturated alluvial zones, *High-voltage direct current, Electrodes, Geologic formations, Hydrogeology, Groundwater movement, Water quality, Seasonal variations, Resistivity, Soil properties, Model studies.

As high-voltage, direct-current (HVDC) electrical power transmission technology advances, the siting and design of the grounded return electrodes become critical factors. Electrode sites should be chosen where surrounding geologic conditions will not unfavorably channel large earth currents and harmfully affect nearby populations, with an optimum site allowing direct contact between the electrode and a large volume of a stable, low-resistivity material. A saturated alluvial zone between dry surface soils and an underlying crystalline bedrock is an ideal material for containing the current flow from the electrode. A hydrogeologic investigation was conducted to delineate the saturated zone in several alluvial valleys in the southwestern desert region. Regional groundwater flow directions, water quality, and seasonal fluctuations of the water table elevations were determined. The structural shape and topography of the crystalline basement beneath the valleys were interpreted from gravity data. Iterative forward-modeling of the data provided a low-cost means of deducing the volume of the lightweight alluvium. Electrical resistivity surveys were completed to measure the lateral and vertical variations in soil resistivities throughout the valleys. The geophysical data were used to extend the known hydrologic information into areas with no wells. Composite models of the saturated zones in each valley were produced by integrating gravity interpretations with hydrologic and resistivity results. The composite models were used to predict current density in the ground that would be associated with a HVDC electrode. This methodology proved to be a cost-effective means of siting electrodes in a suitable geologic environment that would minimize their detrimental effects. (Lantz-PTT)
W86-04471

GEOPHYSICAL MONITORING OF GROUND WATER CONTAMINATION AROUND WASTE DISPOSAL SITES,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04473

ANALYSES OF WELL-AQUIFER RESPONSE TO A SLUG TEST,

Princeton Univ., NJ. Dept. of Civil Engineering.
Z. J. Kabala, G. F. Pinder, and P. C. D. Milly.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1433-1436, September 1985. 7 fig, 7 ref.

Descriptors: *Confined aquifer, *Numerical analysis, *Water level, *Mathematical models, Field tests, Fully penetrating wells, Transmissivity, New Brunswick.

The response of a fully penetrating well to a slug test in a confined aquifer can be described by a single differential equation that is valid for any degree of damping. Although an analytical solution is not available, numerical methods are applied readily. The impact of nonlinear terms becomes significant only when the initial water level displacement is a large fraction of the effective water column height. Linear and nonlinear models presented here represent a unified approach to the description of underdamped, critically damped, and overdamped responses of a fully penetrating well in a confined aquifer. It appears that the linear model is sufficiently accurate in all practical cases. Simulations of well responses at Cap Pele and York Point (New Brunswick) demonstrated that the proposed model is capable of reproducing observed field behavior over a broad range of physical responses. The proposed model can serve as a 'refining device' for estimation of transmissivity for overdamped and underdamped well responses. The model is the only reliable tool for estimation of transmissivity from critically damped well responses. (Rochester-PTT)
W86-04541

OPTIMAL CONTROL OF NONLINEAR GROUNDWATER HYDRAULICS: THEORETICAL DEVELOPMENT AND NUMERICAL EXPERIMENTS,

Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis, and B. A. Finney.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1476-1482, October 1985. 5 fig, 5 tab, 23 ref. NSF CEE 83-01230 and INT 82-03044.

Descriptors: *Unconfined aquifers, *Mathematical models, *Finite difference methods, *Optimal pumping pattern, *Planning model, Water demand, Algorithms, Groundwater management, Well hydraulics.

Nonlinear optimization models are presented for the optimal operation of an unconfined aquifer system. The aquifer's response equations were developed using finite difference methods, aquasilinearization, and matrix calculus. The optimization model, which is structured as a discrete time optimal control problem, identifies the optimal pumping pattern necessary to satisfy an exogenous water demand. A quasilinearization optimization algorithm and project Lagrangian methods are used for the solution of the planning models. Several examples are presented to demonstrate the applicability of the solution algorithms for nonlinear groundwater management problems. Groundwater optimization models can be used to identify locally optimal planning, design, or operational problems in nonlinear and nonconvex groundwater systems. (Rochester-PTT)
W86-04544

IMPROVED FORMULAS FOR A DAM PHREATIC SURFACE WITH ACCRETION,

Hochschule der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Fachbereich Informatik.
U. Hornung, and T. T. Krueger.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1494-1496, October 1985. 5 fig, 2 tab, 13 ref.

Descriptors: *Unconfined aquifer, *Groundwater movement, *Phreatic surface, *Accretion rate, *Dupuit-Forchheimer theory, Steady flow, Mathematical techniques, Numerical methods.

The free boundary value problem of steady groundwater flow in an unconfined aquifer with accretion is solved by numerical methods in an exemplary situation. New formulas, which improve the results of the commonly-used Dupuit-Forchheimer theory, are given for the dependence of the height of the phreatic surface on the accretion rate. It is shown that simple formulas, which describe the flow of groundwater in a more accurate way than the classical ones, can be derived with the help of modern mathematical techniques. (Author's abstract)
W86-04546

GROUNDWATER CONTAMINATION: A NATIONAL PROBLEM WITH IMPLICATIONS FOR STATE AND LOCAL ENVIRONMENTAL HEALTH PERSONNEL,

Winnebago County Dept. of Public Health, Rockford, IL.
For primary bibliographic entry see Field 5B.
W86-04609

SHALLOW SEISMIC REFRACTION SURVEY OF NEAR-SURFACE GROUND WATER FLOW,

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
K. A. Sverdrup.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 80-83, Winter 1986. 4 fig, 1 tab, 11 ref.

Descriptors: *Groundwater movement, *Seismic waves, *Refraction, *Geohydrology, Geological surveys, Monitoring wells, Cores, Illinois.

A shallow seismic refraction survey was conducted as part of a geological and hydrologic investigation of an area adjacent to a proposed coal strip mine in southeastern Illinois. Data obtained from the survey were used to estimate the thickness and geometry of lithologic units within approximately 40 feet of the surface in unconsolidated material overlying bedrock. Data from a nearby groundwater monitoring well and several shallow geologic cores obtained in the survey area indicated the presence of silt-clay unit roughly 10 feet beneath the surface. This unit strongly inhibits the vertical movement of groundwater, resulting in a perched water table. The refraction survey revealed that the morphology of the top of this silt-clay layer is dominated by a narrow, sinuous channel crisscrossing the survey region with an overall downward trend in elevation from the mine site to a small creek roughly 0.25 miles away. Detailed knowledge of the location of this channel was used to identify optimal sites for shallow groundwater monitoring stations. The method proved to be a relatively rapid and cost-efficient means of obtained detailed information concerning the thickness and geometry of the near-surface unconsolidated materials. (Author's abstract)
W86-04658

METHOD FOR SIMULTANEOUS IN SITU MEASUREMENT IN THE VADOSE ZONE OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY AND THE CONDUCTIVITY-PRESSURE HEAD RELATIONSHIP,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W86-04659

CHARACTERIZATION OF SUBSURFACE BACTERIA ASSOCIATED WITH TWO SHALLOW AQUIFERS IN OKLAHOMA,

Florida State Univ., Tallahassee. Dept. of Biological Science.
For primary bibliographic entry see Field 5A.
W86-04664

DISSOLVED IRON IN CHALK GROUNDWATERS FROM NORFOLK, ENGLAND,

Academia Sinica, Beijing (China). Inst. of Technology.
For primary bibliographic entry see Field 2K.
W86-04678

2G. Water In Soils

IRREVERSIBLE SORPTION OF TRACE LEVEL ORGANICS BY GROUND WATER HUMIC SUBSTANCES: A NEW MECHANISM OF TRANSPORT,

Rice Univ., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-04055

DIELECTRIC PROPERTIES OF SATURATED SOILS,

Oklahoma State Univ., Stillwater. Dept. of Physics.
A. Alharthi, and J. Lange.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 173-174, 4 fig. Contract No. CEE-8019278.

Descriptors: *Soil chemistry, *Soil water, *Electrical properties, *Soil physical properties, Soil properties, Soil physics, Chemical analysis, Physical analysis, Porous media.

Characterizing the flow of two fluid components in a porous structure is a complex task. There is a need for new investigative techniques which will determine the time evolution of the flow. This research is directed to developing a time resolved measuring method based on microwave techniques. The porous material is interrogated by a microwave impulse and its response is used to determine the dielectric properties of the composite structure consisting of the soil and saturating fluids. The dielectric constant of the composite material can be related to the saturating fluid content. The object of this investigation is to determine the feasibility of using the dielectric constant of saturated soils to characterize their fluid content. The large difference in the dielectric constant of water and soil components indicates that the composite dielectric constant of the wet soil is strongly dependent on the water content. The initial stages of this investigation focused on three areas. First, a measurement technique to obtain the dielectric constant of saturated soils was established. Second, the relationship between the measured dielectric constant and the volume of saturating fluid was determined. Finally, a variety of fluid saturants were used in the measurements which emphasized the behavior of immiscible organic fluids, particularly those which are not susceptible to any appreciable biological degradation on a long term basis. (Author's abstract)
W86-04087

STOCHASTIC SOIL MOISTURE ESTIMATION AND FORECASTING FOR IRRIGATED FIELDS,

Science and Education Administration, Fort Collins, CO. Agricultural Research.
M. Aboitiz, J. W. Labadie, and D. F. Heermann.
Water Resources Research WRERAO, Vol. 22, No. 2, p 180-190, February 1986. 5 fig, 6 tab, 21 ref. USDA-ARS Project No. 58-9AHZ-9-392.

Descriptors: *Stochastic process, *Soil water, *Forecasting, *Irrigation, Soil moisture deficiency, Evapotranspiration, Colorado, Statistical analysis, Time series analysis.

A methodology is developed for estimating and forecasting soil water depletion and crop evapotranspiration, with explicit consideration of modeling errors and stochastic inputs. The water balance of an irrigated field and a time series model for reference crop evapotranspiration are formulated in state-space form, with soil moisture depletion and reference evapotranspiration as state variables. The Kalman filter is used to generate estimates and forecasts of the state variables, together with statistical information on their associated errors. Model calibration and validity tests are performed with two independent data sets from locations in Colorado. Each set includes several years of reference crop evapotranspiration data calculated from climatological observations, one season of soil moisture measurements, and concurrent irrigation applications. The estimates, forecasts, and error covariance information provided by the model can allow irrigation decisions to be made with explicit consideration of the inherent risks of crop damage or failure under limitations in water, energy, labor, and capital. (Author's abstract)
W86-04172

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL: 1. FUNDAMENTAL CONCEPTS,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, G. Sposito, and R. E. White.
Water Resources Research WRERAO, Vol. 22, No. 2, p 243-247, February 1986. 1 fig, 24 ref. NSF Grant ECE-8513726.

Descriptors: *Solute transport, *Soil water movement, *Unsaturated flow, *Transfer function model, *Path of pollutants, *Soil water, Physical transformations, Biotransformation, Chemical transformation, Model studies, Law of Mass Balance.

The transfer function model (TFM) of solute transport through unsaturated soil is generalized to describe the movement of a solute that may undergo physical, chemical, or biological transformations as it moves in a soil unit through which the water flow may vary in both space and time. The generalized TFM is shown to be related to the law of mass balance for a solute as interpreted in the context of probability theory. The principal conceptual entity in the TEM is the solute lifetime probability density function. Methodologies for determining this function experimentally are outlined and its relation to the solute travel time density function defined by Jury is shown. Since the generalized TFM is formulated independently of any particular mechanism of solute transport through soil, it is concluded that mechanistic models of solute movement consistent with the law of mass balance are also consistent with the TFM. (see also W86-04178 and W86-04179) (Author's abstract))
W86-04177

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL: 2. ILLUSTRATIVE APPLICATIONS,

Oxford Univ. (England). Soil Science Lab.
R. E. White, J. S. Dyson, and R. A. Haigh.
Water Resources Research WRERAO, Vol. 22, No. 2, p 248-254, February 1986. 5 fig, 3 tab, 16 ref.

Descriptors: *Solute transport, *Soil water movement, *Unsaturated flow, *Path of pollutants, *Transfer function model, *Soil water, Field tests, Groundwater movement, Bromine, Chlorine, Clay, Mathematical analysis, Salts, Bacteria, Flow rates.

The results of field and laboratory studies of solute transport through undisturbed soils following narrow pulse or step-change inputs of soluble or bacteria have been analyzed using the transfer function equation previously developed. The travel time probability density function observed for Br and Cl during unsteady flow in an unsaturated, well structured clay suggested a two-component mechanism comprising fast solute transport through large, interped voids and slow to negligible transport through small, intraped voids. The modal and median travel times varied with soil type, initial water content, and rate of water input. The fractional volume of water that participated in solute transport, theta sub st, was calculated from the rate of water input and the median solute travel time. Values of theta sub st ranged from 14% to nearly 90% of the mean volumetric water contents of the soils. (See also W86-04177 and W86-04179) (Author's abstract)
W86-04178

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL. 3. THE CONVECTION-DISPERSION EQUATION,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, R. E. White, P. R. Darrah, and W. A. Jury.
Water Resources Research WRERAO, Vol. 22, No. 2, p 255-262, February 1986. 4 fig, 2 tab, 30 ref. NSF Grant ECE-8513726.

Descriptors: *Solute transport, *Soil water movement, *Unsaturated flow, *Transfer function model, *Path of pollutants, *Soil water, *Convection-dispersion transport, Groundwater movement, Probability density function, Laplace equation, Flow rates, Convection, Dispersion, Sorption.

The two-component convection-dispersion equation (CDE) model is developed as a special case of the transfer function model (TFM) of solute transport. It is shown that the two-component CDE model can be reformulated as an integral equation for the 'fast' solute component which has the same form and interpretation as the TFM integral equation specialized to (1) steady water flow conditions and (2) solute input or loss restricted to the entrance or exit surface of a soil unit. The travel time probability density function (pdf) for a solute according to the two-component CDE model then is calculated analytically as a Laplace transform. Numerical inversion of the transformed pdf is carried out for several different sets of values of the four adjustable parameters in the CDE model. The effects of convection, dispersion, and linear sorption processes, as well as the influence of the slow solute component, are illustrated by the numerically simulated travel time pdf. It is suggested that the fractional transport volume is the most significant physical parameter in the model in terms on the shape of the travel time pdf. (See also W86-04177 and W86-04178) (Author's abstract)
W86-04179

VARIATION OF INFILTRATION INTO A HOMOGENEOUS SOIL MATRIX CONTAINING A POPULATION OF MACROPORES,

Institute of Hydrology, Wallingford (England).
K. J. Beven, and R. T. Clarke.
Water Resources Research WRERAO, Vol. 22, No. 3, p 383-388, March 1986. 5 fig, 1 tab, 8 ref.

Descriptors: *Infiltration, *Soil matrix, *Hydrologic models, Channels, Soil water, Channel flow, Homogeneity, Soil water movement.

A population of channels penetrates a soil matrix that is otherwise homogeneous. The channels are assumed to be vertical and of circular cross section with constant diameter, but channel depths and radii are allowed to vary over the population. This paper uses a model based on the Green-Ampt assumptions to predict infiltration rates through the walls and bases of channels, resulting in a mathematical description of the way in which infiltration develops in the soil and in which channels fill with water until eventually overland flow is initiated. This model takes account of the fact that there may be a random distribution of channels in space. Expressions for the expected mean and variance of infiltration volumes are derived. Some example results are given and show that below the matrix wetting front, the variance of the change in water content with 30 and 50 channels per square meter may be of the same order as the mean change in water content. The presence of channels can lead to significant increases in predicted channel volumes. (Author's abstract)
W86-04202

CONSTRAINTS ON THE VALIDITY OF EQUILIBRIUM AND FIRST-ORDER KINETIC TRANSPORT MODELS IN STRUCTURED SOILS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. C. Parker, and A. J. Valocchi.
Water Resources Research WRERAO, Vol. 22, No. 3, p 399-407, March 1986. 10 fig, 1 tab, 22 ref. EPA Grant No. R-810819-01-0.

Descriptors: *Equilibrium, *Kinetics, *Transport models, *Soil structure, Solute transport, Soil aggregates, Model studies, Mathematical studies.

Solutions are presented for solute transport in a system of spherical aggregates for flux concentrations (C sub f) and for resident concentrations in mobile and immobile zones and in the bulk porous medium, subject to continuous injection or pulse injection of infinitesimal or finite duration. By equating second moments of C sub f versus time for the biocontinuum spherical diffusion model (SD) with those of a monocontinuum model which assumes local equilibrium (LE), an expression for the apparent dispersion coefficient (D sub e) in the LE model in terms of physically meaningful SD model parameters. Constraints on the validity of the LE model are derived by evaluating differences (delta mu sub 3(LE)) between third moments of C sub f versus a temporal variable normalized by the mean residence time. The expression for delta mu sub 3(LE) indicates the manner in which SD-LE model deviation decreases with diminishing aggregate size and immobile zone retardation factor and with increasing mobile zone retardation, mobile pore fraction, and distance from source. For continuous injection delta mu sub 3(LE) = 0.01 generally yields close correspondence between SD and LE models when appropriate D sub e values are used in the latter. For pulse injection of diminishing duration, criteria for the degradation of the SD model to the LE model become more stringent. The SD model is also compared to a first-order kinetic (FO) model to evaluate constraints on the latter in structured soils. Equating second moments of SD and FO models yields an expression for the apparent first-order rate coefficient in terms of SD model parameters. Comparison of third moments yields a criterion delta mu sub 3(FO) for SD-FO model equivalence. A comparison of the error criteria for SD-FO and SD-LE equivalence indicates that the FO model always represents the diffusional kinetics more accurately than the LE model when near a-equilibrium conditions prevail. Surprisingly, for severe nonequilibrium conditions, the LE model may in some instances approximate the SD model results more accurately than the FO model. (Lantz-PTT)
W86-04203

DETERMINING HEAD AND PRESSURE DISTRIBUTION IN LOW TRANSMISSIVITY FORMATIONS AND SOILS,

Gartner Lee Associates Ltd., Markham (Ontario).
For primary bibliographic entry see Field 2F.
W86-04215

TRANSIOMETER: AN ALTERNATIVE METHOD OF SOIL MOISTURE MEASUREMENT IN SLOWLY PERMEABLE SOILS,

Science and Education Administration, Fort Collins, CO. Agricultural Research.
T. P. Trooien, A. R. Bender, and J. H. Bischoff.
Ground Water Monitoring Review, Vol. 6, No. 2, p 99-105, Spring 1986. 5 fig, 3 tab, 16 ref.

Descriptors: *Transiometers, *Soil water, *Soil porosity, *Permeability, Measuring instruments, Data acquisition, Saturated soils, Data interpretation, Voltmeters, Atmospheric pressure.

The union of a piezoresistive pressure transducer and a porous ceramic cup was termed 'transiometer.' The transiometer was constructed from economical and readily available materials. It can be used to be measure soil water potentials in both saturated and unsaturated conditions, and is well suited to continuous monitoring with data acquisition equipment. Transiometer testing was conducted at two sites, one of moderate permeability and the other of slow permeability. The slowly permeable site was instrumented with four replications of the following: (1) transiometers installed at four depths, (2) a transiometer without the ceramic cup, (3) a piezometer, and (4) access tubes for monitoring soil moisture with a neutron probe. The moderately permeable site was instrumented with a transiometer, two piezometers, and an access tube for monitoring with a neutron probe. In saturated conditions the transiometer had a faster response time after installation than the piezometer. Faster response makes the transiometer more desirable for use in slowly permeable soils, especially when monitoring dynamic soil water. Calculated random error of the transiometer measuring system, including a digital voltmeter and a scanner, was typically 0.09 feet , with a maximum calculated to be 0.38 feet. The two most significant components were imprecision of the scanner card and calibration shift. The transiometer was sensitive to atmospheric pressure fluctuations, with sensitivity to atmospheric pressure change increasing with installation depth. (Lantz-PTT)
W86-04216

CONTAMINANT MOVEMENT UNDER PUMPAGE-RECHARGE CONDITION IN STEADY GROUNDWATER FLOW SYSTEM,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-04278

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE IN SUBSURFACE SOILS,

Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
For primary bibliographic entry see Field 5C.
W86-04281

MONITORING CHANGES IN TOTAL AND UNFROZEN WATER CONTENT IN SEASONALLY FROZEN SOIL USING TIME DOMAIN REFLECTOMETRY AND NEUTRON MODERATION TECHNIQUES,

Department of Agriculture, Ottawa (Ontario).
H. N. Hayhoe, and W. B. Bailey.
Water Resources Research WRERAO, Vol. 21, No. 8,P 1077-1084, August 1985. p 1077-1084, 8 fig, 1 tab, 17 ref.

Descriptors: *Soil water, *Moisture profiles, *Snowmelt, *Monitoring, *Seasonal variation, Spatial distribution, Soil temperature, Freezing, Neutron activation analysis, Loam.

This paper presents the results of a study utilizing time domain reflectometry and the neutron moderation technique to monitor changes in total water content and unfrozen water content during fall, winter, and spring on a sandy loam site which was maintained snow free to maximize seasonal frost penetration. Soil temperatures were recorded continuously, and meteorological conditions were observed at a nearby climatological station. The procedure of combining the neutron probe and time domain reflectometry employed here showed good potential for augmenting the limited data on soil moisture redistribution in freezing soils under natural conditions. The data indicated the importane of obtaining a representative spatial average of water content measured with time domain reflectometry in order to obtain a good correspondence with neutron probe observations. (Author's abstract)
W86-04305

MACROSCOPIC BALANCE EQUATIONS IN SOILS AND AQUIFERS: THE CASE OF SPACE- AND TIME-DEPENDENT INSTRUMENTAL RESPONSE,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
P. Baveye, and G. Sposito.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1116-1120, August 1985. 23 ref. NSF Grant No. CEE 79-20778.

Descriptors: *Mathematical studies, *Soil water, *Aquifers, *Groundwater movement, *Mathematical equations, Soil porosity, Temporal distribution, Spatial distribution, Neutron activation analysis.

Macroscopic balance equations for mass and linear momentum in soils and aquifers are derived in the relativist concept under the condition that all physical variables are associated with a single instrumental weighting function that depends on both position and time. The resulting balance equations

differ in concept from expressions obtained recently in the representative elementary volume (REV) approach by exhibiting additional terms that depend on the time and space derivatives of the instrumental weighting function. These terms indicate that mass and linear momentum balance at the macroscopic scale are not preserved unless the weighting function has space-time invariance properties over the period and spatial domain of measurement. (Author's abstract)
W86-04308

COMPARATIVE STUDY OF GREEN AND AMPT ANALYSES FOR A FALLING WATER TABLE IN A HOMOGENEOUS SAND PROFILE,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and S. A. Awadalla.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1157-1164, August 1985. fig, 7 ref.

Descriptors: *Mathematical studies, *Infiltration, *Water table decline, *Numerical analysis, *Soil porosity, Comparison studies, Sand, Soil water, Soil water table, Water table fluctuations.

Equations are developed for a Green and Ampt type analysis for a falling water table regime in an initially saturated homogeneous profile of porous material both with and without the presence of an applied surface flux of constant magnitude. The predictive capability of these Green and Ampt equations for a homogeneous medium sand is then tested against results obtained from a computer-based numerical analysis of the differential equation describing water movement in unsaturated porous media. Three simulations with different rates of water table fall are described for the zero surface flux case with one of these rates also being used when an applied surface infiltration flux is included in the system. Comparisons with Green and Ampt results are then made for these simulations in terms of the discharge-time relationship, the position of the draining front with time, and the thickness of the draining capillary fringe with time. In certain cases the approximate analysis is shown to agree with the numerical simulations quite satisfactorily while in others, notably those involving a more rapid water table fall, the differences are significant. (Author's abstract)
W86-04313

STEADY STATE INFILTRATION: CONSEQUENCES OF (ALPHA) DEPENDENT ON MOISTURE CONTENT,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, and W. L. Hogarth.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1283-1284, August 1985. 1 fig, 8 ref. URG and ARGS F84161771.

Descriptors: *Infiltration, *Mathematical equations, *Soil water, *Clay, *Sand, Saturated flow, Unsaturated flow, Infiltration coefficient, Infiltration rate, Moisture content, Soil porosity, Mathematical studies.

It is shown from the examples of a clay and a sand that the alpha parameter, in the steady state infiltration equation, is usually far from constant over the whole range of moisture content. Thus the linearized form of the steady state infiltration equation does not give, in general, an accurate description of the flow of water in a soil if it has both dry and saturated regions. When alpha is dependent on moisture content, the small limit of alpha may represent either a saturated soil or a soil of low water content. The former is more readily achieved in a coarse-textured soil and the latter in a fine-textured soil. (Author's abstract)
W86-04324

SOIL WATER SAMPLERS IN ION BALANCE STUDIES ON ACIDIC FOREST SOILS,

Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
For primary bibliographic entry see Field 7B.
W86-04364

NUMERICAL STUDY OF THE EFFECTS OF SOIL SURFACE SHAPE UPON THE SOIL TEMPERATURE AND MOISTURE REGIMES,

Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.
Y. Mahrer, and R. Avissar.
Soil Science SOSCAK, Vol. 139, No. 6, p 483-490, June 1985. 10 fig, 2 tab, 17 ref.

Descriptors: *Mathematical analysis, *Soil surfaces, *Soil temperature, *Soil water, Model studies, Soil physical properties, Environment, Slopes, Diurnal distribution.

The purpose of the study was to simulate the diurnal variations and the overall trends of soil temperature and moisture regime in differently oriented soil shapes. Developed was a numerical, two-dimensional model to study the effect of soil surface shape (ridge, furrow, flat), produced by different cultivation techniques, on the soil moisture and temperature regimes. To simplify the study of different soil surface shapes, a terrain-following coordinate system was used. Environmental conditions, soil physical characteristics, and the slope and aspect of the surface are considered. Calculated moisture and temperature profiles are compared against observed ones, and the study shows that they are significantly influenced by both slope and aspect. In general, good agreement was obtained between predicted soil temperatures and observations. Predicted trends of moisture contents also agreed well with the observed data. The model results show a significant diurnal effect in volumetric moisture contents up to a depth of 0.1 m. Therefore, future studies will have to be undertaken to acquire additional experimental data to verify the model results. (Lantz-PTT)
W86-04404

NOTE ON THE PHYSICAL CHARACTERISTICS OF LINEAR SOILS,

Ceske Vysoke Uceni Technicke v Praze.
M. Kutilek, T. Vogel, and D. R. Nielsen.
Soil Science SOSCAK, Vol. 139, No. 6, p 497-499, June 1985. 2 tab, 12 ref.

Descriptors: *Linear soils, *Soil physical properties, *Hydraulic conductivity, Mathematical studies, Diffusivity.

The relationship between relative hydraulic conductivity, soil water content, and the soil water characteristic curve, was related to a soil water diffusivity (D) of constant value. The dissimilarity of such so-called linear soils from other soils is manifested by a special relation that exists between the unsaturated hydraulic conductivity and the soil water content, rather than a special relation for their soil water characteristic curves. The derived relationships can be used when the results of numerical methods are tested by analytical procedures. (Lantz-PTT)
W86-04405

CHANGES IN SOIL POROSITY AND SURFACE SHRINKAGE IN A REMOLDED, SALINE CLAY SOIL TREATED WITH COMPOST,

Florence Univ. (Italy). Inst. of Geopedology and Applied Geology.
G. Sartori, G. A. Ferrari, and M. Pagliai.
Soil Science SOSCAK, Vol. 139, No. 6, p 523-530, June 1985. 7 fig, 2 tab, 29 ref.

Descriptors: *Soil porosity, *Saline soils, *Clays, *Compost, Soil aggregates, Pore size, Soil dynamics, Soil absorption capacity, Moisture availability.

Studied were modifications induced in soil porosity and in surface shrinkage in a saline clay soil treated with compost in laboratory trials, and the effects of wetting and drying cycles were tested. Porosity and pore size distribution were measured on thin sections prepared from soil samples by using electrooptical image-analysis (Quantimet 720). Shrinkage was measured on the surface of dried samples using the same apparatus. The application of wetting and drying cycles to the control samples first increased the proportion of pores ranging from 30 micrometers to 1 mm in equivalent pore diameter to a maximum, and then these pores decreased steadily with further wetting and drying cycles. In treated samples the intra-aggregate porosity was higher than in control samples only after the first wetting and drying cycles; then it was always lower and at the end of the experiment it decreased with respect to the beginning. Modifications of pore size distribution were also observed. The total surface shrinkage increased after wetting and drying cycles and in control samples was always higher than in treated samples but, at the end of the experiment, cracks were larger in treated samples. This unusual behavior of soil-compost interactions could be ascribed to the salinity of both soil and compost. (Lantz-PTT)
W86-04406

EVAPOTRANSPIRATION AND SOIL WATER RELATIONSHIPS FOR SPRING WHEAT AND SOYBEAN,

North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2D.
W86-04407

STEADY-STATE EVAPORATION FROM LAYERED SOILS,

Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
A. Poulovassilis, and M. Psychoyou.
Soil Science SOSCAK, Vol. 140, No. 6, p 399-405, December 1985. 6 fig, 13 ref.

Descriptors: *Soil water, *Evaporation, *Layered soils, Pressure head, Water table fluctuations, Soil types, Soil properties.

The paper theoretically examines the shape of the steady-state soil water profile in layered soils, and the effect of layering on the evaporation rate. It is shown that the soil water pressure head gradient (and the hydraulic head gradient) may show a discontinuity at the layer junction. The characteristics of this discontinuity depend on the value of the pressure head prevailing at the junction and the type of layer considered. Further shown is that the relationships between maximum heights Z above the water table, and the constant evaporation rates U maintained for a relatively coarse and for a relatively fine soil, cross each other at an intermediate value of U, with the relationship for the coarse soil lying lower at small U and higher at large U than that for the fine soil. Finally shown is that when at the layer junction, pressure head values prevail, at which the pressure head-hydraulic conductivity relationships for the two layers cross each other. Then the U-Z sub c,f and the U-Z sub f,c relationships (where Z sub c,f and Z sub f,c denote maximum heights in a fine over coarse and a coarse over fine layer sequence, respectively) form an upper and a lower bound of all other relationships for the layered soils, and of those for the uniform materials that may take part in forming the layered profiles. (Lantz-PTT)
W86-04409

VARIATION IN THE QUALITY OF TENSION LYSIMETER SOIL WATER SAMPLES FROM A FINNISH FOREST SOIL,

Finnish Forest Research Inst., Helsinki.
M. R. Starr.
Soil Science SOSCAK, Vol. 140, No. 6, p 453-461, December 1985. 3 fig, 4 tab, 20 ref.

Descriptors: *Soil water, *Lysimeters, *Water quality, *Forest soils, Iron podsol, Hydrogen, Ammonia, Phosphates, Potassium, Calcium, Conductivity.

The paper examines sources of variation in the chemical quality of soil water collected during a 9-wk period (July to September 1981) with six tensionlysimeters installed at a forest harvested site in central Finland. The soil was an iron podsol, and the lysimeters were installed to a depth of 25 cm. Three lysimeters were installed at 2- to 3-m spacings in the center of two plots, some 200 m apart, and were fitted with 6 cm long x 3 cm o.d. sintered glass cups of pore size 10 to 16 micrometers.

Replicate samples, usually five, were drawn regularly each week with each lysimeter, using a tension pressure of ca. 42 kPa. The mean soil water tension at the 15- and 35-cm depths was 4.1 and 3.1 kPa, respectively. Chemical analysis (conductivity and H(+), NH4(+), PO4(3-), and K(+) and Ca(2+) ion concentrations) of the unfiltered samples was completed within 72 hr of collection. The sampling error among replicates was found to decrease in the order: NH4(+), H(+), PO4(3-), K(+) and Ca(2+), conductivity. Significant differences (P=0.05) in lysimeter water quality within the same plot were found for all determinations except PO4(3-). Significant differences among plots were found for all determinations except NH4(+) and PO4(3-). The amount of spatial variation at each sampling date varied, but the differences among lysimeters were consistent throughout, and all six lysimeters showed generally similar trends. The mean lysimeter/rain quality ratios were: conductivity, 1.9; H(+), 1.1; NH4(+), 0.04; PO4(3-), 0.2; K(+), 6.3; and Ca(2+), 29.3. With the exception of conductivity, lysimeter water quality showed no, or only weak rainfall-related dilution effects. Peak concentrations of H(+) and Ca(2+) followed rainfall with extreme concentrations and loads of these ions. (Lantz-PTT)
W86-04410

SATURATED AND UNSATURATED HYDRAULIC CONDUCTIVITY OF SWELLING CLAYS,

Tokyo Univ. (Japan). Faculty of Agriculture.
M. Nakano, Y. Amemiya, and K. Fujii.
Soil Science SOSCAK, Vol. 141, No. 1, p 1-6, January 1986. 8 fig, 16 ref.

Descriptors: *Soil water movement, *Saturated soils, *Unsaturated soils, *Hydraulic conductivity, *Clays, Soil water, Flow discharge, Swelling clays, Infiltration, Bentonite.

The theory of water flow in swelling clays may be developed in a space coordinate system at rest, assuming that the flux of clay particles can be defined by the space gradients of potential responsible for the movement of clay particles, which is related to the gradients of water potential. Within this framework, the hydraulic conductivity of saturated and unsaturated swelling clays is defined and measured, from the water and clay content profiles obtained from infiltration experiments into unsaturated bentonite. As a result, the hydraulic conductivity is found to increase from 0.000001 - 0.1 cm/d when the volumetric water content increases from 0.5 to 0.95 cu cm/cu cm. (Lantz-PTT)
W86-04411

DETERMINATION OF DIFFUSIVITY AND HYDRAULIC CONDUCTIVITY IN SOILS AT LOW WATER CONTENTS FROM NONDESTRUCTIVE TRANSIENT FLOW OBSERVATIONS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer, D. B. McWhorter, and A. Klute.
Soil Science SOSCAK, Vol. 141, No. 1, p 10-19, January 1986. 9 fig, 1 tab, 15 ref.

Descriptors: *Soil water movement, *Diffusivity, *Hydraulic conductivity, *Soil water, *Transient flow, Experimental design, Mathematical studies, Gamma radiation, Vapor adsorption, Reproducibility.

Presented is an experimental method that nondestructively, relatively quickly, and reproducibly develops data necessary for finite-difference calculations of liquid-vapor diffusivities for water contents between approximately 1% and any intermediate value of interest. The method relies on determining the temporal and spatial distribution of water content using gamma-attentuation techniques during water absorption into a horizontal column containing oven-dry soil. Diffusivities (and conductivities given the water retention curve) are calculated from the measured water-content distributions using a finite difference form of the continuity equation. The method is successfully applied to soils varying in texture from a fine sand to a clay loam. Vapor adsorption and transport mechanisms are discussed in the context of the liquid-vapor diffusivity function, using experimentally measured vapor adsorption isotherms. Conductivities calculated from results of experiments conducted using thermocouple psychrometers to nondestructively measure suction heads in a clay loam during the flow processes are also presented. (Lantz-PTT)
W86-04412

1984 DROUGHT ON THE CANADIAN PRAIRIES,

Saint Patrick's Coll., Maynooth (Ireland).
J. Sweeney.
Weather WTHRAL, Vol. 10, p 302-3009, October 1985. 6 fig, 20 ref.

Descriptors: *Drought, *Canada, *Prairies, *Soil Water, *Precipitation, Grain crops, Alberta, Saskatchewan, Manitoba, Evapotranspiration.

The 1984 drought in the three Prairie Provinces, Alberta, Saskatchewan, and Manitoba, Canada, is described, including water balance components (soil water, potential evapotranspiration, actual evapotranspiration, and precipitation), the chronology of the drought, short- and long-term perspectives on causes of the drought, and its cost. Precipitation, snow, and barometric pressure during the 1983-1984 period are discussed. Drought on the prairies can stem either from a poor winter snow season or from a failure of summer precipitation; both had a role in the 1984 drought. A relationship between enhanced zonal flow, which promotes drought on the Plains and Prairies, and solar cycles may be a reality, and the 1984 drought may be seen in this context. A figure in excess of $2.5 billion may be attached to the 1984 drought, primarily as a result of drops in production of major grain crops. (Rochester-PTT)
W86-04508

MEASURED AND CREAMS-PREDICTED NITROGEN LOSSES FROM TOMATO AND CORN MANAGEMENT SYSTEMS,

Southeast Kansas Branch Experiment Station, Parsons.
For primary bibliographic entry see Field 5B.
W86-04538

ROLE OF WATER IN SOIL FORMATION,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Tabaka i Makhorki, Krasnodar (USSR).
V. K. Uvarov, and A. I. Ionov.
Soviet Soil Science SSSCAE, Vol. 17, No.2, p 1-6, March-April 1985. 1 fig, 16 refs. Translated from Pochvovedeniye, No 2, p 15-20, 1985.

Descriptors: *Soil water, *Soil genesis, *Soil water movement, *Slopes, Caucasus, Soil catena, Elevation, Precipitation, Chernozems, Podzols, Subsurface water.

The role of water in the formation of soils on short slope and on the general slope of the northwest Caucasus is illustrated. The roles of slope, altitude, annual precipitation, and slope aspect in soil development are discussed. With respect to the direction in which the water moves on the general slope of the western Caucasus, soils can be divided into two groups: (1) soils in which the water moves predominantly in a lateral direction and (2) soils in which the water moves in a predominantly vertical direction. To the first group belong the soils of the mountains and the foothills, beginning with the Mountain Meadow soils and ending with the Gray Mountain Forest soils. To the second group belong the soils of the plain at the foot of the mountains: Compact Chernozems and dense leached Chernozems. The most typical soils of the first group are the gray Typical Mountain Forest soils. Almost all of the water in these soils moves as a lateral subsurface flow and only a very small part percolates into the substratum. The typical soils in the second group are the leached Chernozems, in which the lateral flow is almost absent. Podzolization arises in areas where there is a sharp bend in the surface. As a result of decrease in slope in these areas, water movement slows and flooding occurs. (Rochester-PTT)
W86-04550

SOIL FORMATION ON TUFF PARENT MATERIAL IN THE POKAMENYA TUNGUSKA RIVER BASIN,

Akademiya Nauk SSSR, Moscow. Pochvennyi Inst.
N. I. Belousova, I. I. Vasenev, and Y. B. Tsekhanovskaya.
Soviet Soil Science SSSCAE, Vol. 17, No. 2, p 7-17, March-April 1985. 3 fig, 3 tab, 14 ref. Translated from Pochvovedeniye, No 3, p 9-19, 1985.

Descriptors: *Soil genesis, *Sedimentary rocks, *Soil water, *Precipitation, *Leaching, *Soil profiles, *Soil solution, Iron, Slope movements, Temperature, Podzols, Permeability, Seasonal variation.

Podzol formation on basal tuff sedimentary rocks is evaluated from indirect landscape and soil data, direct determinations of permeability and field moisture percentage, and observations carried out on the soil moisture dynamics and penetration of atmospheric precipitation into the soil profile in years differing in amount of soil moisture. The soils studied here are characterized by the following: (1) a leaching regime with an intensive water exchange that ensures the removal of soluble substances from the soil profile, thereby creating the real conditions for the formation of podzolic soils; (2) a seasonally variable water regime that may not arise every year, but results in the segregation of Fe in the A2 horizons typical of texturally differentiated Taiga soils; (3) fall and spring waterlogging of the soil that may cause the temporary disaggregation and makes plastic the substrate in the lower part of the profile, thereby creating the conditions for slope movements, and (4) judging by the temperature, the present sod-podzolic soils are much older than the loamy sod-podzolic soils of the European USSR. (Rochester-PTT)
W86-04551

RELATIONSHIPS BETWEEN THE SWELLING OF SOME SOILS AND SPECIFIC SURFACE CATEGORIES AND THE ENERGETICS OF SOIL MOISTURE,

Akademiya Nauk SSSR, Moscow. Pochvennyi Inst.
P. M. Sapozhnikov.
Soviet Soil Science SSSCAE, Vol. 17, No. 3, p 87-93, May-June 1985. 2 fig, 2 tab, 11 ref. Translated from Pochvovedeniye, No 3, p 40-45, 1985.

Descriptors: *Soil water, *Wetting, *Humus, Soil properties, Podzols, Chernozems.

The relationship between swelling, specific surface categories, and the energy status of soil water was examined in sod-podzolic soils, ordinary chernozems, and red ferralitic soils. External specific surface has the greatest effect on the swelling of sod-podzolic and ferralitic soils, whereas the humus and specific surface (determined by low-temperature nitrogen absorption) have the greatest effect on the swelling of Chernozemic soils. Two stages of swelling, corresponding to the energy states of soil water can be distinguished: intradomain and interdomain. Intradomain swelling corresponds to the interval of potentials from the initial potentials to the first layer of the wetting film. Interdomain swelling corresponds to the interval of potentials from the first layer of the wetting film to the first critical potential, which corresponds to the maximum film moisture. (Rochester-PTT)
W86-04552

DIURNAL VARIATIONS OF SOIL-MOISTURE TENSION,

Moscow State Univ. (USSR). Dept. of Soil Science.
A. D. Voronin, Y. V. Shein, and I. I. Gudima.
Soviet Soil Science SSSCAE, Vol. 17, No. 4, p 85-93, July-August 1985. 4 fig, 12 ref. Translated from Pochvovedeniye, No 6, p 66-74, 1985.

Descriptors: *Soil water, *Temperature, *Evapotranspiration, *Diurnal distribution, Clay loam, Cotton, Alfalfa, Hysteresis, Cultivated lands, Podzols.

Diurnal variations in soil-moisture tension (P sub t) and their causes were conducted on various clay loam soils, either fallow, or under cotton or alfalfa cultivation. Tensiometers with combined water-mercury manometers were employed in sampling. P sub t fluctuates considerably during the day, from -20 to -44 kPa in the surface layers. The amplitude of the fluctuations decreases with depth, reaches maximum values for P sub t from -20 to -40 kPa, and decreases as the soil dries more deeply. The minimum P sub t values are observed at 7-11 pm, and the maximum values at 9-11 am. The diurnal variations of P sub t are produced primarily by evapotranspiration and water inflow from neighboring soil layers. The existence of a diurnal P sub t variation, its dependence on the inflow and outflow of water and, to a lesser extent, on meteorological conditions and soil temperature, elucidates some difficult-to-explain facts, and raises several new problems. The dynamics of P sub t make it difficult to obtain a water-retention curve from field data. Hysteresis also complicates the analysis of field data. (Rochester-PTT)
W86-04553

MODEL OF THE HYSTERESIS OF WATER RETENTION BY SOILS,

Akademiya Nauk SSSR, Moscow. Inst. of Soil Science and Photosynthesis.
R. A. Shcherbakov.
Soviet Soil Science SSSCAE, Vol. 17, No. 4, p 103-111, July-August 1985. 3 fig, 33 ref. Translated from Pochvovedeniye, No. 8, p 54-60, 1985.

Descriptors: *Soil water retention, *Soil water, *Capillary water, *Hysteresis, *Sorption, *Desorption, Mathematical model, Retention capacity.

A mathematical model of capillary hysteresis is proposed that makes it possible to construct intermediate curves from the sorption and desorption curves of soil water retention. The model is based on a description of the relation between the surficial and spatial filling of pores and on the correlation of pore filling with suction pressure. In an example, second order wetting and drying curves are constructed. Experimental and computed curves of water retention by soils (sand, sandy loam, clay, silt loam, and clay loam) showed good agreement, thus verifying the present method for computing intermediate wetting and drying curves. Intermediate curves of higher order can be constructed similarly to second-order curves, making it possible to compute water transport in soils with allowance for hysteretical phenomena. A correlation function of pore filling characterizes the structure of the pore space of soil. (Rochester-PTT)
W86-04554

INTERCEPTION OF SNOW BY THE FOREST CANOPY,

Tennessee Div. of Health Planning, Nashville.
For primary bibliographic entry see Field 2C.
W86-04555

HYDROMORPHIC SOILS WETTED BY GROUNDWATER IN NORTHERN KAZAKHSTAN,

Kazakhskii Gosudarstvennyi Selskokhozyaistvennyi Inst., Alma-Ata (USSR).
V. A. Bobrov, and A. G. Safronov.
Soviet Soil Science SSSCAE, Vol. 17, No. 1, p 11-20, January-February 1986. 2 fig, 5 tab, 10 ref. Translated from Pochvovedeniye, No 2, p 5-14, 1985.

Descriptors: *Soil water, *Soil classification, *Surface water, *Groundwater, *Kazakhstan, Steppes, Plains, Soil profiles.

New large-scale studies, which included boring into main profiles to the groundwater level in soils of Northern Kazakhstan, revealed substantial areas of soils with groundwater close to the surface. The soils of the slightly undulating plains of this area previously were considered to be automorphic. Based on all the currently available data, the authors divide the hydromorphic soils of the steppes (including semihydromorphic into three groups: (1) hydromorphic soils with surface wetting, including (a) surface flowing and (b) surface stagnant; (2) hydromorphic soils wetted by groundwater, including (a) ground-transpiration and (b) ground-hydrodynamic wetting; and (3) hydromorphic soils with mixed wetting, including (a) flowing and (b) stagnant. The genesis of the groundwater lying under these soils requires further study. (Rochester-PTT)
W86-04556

2H. Lakes

MANAGEMENT OF LAKE COMO: A MULTIOBJECTIVE ANALYSIS,

Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
For primary bibliographic entry see Field 6A.
W86-04165

FROM PHYTOPLANKTON TO DETRITUS AND BACTERIA: EFFECTS OF SHORT-TERM NUTRIENT AND FISH PERTURBATIONS IN A EUTROPHIC LAKE,

Oslo Univ. (Norway). Biologisk Inst.
For primary bibliographic entry see Field 5C.
W86-04180

REGULATING FACTORS OF THE CONCENTRATION OF DISSOLVED CARBOHYDRATES IN A CENTRAL WATER COLUMN OF LAKE SUWA, JAPAN,

Yamagata Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-04182

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 1. DYNAMICS OF PRODUCTION AND POPULATION OF THE PHYTOPLANKTON IN DEPENDENCE ON NUTRIENTS (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 1. PRODUCTIONS- UND POPULATIONSDYNAMIK DES PHYTOPLANKTONS IN ABHANGIGKEIT VOM NAHRSTOFFANGEBOT),

Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-04183

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 2. SEASONAL, VERTICAL AND HORIZONTAL DISTRIBUTION OF BACTERIA (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 2. SAISONALE, VERTIKALE UND HORIZONTALE VERTEILUNG DER BAKTERIEN),

Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-04184

UPTAKE OF INORGANIC CARBON AND NITROGEN BY PHYTOPLANKTON DURING THE WINTER MIXING PERIOD IN A FRESHWATER LAKE, LAKE NAKANUMA, JAPAN,

Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Miyazaki, and S. -E. Ichimura.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 409-421, February 1986. 5 fig, 4 tab, 20 ref. Japan Ministry of Education, Science and Culture Grant No. 60540419.

Descriptors: *Absorption, *Inorganic compounds, *Carbon, *Nitrogen, *Phytoplankton, *Lake Nakanuma, Mixing, Light penetration, Opacity, Nitrates, Nitrites, Ammonium, Model studies, Japan.

Assimilation of inorganic carbon and nitrogen into phytoplankton was examined during the winter mixing period in a small, freshwater lake, Lake Nakanuma, Japan. Carbon assimilation in the surface layer (1 m) was larger than that in the deeper layers (4 and 8 m). The difference between the assimilation in the light and that in the dark was large. Ammonium assimilation was largest among inorganic nitrogen examined (ammonium, nitrite and nitrate). Uptake of nitrate and nitrite was almost negligible, compared to that of ammonium. Ammonium assimilation in the dark was slightly smaller than that in the light, the difference between light and dark assimilation of ammonium was not as large as that of carbon. These results are consistent with the model that carbon and nitrogen assimilation into phytoplankton does not necessarily occur simultaneously, and that sorted carbon may be used for assimilation of nitrogen and for synthesis of nitrogen compounds including amino acids, protein and nucleic acids. (Lantz-PTT)
W86-04185

ENERGY FLOW IN THE POPULATIONS OF EUDIAPTOMUS GRACILOIDES AND DAPHNIA GALEATA IN LAKE ESROM,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5C.
W86-04189

VERTICAL DISTRIBUTION OF FEEDING AND PARTICLE-SELECTIVE TRANSPORT OF 137CS IN LAKE SEDIMENTS BY LUMBRICULID OLIGOCHAETES,

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2J.
W86-04246

EFFECT OF FALL TURNOVER ON TERMINAL CARBON METABOLISM IN LAKE MENDOTA SEDIMENTS,

Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. J. Phelps, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1285-1291, Nov. 1985. 2 fig, 6 tab, 39 ref.

Descriptors: *Carbon Cycle, *Sediment Analysis, *Lake Sediments, *Lake Mendota, Wisconsin, *Bacterial Analysis, Methane Bacteria, Sulfates, Eutrophic Lakes, Seasonal Variation, Methanol, Acetate, Ethanol, Stratification, Carbon Dioxide.

The carbon and electron flow pathways and the bacterial populations responsible for the transformation of H2-CO2, formate, methanol, methylamine, acetate, ethanol, and lactate were examined in eutrophic sediments collected during summer stratification and fall turnover in Lake Mendota, Wisconsin. The rate of methane formation averaged 1.130 micromol of CH4/liter of sediment/day during late-summer stratification versus 433 micromol of CH4/liter sediment/day during the early portion of fall turnover, whereas the rate of sulfate reduction of 280 micromol of sulfate/liter of sediment/day versus 1,840 micromol of sulfate/liter of sediment/day during the same time periods, respectively. The sulfate-reducing population remained constant while the methanogenic population decreased by one to two orders of magnitude during turnover. The acetate concentration increased from 32 to 81 micromol/liter of sediment while the acetate transformation rate constant decreased from 3.22 to 0.71/h, respectively, during stratification versus turnover. Acetate accounted for nearly 100% of total sedimentary methanogenesis during turnover versus 70% during stratification. The fraction 14CO2 produced from all 14C-labeled substrates examined was 10 to 40% higher during fall turnover than during stratification. The addition of Desulfovibrio vulgaris to sulfate-amended sediments greatly enhanced the amount of CO2 produced from either (14C)methanol or (2-14C)acetate, suggesting that H2 consumption by sulfate reducers can alter methanol or acetate transformation by sedimentary methanogens. These data suggest that turnover dynamically alters carbon transformation in eutrophic sediments such that sulfate reduction dominates over methanogenesis principally as a consequence of altering hydrogen metabolism. (Author's abstract)
W86-04253

TRACE METAL DEPOSITION AND MOBILITY IN THE SEDIMENTS OF TWO LAKES NEAR SUDBURY, ONTARIO,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W86-04349

WATER BALANCE OF LAKE VICTORIA,

Institute of Hydrology, Wallingford (England).
B. S. Piper, D. T. Plinston, and J. V. Sutcliffe.
Hydrological Sciences - Journal - des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 25-37, March 1986. 5 fig, 3 tab, 16 ref.

Descriptors: *Water balance, *Lakes, *Hydrologic budget, *Rain gages, *Stream discharge, *Rainfall-runoff relationship, *Lake Victoria, *Africa, Statistical analysis.

After reviewing lake inflows and the method of calculating lake rainfall from lakeside gauges, the historic lake water balance between 1961 and 1964 was reproduced. The historic sequence of lake levels can be reproduced using relatively simple combinations of the lakeside rainfall records, without the need for adjustment of the rainfall component during periods of lake rise. This rainfall series can be used either with measured tributary inflows of 1956-1978 or with tributary inflows simulated from catchment rainfall over the longer period 1925-1978. The rainfall and tributary inflows, in combination with a reasonable estimate of evaporation, can reproduce the measured lake levels and lake outflows through the water balance in terms of seasonal and long-term variations. This success can be attributed to the fact that a constant set of rain gauges was used, with no scaling constraint on the weighting factors, so that the important rainfall in the northeast was properly represented. A sequence of three years with rainfall above average, but amplifying its variation from the mean, was sufficient to explain what appears to have been an exceptional event when the lake level series is studied in isolation. (Rochester-PTT)
W86-04386

INTERNAL FACTORS CONTROLLING PEATLAND-LAKE ECOSYSTEM DEVELOPMENT,

Wisconsin Univ.-Madison. Center for Limnology.
T. K. Kratz, and C. B. DeWitt.
Ecology ECOLAR, Vol. 67, No. 1, p 100-107, February 1986. 7 fig, 1 tab, 32 ref. NSF Grant Nos. DEB77-14501 and DEB80-12313.

Descriptors: *Peat bogs, *Lakes, *Ecosystems, *Model studies, *Limnology, Stratification, Mat peat, Peat density, Vertical distribution, Growth rates, Radioactive dating, Wisconsin.

To examine nonclimatic factors controlling a small-peatland development, the classical model of peatland development by hypothesizing the existence of three horizontal zones was expanded. Then tested were five predictions derived from the expanded model. Prediction (1): Pete Strata. There are two vertical strata of peat, an upper layer consisting of peat formed in the floating or grounded mat (mat peat) and a lower layer of peat formed in the floating mat, but dropped from the side or bottom of the mat (debris peat). Underlying these strata are lake sediments originating in the water column. Prediction (2): Strata Boundary. Chamaedaphne calculata provides the framework for mat growth, and therefore stems and roots of this plant from the lake edge to the upland. Prediction (3): Strata Thickness. Thickness of mat peat increases as a function of the depth of the original basin and the length of time peat has been accumulating. Prediction (4): Peat Density. The density of peat increases with distance from the lake edge up to a zone in which peat has reached a maximum density and mean density is constant. Prediction (5): Vertical Accumulation Rate. The long-term rate of vertical accumulation (in grams/sq m/yr) decreases with distance from the lake edge. To test these predictions, data were collected on peat stratigraphy, lake-edge vegetation, and peat age and density in Fallison Bog, a 5.5-ha peatland lake system in Northern Wisconsin, and to a lesser extent from 13 other peatlands in the region. Each prediction was confirmed, except that thickness of mat peat appears to be independent of peat accumulation time. The vertical growth rate of the mat was estimated by radiocarbon dating of C. calculata stems. By dating twigs at different locations in the mat, it was estimated that the rate of vertical peat accumulation ranges from 34-75 gm/sq m/yr, depending on location within the peatland. (Lantz-PTT)
W86-04400

DIURNAL MIXED LAYER,

Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. Imberger.
Limnology and Oceanography LIOCAH, Vol. 30, No. 4, p 737-770, July 1985. 26 fig, 2 tab, 49 ref.

Descriptors: *Wind, *Solar energy, *Mathematical model, *Mixolimnion, *Isotherms, Energy conversion, Upwelling, Monin-Obukhov length, Wellington reservoir, Australia, Diurnal distribution, Limnology.

Fine-scale measurements and temperature gradient microstructure data are used to describe the diurnal energetics of the mixed layer in the Wellington Reservoir, Western Australia. The Wedderburn number (W) ranged from 0.02 at the start of the heating phase to about 10 at the end of the convective period. During the intermediate strong wind period, W remained at about 0.1; the surface wind stress induced a strong tilt of the isotherms at the base of the mixed layer. The ratio of the Monin-Obukhov length to the depth of the mixed layer ranged from about 5.0 during the morning to 0.005 at the end of the convective period. A simple one-dimensional integral mixed layer model was applied to assess the importance of the temporal terms in diurnal simulations and to verify the values of the energy conversion efficiences used in such models. Overall, the model performed extremely well, but the results showed the need to develop parameterizations for the energetics of billowing induced by large shears across the base of the mixed layer and for the mixing accompanying upwelling. (Rochester-PTT)
W86-04510

SPECIAL CONTRIBUTION, MANAGING THE GREAT LAKES BASIN AS A HOME,

Bundesministerium der Finanzen, Bonn (Germany, F.R.).
W. J. Christie, M. Becker, J. W. Cowden, and J. R. Vallentyne.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 2-17, 1986. 16 ref.

Descriptors: *Great Lakes, *Water management, *Lake basins, Lake morphology, Environmental policy, Ecosystems, Economic impact, Public participation.

The ecosystem approach, a more holistic way to planning, research, and management of the Great Lakes basin, was articulated as a concept in the 1978 Great Lakes Water Quality Agreement. In order to stimulate movement of this concept to a series of implementable actions, and Ecosystem Approach Workshop was held in March 1983. The paper describes the process used to define common cause for a group of fifty-six participants a diverse spectrum of backgrounds. Three generic obstacles to attainment of an ecosystem approach, which emerged from pre-workshop. They were: (1) lack of an holistic perspective, (2) predominance of egosystem thinking, and (3) lack of a preventive approach. The strategy suggested for overcoming the obstacles was identified as 'enlightened self-interest.' The participants proposed 33 initiatives for advancing the ecosystem approach. These initiatives related to improving the acquisition of scientific data, directing institutional change for ecosystem management, improving citizen participation, paying the costs for resources use, education, and public awareness. In order to help implement these initiatives, establishment of an ecosystem approach monitoring group and an improved public information program is recommended. (Author's abstract)
W86-04524

SEASONAL AND SPATIAL DISTRIBUTION OF BACTERIA, CHLOROPHYLL, AND NUTRIENTS IN NEARSHORE LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. Moll, and M. Brahce.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 52-62, 1986. 5 fig, 4 tab, 46 ref.

Descriptors: *Lake Michigan, *Bacteria, *Chlorophyll, *Nutrients, *Spatial distribution, Seasonal distribution, Biomass, Grand River, Population dynamics, Ecological effects, Lake morphology, Glucose, Biological analysis.

Bacterial abundances and metabolic activity were related to chlorophyll concentrations, nutrient concentrations, and the physical environment in the vicinity of the Grand River discharge into Lake Michigan. The results show that bacteria and phytoplankton displayed almost opposite seasonal and spatial distributions. Bacterial abundances were at their annual high in the late summer and early fall when chlorophyll concentrations and primary productivity were at a seasonal low and nutrient concentrations were at their annual nadir. These results indicate that bacterial populations were not highly stimulated by the presence of algae or algal extracellular excretions. However, a complete separation of bacterial and algal dynamics was difficult because of the ecological overlap between microalgae (less than 3 micro in diameter) and bacterioplankton. Analysis of bacterial abundance, chlorophyll concentration, and glucose uptake by size fractions showed that Lake Michigan has an abundant crop of microalgae. These microalgae were difficult to separate from the bacterioplankton. The glucose uptake data by size class suggested a significant portion of dark heterotrophy was conducted by algae. (Author's abstract)
W86-04526

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN NON-MIGRATORY FISH FROM THE NIAGARA RIVER AREA AND TRIBUTARIES TO LAKE ONTARIO,

Indiana Univ. at Bloomington. Dept. of Chemistry.
R. Jaffe, and R. A. Hites.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 63-71, 1986. 3 fig, 3 tab, 18 ref. EPA Grant No. R-808961/.

Descriptors: *Organic compounds, *Halogens, *Fish, *Niagara River, *Lake Ontario, Methane, Gas chromatography, Mass spectrometry, Water pollution effects, Bromine, Industrial wastewater, Pesticides, Chlorinated hydrocarbons.

Non-migratory fish from the mouths of tributaries to Lake Ontario and from the Niagara River and its tributaries were analyzed for anthropogenic organic compounds by methane enhanced, negative ion, gas chromatographic mass spectrometry. The results indicate that non-migratory fish, sampled at distances of up to 300 km from Niagara Falls, New York, accumulate pollutants originating at a particular hazardous waste site in that city. Several brominated aromatic compounds that apparently come from Rochester, New York, were also identified. A variety of chlorinated pesticides and compounds of industrial origin were found. (Author's abstract)
W86-04527

RELATIONSHIPS BETWEEN CHLORINATED HYDROCARBON CONCENTRATIONS AND REARING MORTALITY OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EGGS FROM LAKE MICHIGAN,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-04528

EVALUATION OF MANAGEMENT ASPECTS OF A HYPERTROPHIC AFRICAN IMPOUNDMENT,

National Inst. for Water Research, Pretoria (South

Africa).
For primary bibliographic entry see Field 5G.
W86-04569

SIMULATION OF WATER-BLOOM IN A EUTROPHIC LAKE - IV: MODELING THE VERTICAL MIGRATION IN A POPULATION OF MICROCYSTIS AERUGINOSA,

Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W86-04579

USE OF ENHANCED LANDSAT IMAGERY FOR MAPPING LAKE DEPTH,

Winnipeg Univ. (Manitoba). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04603

MODEL FOR SEDIMENT OXYGEN DEMAND IN LAKES,

Beak Consultants Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 5B.
W86-04639

RESPONSE OF PHOTOSYNTHETIC PARAMETERS TO ENVIRONMENTAL FACTORS IN SIGGEFORASJON, SWEDEN,

Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W86-04647

MACROPHYTE DECOMPOSITION IN TWO TROPICAL LAKES,

Fisheries Research Inst., Szarvas (Hungary).
For primary bibliographic entry see Field 5C.
W86-04649

ECOLOGICAL ZOOGEOGRAPHY OF PALAEMONETES ANTENNARIUS (CRUSTACEA, DECAPODA),

Innsbruck Univ. (Austria). Inst. fuer Zoologie.
G. J. Dalla Via.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 251-262, April 1986. 3 fig, 3 tab, 35 ref. Osterreichische Nationalbank Project No. 1208.

Descriptors: *Shrimp, *Physiological ecology, *Palaemonetes antennarius, Ecological distribution, Temperature effects, Hydrogen ion concentration, Sodium, Calcium, Brackish water, Salinity, Lakes, Lagoons, Rivers, Italy.

The distribution pattern of the fresh and brackish water shrimp Palaemonetes antennarius, shows specific ecological and physiological requirements. These are discussed and reviewed for the species found in Italian lakes, lagoons and rivers. Water temperature influences the occurence of the shrimps, with a temperature level above 18-20 C which continues for at least 3-4 months, necessary. Palaemonetes antennarius occurs only in water with pH values above 8.0. The ion requirements of the shrimp are also very specific; in fresh water, the critical Na(+) concentration lies between 0.125 and 0.183 mM Na(+)/l at 0.8 mM Ca(++)/l. Below these levels the mortality rate increases. In 4% brackish water, the critical Ca(++) level drops to 0.09 mM Ca(++)/l. In fresh water as well as in brackish water a high Na(+) concentration can compensate for a Ca(++) concentration that is lower than required by the shrimps. The upper limit of the tolerable salinity range of Palaemonetes antennarius is around 20%. The highest survival rate of the species in brackish water is between 3-5%. (Lantz-PTT)
W86-04650

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES: 4. LINDANE (GAMMA-HEXACHLOROCYCLOHEXANE),

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W86-04651

MICROBIAL DECOMPOSITION OF CELLULOSE IN ACIDIFYING LAKES OF SOUTH-CENTRAL ONTARIO,

Toronto Univ. (Ontario). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W86-04672

INCIDENCE OF VIBRIO CHOLERAE AND RELATED VIBRIOS IN A COASTAL LAGOON AND SEAWATER INFLUENCED BY LAKE DISCHARGES ALONG AN ANNUAL CYCLE,

Valencia Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W86-04674

MODEL FOR THE DISTRIBUTION OF SULFATE REDUCTION AND METHANOGENESIS IN FRESHWATER SEDIMENTS,

Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
D. R. Lovley, and M. J. Klug.
Geochimica et Cosmochimica Acta GCACAK, Vol. 50, No. 1, p11-18, January 1986. 4 fig, 1 tab, 70 ref. NSF grant DEB 81-09994.

Descriptors: *Mathematical models, *Lake sediments, *Methane bacteria, *Sulfates, Acetate, Microorganisms, Sediments, Bacterial physiology.

A model based on the in situ physiological characteristics of methanogens and sulfate reducers was developed to describe the distribution of methanogenesis and sulfate reduction in freshwater sediments. The model predicted the relative importance of methane production and sulfate reduction in lakes of various trophic status and generated profiles of sulfate, acetate, methanogenesis, and sulfate reduction comparable to the profiles that are expected based on field studies. The model indicated that at sulfate concentrations 30 micromolar a sulfate-reducing zone develops because sulfate reducers maintain acetate concentrations too low for methanogens to grow. At lower sulfate concentrations a methanogenic zone develops because the dual limitations of low sulfate concentrations and acetate consumption by methanogens prevents sulfate reducers from growing. The model and a compilation of previously published field data indicate that, within the reported range of sulfate concentrations (0-280 micromolar) the relative importance of methanogenesis and sulfate reduction in freshwater sediments is primarily dependent upon the rates of organic matter decomposition. (Peters-PTT)
W86-04680

2I. Water In Plants

GAMMA RAY ATTENUATION STUDIES OF INTERCEPTION FROM SITKA SPRUCE: SOME EVIDENCE FOR AN ADDITIONAL TRANSPORT MECHANISM,

Institute of Hydrology, Wallingford (England).
I. R. Calder, and I. R. Wright.
Water Resources Research WRERAO, Vol. 22, No. 3, p 409-417, March 1986. 6 fig, 1 tab, 48 ref.

Descriptors: *Interception, *Gamma radiation, *Sitka spruce, Plant water potential, Water loss, Canopy, Water storage, Wales, Scotland, Water vapor.

Various forest canopy characteristics of stands of Sitka spruce (Picea sitchensis (Bong.) Carr.), including canopy density, the aerodynamic resistance to the transfer of water vapor, and the rates of change of drainage and evaporation of water with respect to canopy storage, were investigated using direct measurements of canopy mass and water storage. The measurements, made at sites located in Wales and Scotland, utilized the attenuation of a horizontal beam of gamma rays which was arranged to scan through the canopy at different levels. The aerodynamic resistance to the transport of water vapor from the canopy to a reference level 5 m above mean tree height was found to be consistent with the value of 3.5 s/m, determined from earlier modeling studies. This value is, however, lower and shows less wind speed dependence than would be expected from conventional formulae which are based on eddy diffusion theory and tree height. The possibility of explaining these discrepancies in terms of an additional transport mechanism involving large-scale eddies is discussed. (Author's abstract)
W86-04204

EVAPOTRANSPIRATION AND SOIL WATER RELATIONSHIPS FOR SPRING WHEAT AND SOYBEAN,

North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2D.
W86-04407

WATER-LIMITED EQUILIBRIUM OF SAVANNA VEGETATION SYSTEMS,

Massachusetts Inst. of Tech., Cambridge.
P. S. Eagleson, and R. I. Segarra.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1483-1493, October 1985. 7 fig, 3 tab, 40 ref, NSF ATM-8114723.

Descriptors: *Mathematical models, *Hydrologic budget, *Evapotranspiration, *Ecological optimality hypotheses, *Climates, *Plant populations, Trees, Grass, Vegetation canopy, Vegetation density, Sudan, South Africa.

The average annual water balance of savanna vegetation systems is modeled as an interactive competition between trees and grass for water and energy. Ecological optimality hypotheses are introduced that allow specification of the woodland canopy density, the grass canopy density, and the plant (water use) coefficients of both tree and grass under conditions of natural equilibrium. Only one tree-grass equilibrium state was found; it agreed well with the observed state of savanna in Sudan and the Transvaal (South Africa). This state is stable with respect to perturbations of vegetation canopy density, but is metastable with respect to shifts in climate. Two other equilibrium states exist as vegetation monocultures, i.e., grassland and forest, but both are shown to be unstable with respect to perturbations in vegetation density. (Author's abstract)
W86-04545

ECOLOGY OF ACHENE DIMORPHISM IN HETEROTHECA LATIFOLIA. III. CONSEQUENCES OF VARIED WATER AVAILABILITY,

Arizona Univ., Tucson. Dept. of Ecology and Evolutionary Biology.
D. L. Venable.
Journal of Ecology JECOAB, Vol. 73, No. 3, p 757-763, November 1985. 2 fig, 1 tab, 23 ref.

Descriptors: *Drought, *Water shortage, *Germination, *Plant growth, *Available water, Water deficit, Competing use, Water stress, Weeds, Biomass, Heterotheca latifolia, Athenes.

The relative success of plants derived from the ray and disc achenes of Heterotheca latifolia when in competition and potentially short of water was examined. The number of living plants was counted at various times during the growth of pure and mixed sowings with regular watering, and mixed sowings with droughts beginning and ending at various times. Disc achenes proved more successful than ray achenes when a plentiful water supply resulted in a high overall biomass and density at the end of the experiment. The inferior performance of ray achenes is attributed to lower embryo provisioning, lower and later germination, and suppression by the early-germinating disc achenes. Ray achenes were more successful than disc achenes when water was scarce and overall biomass and density were low at the end of the experiment. Their superior performance resulted from escaping the water shortage by dormancy. While the disc achene strategy resulted in a higher mean performance across treatments, the ray

scheme strategy exhibited lower variance in performance. This result is discussed in terms of fitness in variable environments. (Geiger-PTT)
W86-04618

EFFECTS OF O3 AND ACIDIC RAIN ON PHOTOSYNTHESES AND GROWTH IN SUGAR MAPLE AND NORTHERN RED OAK SEEDLINGS,

Boyce Thompson Inst. for Plant Research, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W86-04660

WATER USE IN WINTER WHEAT AS INFLUENCED BY CEPHALOSPORIUM GRAMINEUM,

Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
J. M. Martin, D. E. Mathre, and R. H. Johnston.
Crop Science CRPSAY, Vol. 26, No. 1, p 14-20, January-February 1986. 5 fig, 2 tab, 15 ref.

Descriptors: *Winter wheat, *Soil-water-plant relationships, *Plant pathology, *Cephalosporium gramineum, Water use, Soil water depletion, Grain crops, Bozeman, Montana.

Cephalosporium stripe disease of winter wheat (Triticum aestivum L.) is caused by the soil borne fungus Cephalosporium gramineum. The effect of C. gramineum on root activity and subsequent soil water depletion is unknown. Our objective was to measure water use and soil water depletion patterns for six winter wheat genotypes with differing reactions to C. gramineum, under disease and non-disease conditions. Six winter wheat genotypes, 'aries', 'Widridge', 'Redwin', 'Lenore', MT 7579, and MT 7811 were evaluated for grain yield in replicated control and inoculated plots in 1982 and 1983 near Bozeman, MT, of an Amsterdam silt loam (fine silty mixed family of Haploborolls). Soil water was measured in each plot at 15-cm depth increments to 145-cm with a neutron moisture meter. Soil water measurements were taken at roughly weekly intervals commencing in early May and continuing until harvest in early August. C. gramineum reduced grain yield, water use, and water use efficiency in both years but to a greater extent in 1982 than in 1983. Lenore proved least susceptible and Maries and MT 7811 were most susceptible as measured by reduction in grain yield, water use, and water use efficiency when averaged over both years. Genotypes differed in rate of water use in both years in the presence of the disease, but differences among genotypes were detected only in 1982 in the non-disease situation. Infection by C. gramineum affected water depletion patterns least in Lenore and Winridge, and most in Maries and MT 7811. Genotype x time and genotype x depth interactions were such that relative differences among genotypes were amplified with increasing time and depth. C. gramineum affected soil water extraction throughout the soil profile. Reduction in water extraction may be due to reduced root activity and/or reduced demand for water by infected plants. (Lantz-PTT)
W86-04667

2J. Erosion and Sedimentation

SEDIMENTATION PROBLEMS IN RIVER BASINS,

United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
UNESCO: Paris, France, 1982. Edited by W. R. White. 152 p, 92 fig, 4 tab, 178 ref, 1 append.

Descriptors: *Erosion, *Erosion control, *Sediment transport, *River basins, *Environmental effects, Sedimentation, Land use, Agriculture, Grazing, Urbanization, Construction, Channels, Weathering, Vegetation, Remote sensing, Watersheds, Model studies, Mathematical models, Forest hydrology, Hydrology, Rivers, Hydraulic structures, Dams, Reservoirs, Banks.

This report has several objectives: (1) to define the effects of man's activities (land use, agriculture, forestry, grazing, mining, construction, urban development, and hydraulic structures) on erosion and sedimentation processes in river basins, (2) to describe the state of knowledge of the cause-effect relationships between plant cover, surface runoff, sediment production and deposition, (3) to inform about amelioration of existing sedimentary conditions, and (4) to describe methods for estimating and predicting changes in erosion and sedimentation processes following manmade changes in watersheds and river channels. Data can be acquired by review of existing data, ground inspection, aerial photography, and remote sensing. Predictive methods include empirical methods, calculation methods, and modeling (mathematical and scale). Control techniques in river basins are divided into agrotechnical measures, forest reclamation, and hydrotechnical measures. Control techniques in the water courses may involve bank protection, flow retardation, flow deflection, and hydraulic structures. Several case studies are presented: sediment study of a wet tropical area of Puerto Rico, problems related to creation of a lake in a semi-arid region of Tanzania, use of a mathematical model to simulate long-term changes in bed levels in estuaries, use of a scale model to study problems associated with dam construction, and quantification of soil erosion caused by storms in a semi-arid region. (Cassar - PTT)
W86-03973

PERSISTENCE IN THE SIZE DISTRIBUTION OF SURFICIAL BED MATERIAL DURING AN EXTREME SNOWMELT FLOOD,

Geological Survey, Denver, CO.
E. D. Andrews, and D. C. Erman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 191-197, February 1986. 3 fig, 80 ref. Research Grant T3770171.

Descriptors: *Maximum likelihood method, *Sediment transport, *Bed load, *Sediment load, *Floods, Statistical analysis, Inverse problem, Hydraulic properties, Regression analysis, Transient conditions, Steady-state conditions.

Sagehen Creek is a small, gravel bed stream in the Sierra Nevada of California. The reach studied has a single-thread, meandering channel with alluvial bed and banks. Surficial bed material sampled throughout a 160-m-long reach has a median diameter of 58 mm. The underlying subsurface bed material is appreciably finer and has median diameter of 30 mm. The bank-full discharge is approximately 2.0 cu m/s, and has been equaled or exceeded on an average of 12.1 days per year during the period of continuous gage operation, water years 1953-1983. Snowmelt runoff in the spring of 1983 was the longest period of sustained, high flows that has occurred in the past 30 years. Bed load transport rates were sampled daily at the peak of the snowmelt flood, May 30 to June 12, 1983. Whole-channel bedload transport rates varied between 0.012 and 0.10 kg/s. An estimated 5800 kg of material larger than 45 mm was transported past the sampling cross section between May 30 and June 12, 1983. These measurements show that a significant quantity of material involving a majority of the particle sizes present in the streambed surface was transported during the period of sustained, large discharges. The size distribution of surficial bed material immediately upstream of the bedload sampling cross section was measured on June 6 near the flood peak and again on July 12 after the flood had subsided. In spite of large differences in discharge and bedload transport the size distributions of particle sizes in the surficial bed material that is present in Sagehen Creek during small discharges also was in place and unchanged during a sustained period of very large discharges. Bedload sampling and measurements of trace-particle movement indicate that only a few particles, though involving nearly all available sizes, were entrained at any instant by even the peak flood flows. (Author's abstract)
W86-04173

ROLE OF COAGULATION IN THE KINETICS OF SEDIMENTATION,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5D.
W86-04229

VERTICAL DISTRIBUTION OF FEEDING AND PARTICLE-SELECTIVE TRANSPORT OF 137CS IN LAKE SEDIMENTS BY LUMBRICULID OLIGOCHAETES,

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. R. Krezoski, and J. A. Robbins.
Journal of Geophysical Research, Vol. 90, No. C6, p 11,999-12,006, November 20, 1985. 5 fig, 1 tab, 31 ref. OCE-7825680.

Descriptors: *Lake sediments, *Deposit feeding species, *Tracers, *Sediment redistribution, *Cesium radioisotopes, Sediment-water interfaces, Bottom sediments, Sedimentation.

Two replicate microcosms of rectangular cross section (3x5 cm) containing evenly spaced (1 cm) thin layers (0.5 mm) of sediment labeled with gamma-emitting 137Cs were inoculated with the lumbriculid Stylodrilus heringianus at a density of 7.9 x 10000/sq m (10 C). The subsequent amount of tracer lost from each layer as well as the downward movement of the layers were determined by periodically scanning the length of the cells with a well-collimated gamma detector system. During the course of the 600-hour experiment, 137-Cs activities decreased only in layers between 0 and 6 cm depth. These decreases were accompanied by the appearance of a new layer at the sediment surface. Between 80 and 90% of the activity lost from the underlying layers appeared in the emergent surface peak, thus indicating that subsurface defecation is a minor aspect of conveyor belt transport. Decreases in 137-Cs activity within layers were consistent with first-order kinetics with a maximum loss rate of about 0.08%/hr. The vertical distribution of the rate constant was very nearly Gaussian with the maximum at 3.3 cm and a spread (SD) of 1.4 cm. The rate of layer burial decreased monotonically but nonlinearly with sediment depth from an extrapolated surface value of about 1.8 x 0.01 mm/hr. A model based on conservation of mass was developed which relates the tracer feeding distribution to the velocity distribution assuming that the distribution of mass removed through feeding was proportional to the amount of tracer removed. The model takes rigorous account of depth-dependent porosity and provides an excellent description of the velocity distributions if the transfer of 137-Cs is taken to be 1.67 times the mass transfer rate. This factor, termed the feeding selectivity factor, is attributed to the selection of fine particles by worms and is important in models describing trace and contaminant diagenesis in sediments reworked by conveyor belt species. (Author's abstract)
W86-04246

DISSOLVED AND SUSPENDED MATTER TRANSPORTED BY THE GIROU RIVER (FRANCE): MECHANICAL AND CHEMICAL EROSION RATES IN A CALCAREOUS MOLASSE BASIN,

Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
J.-L. Probst.
Hydrological Sciences - Journal - des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 61-79, March 1986. 14 fig, 4 tab, 52 ref.

Descriptors: *Dissolved load, *Suspended load, *Girou River, *France, *Erosion rates, *Calcareous soils, Temperate region, Geologic erosion, Runoff, Mechanical erosion, Chemical erosion, Simple mixing model, Fluvial transport, Sediment yield, Calcium, Biocarbonate, Weathering, Storms.

The mean mechanical and chemical erosion rates of the Girou basin are calculated from the amount of suspended and dissolved material transported by the river. The chemical and mineralogical characteristics of the river load and its behavior are studied during the water year 1980-1981. The origins of the major compounds in the drainage basin

were determined and the contribution of mechanical and chemical erosion to the fluvial transport of each compound were calculated. Calcium and bicarbonate represent about 80% of the total dissolved load, and carbonate dissolution is responsible for 93% of the chemical weathering processes, whereas rock weathering accounts for only 61% of the dissolved material carried by the river. The suspended and dissolved concentrations in the river result from a hydrological and geochemical mixing of runoff from different sources. Suspended material is exported mainly by surface runoff during storm periods. A simple mixing model suggests that the suspended sediment concentration of surface runoff may be assumed to have a constant value of 0.5 g/liter. The Giron suspended sediments closely reflect the nature of soil materials in the temperate regions. (Rochester-PTT)
W86-04387

SUSPENDED SEDIMENT PRODUCTION IN A SUBURBAN TROPICAL BASIN (LUBUMBASHI, ZAIRE),

Ghent Rijksuniversiteit (Belgium).
M. Lootens, and S. Lumbu.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 39-49, March 1986. 4 fig, 3 tab, 29 ref.

Descriptors: *Runoff, *Suspended sediment yield, *Suburban areas, *Tropic zone, *Suspended load, *Floods, Seasonality, River Lubwe, Zaire, Rating Curve technique.

A study of suspended sediment transport in the 8.5 sq km River Lubwe catchment was carried out during the wet season 1983-1984. The suspended sediment yield was estimated using the suspended-sediment rating curve technique and detailed observations of 10 runoff events. The River Lubwe is characterized by periodic high magnitude floods, during which the bulk of the load is transported. The total suspended load for the hydrologic year 1983-1984 is estimated at 108 t, representing a sediment yield of 12.7 t per sq km per yr. (Author's Abstract)
W86-04392

GEOCHEMISTRY OF SUSPENDED PARTICULATE MATTER IN TWO NATURAL SEDIMENTATION BASINS OF THE RIVER RHINE,

Technische Hogeschool Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
For primary bibliographic entry see Field 5B.
W86-04547

2K. Chemical Processes

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICO-CHEMICAL DATA AND MICROSCOPICAL OBSERVATIONS,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
G. G. Leppard, J. Buffle, and R. Baudat.
Water Research WATRAG, Vol. 20, No. 2, p 185-196, February 1986. 9 fig, 1 tab, 54 ref.

Descriptors: *Aggregates, *Fulvic acids, *Soil organic matter, *Water analysis, *Organic matter, Electron microscopy, Ultrafiltration.

The size and aggregation properties of water fulvic acids of pedogenic origin (the pedogenic refractory organic matter of PROM) is discussed on the basis of: (1) physico-chemical data (molecular weight, diffusion coefficient, molecular size both in solution and while adsorbed at air-water and mercury-water interfaces); and (2) photomicrographic data using transmission electron microscopy, or TEM, applied to ultrathin sections of embedded PROM. The usefulness of combining these two types of technologies is demonstrated. The former indicates that aggregation occurs at PROM concentrations >200 mg/l and that the size of dissolved non-aggregated molecules is close to 1 nanometer. The size of molecules adsorbed at some interfaces is smaller, possibly as a result of dehydration. Using TEM, only particles with a size >2-3 nanometer are clearly resolved, a result which may be due to (a) the limited resolution of the TEM technique employed and/or (b) possible aggregation processes which occur during the preparation of samples. Microscopical observations show that most of the PROM fraction is composed of 3 nanometer granules, either isolated or aggregated together into much larger entities. The granules are similar to those observed by others studying soil fulvic acids. The aggregates must be loose ones, as they can pass ultrafiltration membranes, even when the aggregate size is much larger than the pore size. An integrated interpretation of the results from both types of technologies suggests that, in fresh surface waters, PROM can form a continuum of aggregated particles with widely varying size, in rather fast equilibrium. At surfaces, dehydration may occur, making the aggregation a less readily reversible process. (Author's abstract)
W86-04125

SCAVENGING OF AIRBORNE POLYCYCLIC AROMATIC HYDROCARBONS BY RAIN,

Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands). Lab. for Ecology, Water and Drinking Water.
For primary bibliographic entry see Field 5B.
W86-04135

CONSIDERATIONS ABOUT WATER MINERALIZATION OF SOME MOZAMBICAN RIVERS,

Direccao Nacional de Aq
For primary bibliographic entry see Field 2E.
W86-04151

ORIGIN AND DISTRIBUTION OF SULFATE IN A FRACTURED TILL IN SOUTHERN ALBERTA, CANADA,

Department of Agriculture, Lethbridge (Alberta). Groundwater Section.
M. J. Hendry, J. A. Cherry, and E. I. Wallick.
Water Resources Research WRERAO, Vol. 22, No. 1, p 45-61, January 1986. 12 fig, 5 tab, 40 ref.

Descriptors: *Sulfates, *History, *Alberta, *Canada, Weathering, Sulfur, Groundwater pollution, Path of pollutants, Calcium, Fluctuations, Groundwater movement, Distribution patterns.

Glacial till in a 22 sq km area of the Interior Plains Region of southern Alberta, Canada consists of an upper brown gypsiferous weathered zone (up to 20 m thick) and a lower discontinuous grey nonweathered zone (up to 25 m thick). Although the total sulfur content of the two till zones is the same (0.34%), the mean total sulfate content of the weathered till (4.0 mg/g) exceeds that of the nonweathered till (0.8 mg/g). Similarities suggest that all SO4(2) in the nonweathered till and 20% of the sulfate in the weathered till was derived from sulfate-rich bedrock fragments incorporated in the till during deposition. Laboratory experiments and delta-18 O and delta-34 S analyses of total SO4(2) and the sulfur forms in the two zones show that the majority of the sulfate in the weathered till was derived from the oxidation of organic S at some time after the till was deposited. Mass balance and flux calculations indicate that this oxidation occurred under partially saturated conditions. Groundwater flow simulations suggest that the water table was much lower and that a thick partially saturated zones was possible during the drier Altithermal period (11,000 to 3,000 years B.P.). The following chemical processes account for the major ions that are found in the groundwater but were generated when the partially saturated zone existed. The oxidation of reduced S produced SO4(2) and H(+). The H(+) reacted with carbonate minerals under elevated p sub CO2, with Ca(2+) loss by exchange for Na(+) and gypsum precipitation. Volume shrinkage in the weathered till resulting from these geochemical processes may have enhanced the development of fractures and caused the associated increased hydraulic conductivity. (Lantz-PTT)
W86-04160

SOLUTE DISPERSION IN MULTIDIMENSIONAL PERIODIC SATURATED PORUS MEDIA,

Mississippi Univ., University. Dept. of Civil Engineering.
V. K. Gupta, and R. N. Bhattacharya.
Water Resources Research WRERAO, Vol. 22, No. 2, p 156-164, February 1986. 1 fig, 25 ref. NSF Grant Nos. ECE-8513638, ECE-8513980 and CME-8004498.

Descriptors: *Solute transport, *Porus media, *Saturation, *Mathematical analysis, Gaussian density, Aquifers, Velocity, Dispersion coefficients, Parametric hydrology, Path of pollutants.

If in a convection-dispersion equation, governing solute movement in a saturated porous medium of infinite extent, the convection velocity components are periodic functions of spatial coordinates, then it follows from a general mathematical result that the solute concentration can be asymptotically approximated by a Gaussian density. Two theoretical examples, with and without a constant vertical velocity, are given to illustrate an application of this mathematical result to solute dispersion in a parallel-bedded, three-dimensional aquifer of infinite extent. Analytical expressions are obtained for dispersion coefficients in the asymptotic Gaussian approximations in the two examples. The dispersion coefficients functionally depend on a velocity scaling parameter U sub o and a spatial scaling parameter (period) a via their product aU sub o, and this functional dependence on aU sub o is different in the two examples. The expressions for dispersion coefficients are formally contrasted and compared with those obtained previously by other authors in a parallel-bedded infinite aquifer in which the convection velocity is a random field. Some physical implications of dependence of dispersion coefficients on a spatial scaling parameter (i.e., the scale effect) are discussed in the context of modeling in an aquifer with evolving heterogeneities. This interpretation of 'scale effect' in dispersion coefficients is contrasted with the preasymptotic interpretation in the current literature. (Author's abstract)
W86-04170

STOCHASTIC MODELING OF THE SPACE-TIME STRUCTURE OF ATMOSPHERIC CHEMICAL DEPOSITION,

Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 5B.
W86-04171

REGULATING FACTORS OF THE CONCENTRATION OF DISSOLVED CARBOHYDRATES IN A CENTRAL WATER COLUMN OF LAKE SUWA, JAPAN,

Yamagata Univ. (Japan). Dept. of Chemistry.
Y. Satoh, H. Hayashi, N. Nakamoto, and T. Okino.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 299-319, January 1986. 11 fig, 2 tab, 57 ref. Japan Ministry of Education Grant No. 503040.

Descriptors: *Water columns, *Dissolved carbohydrates, *Lake Suwa, *Japan, Water chemistry, Dissolved organic carbon, Ammonia, Phosphates, Nitrates, Nitrites, Phytoplankton, Bacteria, Ecosystems.

In order to elucidate the interrelationships between dissolved carbohydrates (DCHO) and other chemical and biological parameters, and to make clear the regulating factors of the concentration of DCHO, a 15 month observation was carried out in a central water column of a eutrophic lake, Lake Suwa, in Japan. The results include the vertical and seasonal changes in the concentration of DCHO, seasonal changes in the standing stock of DCHO, seasonal changes in the ratio of DCHO/DOC and correlation. The concentrations of DOC, ammonia, reactive phosphate, Chl-a and seston were positively and nitrite and nitrate were inversely correlated with the concentration of DCHO at p = 0.01 level. The study suggests the following: 1) Phytoplankton played the role of supplier of DCHO, through the release of photosynthetic carbohydrates or those contained in

sheath materials; 2) Aquatic animals also take part in the supply of DCHO probably through damaging phytoplankton during feeding, from which carbohydrates may be lost into water; 3) Heterotrophic bacteria solubilize carbohydrates contained in decomposing particulate organic matter, and at the same time they consume DCHO. Thus heterotrophic bacteria have two faces of suppliers and consumers; and, 4) The combined effect caused by primary producers, secondary producers and decomposers controls the vertical and seasonal changes in the concentration of DCHO in Lake Suwa. (Lantz-PTT)
W86-04182

UPTAKE OF INORGANIC CARBON AND NITROGEN BY PHYTOPLANKTON DURING THE WINTER MIXING PERIOD IN A FRESHWATER LAKE, LAKE NAKANUMA, JAPAN,

Tsukuba Univ. (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W86-04185

COMPARISON OF METHODS FOR THE CONCENTRATION OF SUSPENDED SEDIMENT IN RIVER WATER FOR SUBSEQUENT CHEMICAL ANALYSES,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-04225

WATER SOLUBILITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,

Syntex Research, Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5B.
W86-04227

INSIGHT INTO THE MECHANISM OF ACCUMULATION OF ARSENATE AND PHOSPHATE IN HYDRO LAKE SEDIMENTS BY MEASURING THE RATE OF DISSOLUTION WITH ETHYLENEDIAMINETETRAACETIC ACID,

Auckland Univ. (New Zealand). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04228

SHORT-TERM STABILITY OF TRACE METALS IN ESTUARINE WATER SAMPLES,

Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 2L.
W86-04232

USE OF HYDROGEOCHEMICAL PATTERNS IN CARBONATE SAND AND SANDSTONE AQUIFERS TO IDENTIFY INTRUSION AND FLUSHING OF SALINE WATER,

TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
A. Mercado.
Groundwater GRWAAP, Vol. 23, No.5, p 635-645, September-October 1985. 9 fig, 2 tab, 13 ref, 2 append.

Descriptors: *Coastal Aquifers, *Saline Water Intrusion, *Flushing, Chemical Properties, Hardness, Salinity, Israel, Groundwater, Halides, Sulfates.

Chemical analyses of wells penetrating the coastal aquifer of Israel indicate that the relative concentrations of sodium, calcium, magnesium, bicarbonate, and hydrogen species deviate considerably from the ideal mixing line between fresh water and sea water, as represented by the concentration of chlorides. Deviation patterns were found to be distinctly different for areas of present sea-water intrusion, and areas from which ancient brines are still flushed. These differences, explainable in major part as the combined effects of cation exchange and carbonate equilibria, can be utilized to distinguish between invading and retreating saline-water bodies, and identify their existence at the very beginning of the salinization process. Among the parameters investigated, it is recommended that combined parameters, such as Na/Cl, sodium adsorption ratio, and noncarbonate hardness, be preferred over the concentration plots of single ions. Observed patterns are verified with the aid of a single-cell simulation model. (Peters-PTT)
W86-04241

GROUND-WATER PROBLEMS IN THE MESOZOIC PAX MOUNTAIN FAULT ZONE,

Clemson Univ., SC. Dept. of Chemistry and Geology.
For primary bibliographic entry see Field 2F.
W86-04282

DISCRIMINATION OF GROUNDWATER SOURCES USING CLUSTER ANALYSES, MANOVA, CANONICAL ANALYSIS AND DISCRIMINANT ANALYSIS,

Idaho Univ., Moscow. Dept. of Mathematics and Applied Statistics.
For primary bibliographic entry see Field 2F.
W86-04312

STRONTIUM AND ITS ISOTOPES IN CANADIAN RIVERS: FLUXES AND GLOBAL IMPLICATIONS,

Ottawa Univ. (Ontario). Dept. of Geology.
M. A. Wadleigh, J. Veizer, and C. Brooks.
Geochimica et Cosmochimica Acta GCACAK, Vol. 49, No. 8 p 1727-1736, August 1985.

Descriptors: *Geochemistry, *Strontium, *Isotopes, *Rivers, *Canada, Environmental effects, Dissolved solids, Geohydrology, Carbonates, Scates, Calcium, Chlorine.

Systematic sampling of the 39 largest Canadian rivers shows that the weighted average 87-Sr/86-Sr ratio in the dissolved load is 0.7111, similar to previous measurements on such large rivers as the Amazon and Mississippi. Consequently, it is believed that the above estimate is likely representative of the global average. This imposes a limit of 6.8 times 10 to the 11th power gm/yr on the amount of Sr exchanged with basalts in hydrothermal cells on mid-oceanic ridges. Evaluation of geological information suggests that Sr from silicate sources is of considerable importance for all but the largest Canadian rives. The latter have chemical and isotopic composition consistent with approximately 4:1 carbonate vs. silicate derivation of Sr, but such interpretation is not unique. In terms of their water discharge, the 39 Canadian rivers studied account for 4.2% of the world total and their weighted average concentrations for other dissolved solutes are: TDS 176 ppm, Ca 18 ppm and Sr 84 ppb. (Author's abstract)
W86-04348

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. II. ARGENTIERE (FRENCH ALPS): BULK MELT WATERS WITH OPEN-SYSTEM CHARACTERISTICS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04352

CHEMICAL MODELS OF SOLUTE ACQUISITION IN GLACIAL MELT WATERS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04353

INSTRUMENTS AND METHODS. FIELD PH DETERMINATIONS IN GLACIAL MELT WATERS,

Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04355

SOIL WATER SAMPLERS IN ION BALANCE STUDIES ON ACIDIC FOREST SOILS,

Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
For primary bibliographic entry see Field 7B.
W86-04364

METHODS FOR VALIDATION OF PRECIPITATION PH: APPLICATIONS TO TEXAS DATA,

Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
For primary bibliographic entry see Field 5A.
W86-04389

SPECIFIC CONDUCTANCE AS AN INDICATOR OF TOTAL DISSOLVED SOLIDS IN COLD, DILUTE WATERS,

Institute of Hydrology, Wallingford (England).
A. G. Thomas.
Hydrological Sciences – Journal – des Sciences Hydologiques HSJODN, Vol. 31, No. 1, p 81-92, March 1986. 4 fig, 3 tab, 15 ref.

Descriptors: *Specific conductivity, *Total dissolved solids, *Temperature, *Error analysis, *Ions, Statistical methods, Cairngorm Mountains, Scotland.

Specific conductance is shown to bear a well-defined, linear relationship to total dissolved solids for a cold, low-ionic strength stream in the Cairngorm Mountains, Scotland. Unless the water temperature is constant, it is necessary first to correct the conductivity data to 25 C. This temperature correction may be taken as linear, even below 4 C, but not necessarily to be 2% per degree C as is commonly used. The error incurred by assuming the 2% figure for cold streams could be greater than 5%. Values of specific conductance using data for the limiting equivalent conductivities of the individual ions are shown to be poor estimates of actual specific conductances even for these dilute waters. Relationships between total dissolved solids and specific conductances may be impaired by changing proportions of ionic species in the samples. In general, however, an empirical straight line provided a good fit. (Rochester-PTT)
W86-04394

NITRIFICATION, NITRATE REDUCTION, AND NITROGEN IMMOBILIZATION IN A TIDAL FRESHWATER MARSH SEDIMENT,

Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
W. B. Bowden.
Ecology ECOLAR, Vol. 67, No. 1, p 88-99, February 1986. 4 fig, 3 tab, 59 ref.

Descriptors: *Nitrification, *Nitrate reduction, *Nitrogen immobilization, *Marsh sediments, Freshwater marshes, Ammonium, Nitrates, Path of pollutants, Litter.

The dominant microbial transformations of ammonium and nitrate in the sediments of a tidal freshwater marsh were estimated from measured rates of isotope dilution of ammonium (15-N) added to sediment and litter samples, reduction of nitrate (15-N) to ammonium (15-N) in fresh sediments, and net exchange of ammonium and nitrate between the marsh and river water in flumes built in the field. In two separate laboratory experiments, nitrification in mixed, fresh, surface sediments was 2.8 and 3.4 nanomoles/cu m/hr. Additions of nitrate (15-N) to fresh sediments showed that nitrate produced from ammonium by nitrification was reduced very quickly. Less than 10% of this nitrate was reduced back to ammonium by dissimilation. The net transfer of nitrate in this marsh is to the sediments, and since nitrate does not accumulate in these sediments, the remaining nitrate produced by nitrificiation must be reduced by denitrification or by assimilatory nitrate reduction. Ammonium was removed quickly from filtered and aerated river water that was mixed with plant litter in laboratory incubations. Ammonium-N removal from experimental flasks (215 nanomoles/g/hr) was dependent on the presence of litter and was biologically mediated, but was not due to nitrification since nitrate concentrations were constant in the same experiments. Under anaerobic conditions, ammonium-N was released from litter to river water (93 nano-

moles/g/hr). The estimated total rate of ammonium-N immobilization by microbes on aerobic litter (130 micromoles/sq m/hr) agrees well with measured losses of ammonium from river water in field flume studies (156 micromoles/sq m/hr). An aerobic litter layer may enable marshes to regulate the loss of ammonium that is regenerated in reduced, subsurface sediments and that would otherwise be lost by diffusion or advection. (Lantz-PTT)
W86-04399

INTERNAL FACTORS CONTROLLING PEATLAND-LAKE ECOSYSTEM DEVELOPMENT,

Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2H.
W86-04400

TRACE ORGANIC COMPOUNDS IN RAIN. 4. IDENTITIES, CONCENTRATIONS, AND SCAVENGING MECHANISMS FOR PHENOLS IN URBAN AIR AND RAIN,

Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W86-04422

LEAD CYCLING IN AN ACIDIC ADIRONDACK LAKE,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. R. White, and C. T. Driscoll.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1182-1187, December 1985. 5 fig, 6 tab, 42 ref. NSF Grant No. CME-8006733.

Descriptors: *Lead, *Lake sediments, *Acidic water, *Aluminum, *Fate of pollutants, Trace metals, Deposition, Seasonal variation, Temporal distribution, Spatial distribution, Heavy metals, Hydrogen ion concentration, Organic carbon, Particulate matter, Chemical stratification, Stratification, Metals, Lead, Darts Lake, New York, Aluminum, Acid rain.

A water column and sediment trap monitoring program was used to study important mechanisms regulating the chemistry and cycling of Pb in dilute acidic Darts Lake, Adirondack State Park, New York. Temporal and spatial variations in the concentration and transport of Pb were observed; vertical deposition of Pb through the water column was most pronounced during stratification periods (winter and summer), while during high flow (spring and autumn), Pb was more conservative within the lake. Deposition of particulate Pb was strongly correlated with Al and organic carbon deposition. Increases in metal (Pb and Al) deposition coincided with periods of increasing pH. It seems likely that in-lake formation of particulate Al facilitates the vertical transport of Pb in Darts Lake. (Geiger - PTT)
W86-04425

IMPLICATIONS OF A GRADIENT IN ACID AND ION DEPOSITION ACROSS THE NORTHERN GREAT LAKES STATES,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W86-04431

SNOW CHEMISTRY OF THE CASCADE-SIERRA NEVADA MOUNTAINS,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-04442

DIAGENETIC TRACE-METAL PROFILES IN ARCTIC LAKE SEDIMENTS,

Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 5B.
W86-04444

DOES FLUORIDATION OF DRINKING-WATER PREVENT BONE FRAGILITY AND OSTEOPOROSIS,

National Board of Health, Helsinki (Finland).
For primary bibliographic entry see Field 5F.
W86-04453

CONCENTRATION OF TRACE ELEMENTS IN WATER SAMPLES BY REDUCTIVE PRECIPITATION,

Colorado State Univ., Fort Collins. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W86-04456

DETERMINATION OF TRACE ELEMENTS IN RAINWATER BY TOTAL-REFLECTION X-RAY FLUORESCENCE,

GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik.
For primary bibliographic entry see Field 5A.
W86-04457

EXTRACTION OF ARSENIC (III) AND ARSENIC (V) FROM NATURAL WATERS FOR NEUTRON ACTIVATION ANALYSIS,

Idaho Univ., Moscow. Dept. of Chemistry.
W. M. Mok, N. K. Shah, and C. M. Wai.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 110-113, January 1986. 1 fig, 3 tab, 15 ref.

Descriptors: *Arsenic, *Neutron activation analysis, *Natural waters, Quantitative analysis, Speciation, Nitric acid, Chemical analysis.

Because of its toxicity and possible carcinogenicity, arsenic is one of the most widely measured trace metals in many environmental monitoring programs. Arsenic generally occurs in the oxidation states as Arsenic (III) and Arsenic(V) in natural water systems. Quantification and speciation of As(III) and As(V), can be achieved by extracting the former species with pyrrolidinecarbodithioate at pH 1-1.5 into chloroform, followed by a nitric acid back extraction for neutron activation analysis (NAA). Besides eliminating interferences from matrix species in natural waters, the two-step extraction procedure also provides a large preconcentration factor for arsenic. Detection of 0.1 microgram/L of arsenic can be achieved by using this extraction method and NAA. Applications of this method to arsenic speciation studies in natural water systems are discussed. (Lantz-PTT)
W86-04461

DISSOLVED IRON IN CHALK GROUNDWATERS FROM NORFOLK, ENGLAND,

Academia Sinica, Beijing (China). Inst. of Technology.
S. Lin-Hua, and T. C. Atkinson.
Quarterly Journal of Engineering Geology SSQJEGA, Vol. 18, No. 3, p 261-274, 1985. 9 fig, 3 tab, 20 ref.

Descriptors: *Groundwater, *England, *Chemical reactions, *Chalk aquifiers, *Iron, Chemical properties, River Bure, Oxidation-redirection potential, Aquifiers, Hydrogen ion concentration, Iron bacteria, Groundwater movement, Groundwater recharge, Soil types.

The result of a hydrochemical survey of groundwater in the upper catchment of the River Bure in Norfolk, England, is reported, and the occurrence of iron is related to chemical reactions between water and rock and within the water itself, as well as to the groundwater flow pattern. In the upper River Bure catchment in Norfolk the Chalk aquifer is covered by sand and gravel drift aquifers and a leaky till aquiclude. Iron contents of groundwaters are several mg/liter beneath till, but less beneath valleys where till is not present. The iron contents and redox potentials of chalk waters are related to groundwater flow in two separate circulation cells. In the larger cell, chalk beneath the higher parts of the catchment receives recharge which has high Fe and low redox potential due to oxidation of pyrite in the drift formations. Iron contents in the chalk groundwater decrease with depth and towards discharge areas. Iron content decreases further where groundwater discharges upwards beneath the Bure valley and mixes with waters of the second circulation cell which occurs where the till has been removed by erosion. Oxygenated, iron-poor waters recharge the chalk beneath the upper parts of the valley floor. Mixing between waters in the two cells may cause precipitation of iron oxides. Similar flow patterns have been demonstrated elsewhere in East Anglia. It is likely that iron contents will generally be lowest where active groundwater circulation occurs beneath till-free valley floors. (Peters-PTT)
W86-04678

MODEL FOR THE DISTRIBUTION OF SULFATE REDUCTION AND METHANOGENESIS IN FRESHWATER SEDIMENTS,

Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W86-04680

DISSOLVED ALUMINUM IN THE TAMAR ESTUARY, SOUTHWEST ENGLAND,

Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W86-04681

2L. Estuaries

BEHAVIOR OF METHYLTIN COMPOUNDS UNDER SIMULATED ESTUARINE CONDITIONS,

New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04133

DIMENSIONAL DIFFERENTIATION BETWEEN FIVE PLANKTONIC ORGANISMS LIVING IN TWO AREAS CHARACTERIZED BY DIFFERENT SALINITY CONDITIONS,

Athens Univ. (Greece). Zoological Lab. and Museum.
For primary bibliographic entry see Field 5C.
W86-04187

SHORT-TERM STABILITY OF TRACE METALS IN ESTUARINE WATER SAMPLES,

Water Research Centre, Medmenham (England). Medmenham Lab.
J. A. Campbell, M. J. Gardner, and A. M. Gunn.
Analytica Chimica Acta, Vol. 176, p 193-200, October 31, 1985. 1 fig, 2 tab, 4 ref.

Descriptors: *Estuaries, Data Acquisition, *Trace Metals, *Mersey River, Copper, Nickel, Cadmium, Lead, Sample Preservation, Chemical Analysis.

As part of a survey of metal concentrations in the estuary of the river Mersey, a study was undertaken to assess the changes that can take place over a 24 hr period, which is roughly equivalent to the period between sample collection and laboratory analysis. The estuarine water samples with high (22%) and low (<1%) salinity, were stored unacidified in polythene containers prior to filtration, preservation and determination of dissolved trace metals. For the low-salinity sample a massive (140%) increase in copper concentration was observed, indicating desorption from the particulate phase; a similar, although less pronounced (11%) effect was found for the high-salinity sample. Evidence was also obtained for a significant loss (30%) of lead from a pre-filtered low-salinity sample, suggesting appreciable adsorption to the container walls. For cadmium and nickel, no substantial changes in concentration were observed. The zinc results were subject to contamination and no useful conclusions could be drawn. The apparent instability of copper in estuarine water samples points to the need for an appropriate protocol to prevent the generation of seriously biased data. (Peters-PTT)
W86-04232

Group 2L—Estuaries

USE OF HYDROGEOCHEMICAL PATTERNS IN CARBONATE SAND AND SANDSTONE AQUIFERS TO IDENTIFY INTRUSION AND FLUSHING OF SALINE WATER,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 2K.
W86-04241

SIMPLE MODEL OF ESTUARINE SUBTIDAL FLUCTUATIONS FORCED BY LOCAL AND REMOTE WIND STRESS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Journal of Geophysical Research, Vol. 90, No. C6, p 11,945-11,948, November 1985. 2 fig, 7 ref. OCE-8315207.

Descriptors: *Estuaries, *Mathematical Models, *Wind, *Tides, Water Currents, Sea Level, Ekman Transport, Chesapeake Bay, Delaware Estuary.

Observations of estuarine low subtidal sealevel and current fluctuations have often shown domination by the remote effects of the wind, acting on the adjacent coastal ocean, over the local surface stress, acting on the estuary itself. The remote effects are transmitted to the estuary by impressment on its mouth of sea level change induced by the onshore component of coastal Ekman transport and become increasingly dominant as the frequency decreases. A simple, linear, barotropic model was developed to investigate the joint action of these two wind forcing mechanisms. The relative shortness of most estuaries relative to low subtidal estuarine wavelengths explains the dominance of the remote effect for both sea level and barotropic current fluctuations in the estuary. For the same reason, however, surface slope is dominated by local wind setup. For an estuary with axis nearly parallel to the coast the two effects will operate either in concert or in opposition, depending on hemisphere and orientation of the estuary axis relative to the coast. For the geometries of both Chesapeake Bay and the Delaware Estuary the model predicts opposition with the remote effect dominant at lower frequencies, consistent with recent observations. (Author's abstract)
W86-04244

VARIABILITY OF SUBTIDAL CURRENT STRUCTURE IN A FJORD ESTUARY: PUGET SOUND, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
D. E. Bretschneider, G. A. Cannon, J. R. Holbrook, and D. J. Pashinski.
Journal of Geophysical Research, Vol. 90, No. C6, p 11,949-11,958, November 20, 1985. 11 fig, 2 tab, 28 ref.

Descriptors: *Estuaries, *Fjords, *Water Currents, *Wind, *Tides, *Puget Sound, Water Properties, Temperature, Salinity, Density, Physical Properties, Chemical Properties.

Simultaneous observations of currents and water properties were made in a section across East Passage in Puget Sound over a 31-day period between March and April 1983. These observations, supplemented with CTD profiles, shore-based wind data, and far-field current measurements, were used to describe the cross-channel variability of subtidal currents. The mean circulation consisted of seaward flow in the near surface and landward flow below 7 m, with a core of maximum velocity at mid-depth. Volume transport was 22,000 cum/s. Topographic effects force most of the seaward compensating flow through an adjacent channel, creating a clockwise circulation around an intervening island. Empirical orthogonal function analysis was used to describe the spatial structure of current fluctuations. At subtidal time scales, three circulation modes are evident: (1) a near-surface (upper 20 m), wind-driven shear; (2) a near-bottom layer (150-200 m) dominated by density currents that propagate up estuary after generation during neap tidal mixing at the entrance sill to Puget Sound; and (3) an intermediate layer (3) 25-75 m) influenced by partial refluxing of Colvos Passage water and modulated at fortnightly periods by nonlinear mixed tides. These current observations are the first to show recirculation of seaward flowing water from Colvos Passage to landward flow in East Passage. (Peters-PTT)
W86-04245

SOLUTE-TRANSPORT SIMULATION OF BRACKISH-WATER INTRUSION NEAR BALTIMORE, MARYLAND,
For primary bibliographic entry see Field 5B.
W86-04274

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. I. FJALLSJOKULL (SOUTH-EAST ICELAND): BULK MELT WATERS WITH CLOSED-SYSTEM CHARACTERISTICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04351

NITRIFICATION, NITRATE REDUCTION, AND NITROGEN IMMOBILIZATION IN A TIDAL FRESHWATER MARSH SEDIMENT,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2K.
W86-04399

GEOCHEMISTRY OF SUSPENDED PARTICULATE MATTER IN TWO NATURAL SEDIMENTATION BASINS OF THE RIVER RHINE,
Technische Hogeschool Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
For primary bibliographic entry see Field 5B.
W86-04547

ASSESSING PHOSPHORUS CONTROL IN THE JAMES RIVER BASIN,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04640

SULFATE-REDUCING BACTERIA: PRINCIPAL METHYLATORS OF MERCURY IN ANOXIC ESTUARINE SEDIMENT,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
For primary bibliographic entry see Field 5B.
W86-04676

DISSOLVED ALUMINUM IN THE TAMAR ESTUARY, SOUTHWEST ENGLAND,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, R. J. M. Howland, and A. J. Bale.
Geichimica et Cosmochimica Acta GCACAK, Vol. 50, No. 2, p 189-197, February 1986. 7 fig, 2 tab, 36 ref. U. K. Dept. of Environmental Contracts 480/684 and PECD 7/7/076.

Descriptors: *Estuaries, *Aluminum, *Tamar Estuary, *Chemical Reactions, Sediments, Tidal effects, Colloids, Solubility.

Distributions of dissolved Al in the Tamar Estuary were recorded through spring-neap tidal cycles in winter and summer. Dissolved Al is a highly reactive constituent in this estuary, undergoing net removal in the very low salinity region and net input to the mid-estuary. The extent of both the depletion and the augmentation varied systematically with tidal energy input, indicating that tidal sediment disturbance was the principal controlling agency. These field data, supported by the results of laboratory simulations, show that the removal is regulated by sorption onto resuspended sediment particles, which dominates kinetically over authigenic aluminosilicate formation. removal of dissolved Al by flocculation of riverborne colloids is not significant. The mid-estuarine input is consistent with dissolution of authigenic aluminosilicate following net remobilization of estuarine sediment. The internal cycling of Al in the estuary, generated by these processes, alters both the time-course and the soluble-particulate balance of the riverine discharge of Al to the adjacent coastal water. (Author's Abstract)
W86-04681

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION PLANT TECHNOLOGY OPTIMISATION,
Tractionel S.A., Brussels (Belgium).
R. Muylle.
Aqua AQUAAA, No. 1, p 5-9, 8 fig, 3 tab.

Descriptors: *Desalination, *Desalination plants, *Reverse osmosis, *Distillation, Water treatment facilities, Water supply development, Water use, Drinking water, Economic aspects.

The most common water treatments are filtration with or without flocculation-settling. But, when available water salt content is too high to meet international local rules or recommendations, a salt reducing treatment must be provided. For other waters, two main desalination technologies remain on the market: reverse osmosis (RO) and distillation. If the two technologies are compared, taking, as an example, a 100,000 cu m/day plant somewhere in a Middle East country, with the following characteristics (only valid for one special case): (1) a net constant production of 100,000 cu m/day: for RO:102.5% installed capacity; for MSF, taking into account the combined fiability and availability for both desalination and electrical power plants, four units with a total capacity of 120,000 cu m/day may be installed giving a load factor of 83% (special case, allowing a water shortage during a few periods of time during the year); (2) to obtain non-corrosive drinking water from MSF distillation plant, some modifications are needed, like addition of O_2 (air), CO_2, lime, Cl_2; (3) energy: for RO, it is assumed that electricity is taken out of the network; for MSF, a dual purpose plan is provided and an optimization study (special case) shows production of steam and electricity should be economically produced with boilers and back pressure turbines. Excess of electricity is provided to be fed in the electrical network. These values are to be taken with caution due to the high influence of each parameter on the water cost, especially the cost of: fuel, electricity, chemicals, manpower. Each special case must be studied taking into account each parameter, local prices and market fluctuation. (Lantz-PTT)
W86-04148

DESALINATION - TECHNOLOGICAL TRENDS AND OPERATIONAL RESULTS (LE DESSALEMENT - CHOIX TECHNIQUES ET RESULTATS DE PRODUCTION,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
J. M. Rovel.
Aqua AQUAAA, No. 1, p 10-13, 1986. 4 fig, 6 tab, 4 ref.

Descriptors: *Desalination, *Reverse osmosis, *Water supply, development, Salbukh, Saudi Arabia, Desalination apparatus, Desalination plants, Water treatment.

The first part of this report describes the different technological trends applied in desalting, more specifically in the case of the Reverse Osmosis. This process and the related design of the Salbukh Plant (Saudi Arabia) is presented in detail, with an emphasis on the application of the design principles described in the first part. Also, the results obtained on this plant show that the plant design complies with the production requirements and the site constraints. (Author's abstract)
W86-04149

3B. Water Yield Improvement

PHYSICAL RESPONSE OF CONVECTIVE CLOUDS OVER THE SIERRA NEVADA TO SEEDING WITH DRY ICE,
Electronics Techniques, Inc., Auburn, CA.
A. W. Huggins, and A. R. Rodi.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1082-1098, October 1985. 27 fig, 22 ref. Bureau of Reclamation Contract Nos. 9-07-85-V0021, 4-CR-81-03860, and 2-07-81-V0256.

Descriptors: *Cloud seeding, *Weather modification, *Radar, *Clouds, Remote sensing, Artificial precipitation, Precipitation, Supercooled liquid water, Sierra Nevada, California, Dry ice.

The effect of seeding convective clouds with dry ice was studied using simultaneous aircraft and radar observations. Clouds that were initially ice-free with supercooled liquid water contents of 0.5 g/cu m when the tops reached the -10 degrees level had similar responses to seeding, although significant natural variability existed. Aircraft particle probes detected sharp increases of small crystals (<100 micrometers) in 3-6 min followed by >1 mm aggregates about 10 min after seeding. Observations supported in the expectation that riming growth should not be important at these liquid water contents. Initial radar echoes formed in 7 min with distinctive time-height profiles of reflectivity. Most radar echoes forming downwind of the seeding line were small and relatively weak compared with the natural echoes forming further downwind over the mountains. The impact of the seeding was shown to be observable but relatively small. It was found that unseeded clouds formed radar echoes later, and produced reflectivity time-height profiles that were significantly different from the seeded ones. the differences are considered in part to be due to variability in the initial cloud properties as well as the obvious and well-documented effects of injection of the seeding material early in the cloud lifetime. While the meteorological impact was small, documentation of the evolution of the seeding effect from cloud to ground is a prerequisite to further experimentation. (Author's abstract)
W86-04628

DISPOSITION OF SILVER RELEASED FROM SOVIET OBLAKO ROCKETS IN PRECIPITATION DURING THE HAIL SUPPRESSION EXPERIMENT GROSSVERSUCH IV. PART II: CASE STUDIES OF SEEDED CELLS,
Clermont-Ferrand-2 Univ., Aubiere (France).
J. P. Lacaux, J. A. Warburton, J. Fournet-Fayard, and P. Waldteufel.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 9, p 977-992, September 1985. 15 fig, 6 tab, 12 ref. DGRST Grant 76-7-2847 and NSF Grant ENV 77-01600.

Descriptors: *Cloud seeding, *Weather modification, *Silver, *Hail, *Radar, *Precipitation intensity, Rainfall disposition, Precipitation, Clouds, Groissversuch, Switzerland, Silver iodide.

Cloud seeding quality was estimated in each of four seeded storms during the 1975 summer program of Grossversuch IV in Switzerland by observing the internal structure of storm cells with C, S and X-band radar, and the trajectory, time of residence and dispersion of the AgI aerosols in the seeded clouds with radar and chemical techniques. Seeding coverage was measured as the ratio of the surface area of precipitation in which the seeding chemical is found at the ground to the surface area of the rainfall (using the 40 dBZ radar reflectivity contour near the ground). Two cells in June with seeding coverages of 7 and 25%, respectively, had insufficient residence times for AgI in those portions of the cloud colder than -5 degrees. Two cells seeded in July which had seeding coverages of 100% had AgI residence times in cloud colder than -5 degrees of 500-700 seconds, which was adequate for modification of the water-ice balance. Positive correlations exist between precipitation intensity and seeding chemical concentration when the seeding aerosol has a long residence time in cloud colder than -5 degrees, except when the AgI aerosols are scavenged in a short period of time. The hail suppression plan for the Grossversuch IV experiment was designed in accordance with the Moldavian hail suppression organization. Although the Soviet criteria were met for seeding purposes in all cases, the results show that the reflectivity structure of the storms is also an important factor in assessing where and when the seeding agent should be injected to suppress hail growth. (Geiger-PTT)
W86-04630

PREDICTIONS BY TWO ONE-DIMENSIONAL CLOUD MODELS: A COMPARISON,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W86-04632

3C. Use Of Water Of Impaired Quality

TREATMENT OPTIMIZATION OF MUNICIPAL WASTEWATER AND REUSE FOR REGIONAL IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
A. Dinar, and D. Yaron.
Water Resources Research WRERAO, Vol. 22, No. 3, p 331-338, March 1986. 8 tab, 24 ref. BARD Grant I-101-79.

Descriptors: *Water reuse, *Impaired water use, *Wastewater irrigation, *Municipal wastewater, Models, Wastewater renovation, Israel, Competing use, Effluents.

Municipal wastewater warrants increased attention as a potential environmental pollution and a possible irrigation water source. A long-run mathematical programming model aimed at regional optimization with regard to plant capacity, treatment level, allocation of the effluent to the participating farms, and cropping patterns at each farm is presented. The model is applied to an agricultural region in Israel which includes a town and several farms. The results indicate the necessity of a subsidy for regional cooperation and provide a regional setup of reusing municipal wastewater for irrigation. The optimal solution enables each farm to reallocate the freshwater quota among the different land sections, to cultivate new land areas, and to expand the irrigated crops by using effluent. (Author's abstract)
W86-04196

SHARING REGIONAL COOPERATIVE GAINS FROM REUSING EFFLUENT FOR IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 6C.
W86-04197

SOME ENVIRONMENTAL CONSEQUENCES OF WATER AND ENERGY CONSERVATION IN THE HANDLING OF MINE TAILINGS IN SUB-ARCTIC REGIONS,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
A. Sellgren.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 141-149, 1986. 8 fig, 8 ref.

Descriptors: *Water conservation, *Energy conservation, *Mine wastes, *Subarctic zone, Heat pump, Water quality standards, Water quality, Water reuse, Flotation, Aeration.

In the refining of ores large amounts of fine-grained mineral particles (tailings) are generally transported together with water (slurry) in pipelines, sometimes as far as several kilometers to the disposal area. Great savings of energy and water can be obtained at concentrators if the tailings slurry is thickened more effectively and water is reused directly instead of being transported the longway around the disposal area. With direct circulation in sub-arctic regions, large amounts of heating energy can be recovered using a heat pump arrangement. The potential savings at a Swedish concentrator were estimated to be about 10-20 GWh per year, the majority of which would be savings in oil. Furthermore, handling of mine tailings products at low water content offers environmental benefits, and more effective deposition techniques can be used. In cold areas, temperature and hydrological conditions greatly influence spreading and dissipation mechanisms of pollutants released in the process. Monthly variations of the discharge to the recipient of a substance emitted in the process were simulated in an example. The degree of direct circulation in flotation of complex sulphide ores may be limited by water quality problems in the process. A mathematical model was developed and used to simulate the accumulation of a substance in the process for different degrees of direct circulation. Finally, a schematic layout of a simple aeration plant for recycled process water was outlined and some regional water-related problems were discussed. (Author's abstract)
W86-04486

EFFECTS OF WATER REUSE, RECYCLING AND RESOURCE RECOVERY ON FOOD PROCESSING WASTE TREATMENT IN THAILAND,
Siametec International Ltd., Bangkok (Thailand).
For primary bibliographic entry see Field 5D.
W86-04513

SOURCES OF WATER TO THE SEAWATER WELL WHICH SUPPLIES THE FISH PONDS IN EILAT: IMPLICATIONS FOR FISHPOND MANAGEMENT,
National Mariculture Centre, Eilat (Israel).
For primary bibliographic entry see Field 5B.
W86-04576

3D. Conservation In Domestic and Municipal Use

MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN CIUDAD JUAREZ, MEXICO,
California State Univ., Fullerton. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-04535

3E. Conservation In Industry

SOME ENVIRONMENTAL CONSEQUENCES OF WATER AND ENERGY CONSERVATION IN THE HANDLING OF MINE TAILINGS IN SUB-ARCTIC REGIONS,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 3C.
W86-04486

ULTRAPURE WATER IN THE ELECTRONICS INDUSTRY,
Esmil International B.V., Amsterdam (Netherlands).
For primary bibliographic entry see Field 5F.
W86-04518

PROCESS CONTROL AND DATA ACQUISITION COMPUTERS IN THE WATER INDUSTRY,
Brown Boveri Kent (East Africa) Pty Ltd., Singapore.
For primary bibliographic entry see Field 5G.
W86-04519

REDUCTION OF PULP AND PAPER INDUSTRY EFFLUENT LOADING,
Tampere Univ. of Technology (Finland).
For primary bibliographic entry see Field 5D.
W86-04521

MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN CIUDAD JUAREZ, MEXICO,
California State Univ., Fullerton. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-04535

SHORT-TERM HYDROELECTRIC SCHEDULING USING THE PROGRESSIVE OPTIMALITY ALGORITHM,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 4A.
W86-04542

3F. Conservation In Agriculture

MODEL OF THE TERMINAL COMPLEX OF THE OUED R'HIR (ALGERIA),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W86-03992

REDUCED PRESSURE IRRIGATION INVESTMENT ECONOMICS,
South Dakota State Univ., Brookings. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W86-04166

STOCHASTIC SOIL MOISTURE ESTIMATION AND FORECASTING FOR IRRIGATED FIELDS,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
For primary bibliographic entry see Field 2G.
W86-04172

EXPECTED UTILITY, BENEFIT, AND LOSS CRITERIA FOR SEASONAL WATER SUPPLY PLANNING,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 6B.
W86-04193

TREATMENT OPTIMIZATION OF MUNICIPAL WASTEWATER AND REUSE FOR REGIONAL IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 3C.
W86-04196

SHARING REGIONAL COOPERATIVE GAINS FROM REUSING EFFLUENT FOR IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 6C.
W86-04197

1984 DROUGHT ON THE CANADIAN PRAIRIES,
Saint Patrick's Coll., Maynooth (Ireland).
For primary bibliographic entry see Field 2G.
W86-04508

MEASURED AND CREAMS-PREDICTED NITROGEN LOSSES FROM TOMATO AND CORN MANAGEMENT SYSTEMS,
Southeast Kansas Branch Experiment Station, Parsons.
For primary bibliographic entry see Field 5B.
W86-04538

ECOLOGY OF ACHENE DIMORPHISM IN HETEROTHECA LATIFOLIA. III. CONSEQUENCES OF VARIED WATER AVAILABILITY,
Arizona Univ., Tucson. Dept. of Ecology and Evolutionary Biology.
For primary bibliographic entry see Field 2I.
W86-04613

WATER USE IN WINTER WHEAT AS INFLUENCED BY CEPHALOSPORIUM GRAMINEUM,
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 2I.
W86-04667

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ANALYSIS OF STORAGE FOR THE REGULATION OF SURFACE WATER IN THE HUANG-HUAI-HAI PLAIN FOR SOUTH-TO-NORTH WATER TRANSFER,
Hebei Inst. of Geography, Shijiazhuang (China)
Y. Fenglan, and W. Wenkai.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p. 289-298, 2 fig, 2 tab.

Descriptors: *Water storage, *Water transfer, *China, Water supply development, Diversion, Canals, Irrigation, Economic aspects, Environmental effects, Water conveyance.

As part of the overall assessment of the south-north water transfer program proposed for eastern China, the storage of surface water in the Huang-Huai-Hai Plain is analyzed. The three main forms of storage of water resources are discussed. They include: surface reservoirs, and underground reservoirs with emphasis on ponds; reticulated reservoirs on the plain formed by natural channels, deep trench waterway networks, ponds, lowlands and shallow lakes. Water storage has a very large impact on the natural environment. The need to consider environmental effects in the immediate surroundings of the storage areas in order to achieve useful storage without flooding or salinization, is discussed. (Halterman - PTT)
W86-03938

USING ANCIENT CHANNELS TO REGULATE WATER THROUGH STORAGE: THE EXAMPLE OF THE HEBEI PLAIN,
Hebei Inst. of Geography, Shijiazhuang (China)
W. Chen, and W. Jinxiang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 299-308, 3 fig, 2 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *China, Canals, Irrigation, Water storage, Water conveyance, Groundwater.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the potential use of underground storage is evaluated. There are many ancient channels buried at a depth of 30 to 50 m under the plains of the Hebei Province whose sand and gravel layers can provide ample storage capacity for groundwater. The 41 reservoirs present in the area have a combined capacity of 12.726 cu km. Most of the capacity is in alluvial fans, where paths of infiltration are best. The river channel belts have the next best conditions. Under present circumstances, the underground storage capacity of the deltas is not practical. Storage capacity and infiltration conditions are greater in the irrigation districts of the Middle Route. Capacity is less in the East Route irrigation districts and infiltration conditions are most deficient. (Halterman - PTT)
W86-03939

TOPOGRAPHIC PARTITION OF WATERSHEDS WITH DIGITAL ELEVATION MODELS,
Hunter Coll., New York. Dept. of Geology and Geography.
L. E. Band.
Water Resources Research WRERAO, Vol. 22, No. 1, p 15-24, January 1986. 10 fig, 27 ref.

Descriptors: *Topography, *Watershed management, *Digital elevation models, Partitioning, Network design, Channels, Runoff, Remote sensing, Hydrologic models, Simulation analysis.

Digital elevation models are used to automatically map the stream channel and divide networks of a watershed. These topographic skeletons are used to partition the watershed into a set of fundamental, runoff producing subregions, each of which drains into one stream link. Construction of a code describing the network topology, along with parallel files containing attribute information of each drainage area and associated stream link may form the basis for an efficient watershed information system. Registration of remotely sensed imagery and maps of important soils information to the digital elevation model allows an effective organization of this data as input to hydrologic simulation models. The methodology described here is designed to aid in the efficient parameterization of a distributed components approach to watershed simulation. (Author's abstract)
W86-04157

MANAGEMENT OF LAKE COMO: A MULTIOBJECTIVE ANALYSIS,
Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
For primary bibliographic entry see Field 6A.
W86-04165

STOCHASTIC MODEL OF SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2E.
W86-04192

OPTIMIZATION OF REAL-TIME RESERVOIR OPERATIONS WITH MARKOV DECISION PROCESSES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
D. Wang, and B. J. Adams.
Water Resources Research WRERAO, Vol. 22, No. 3, p 345-352, March 1986. 3 fig, 3 tab, 38 ref, 1 append.

Descriptors: *Reservoir operation, *Optimization, *Markov Process, Model studies, Policy making.

Reservoir inflows are described as periodic Markov processes, in recognition of hydrologic uncertainty and seasonality. The optimization of reservoir operations involves determination of the optimal release volumes in the successive time periods so that the expected total rewards from the operations are maximized. A two-stage optimization framework, which consists of a real time model followed by a steady state model, is proposed. The steady state model that describes the convergent nature of the prospective future operations is regarded as a periodic Markov decision process and is optimized with the generalized policy iteration procedure. This result is in turn used as an interim step for deriving the optimal immediate decisions for the current period in the real-time model. Significant computational efficiency results from this framework and the respective optimization procedure. (Lantz-PTT)
W86-04198

EVALUATION OF THORNTHWAITE'S WATER BALANCE TECHNIQUE IN PREDICTING STREAM RUNOFF IN COSTA RICA,
Instituto Tecnologico de Costa Rica, Cartago. Dept. de Ingenieria Forestal.
For primary bibliographic entry see Field 2E.

W86-04393

PARAMETRIC/NONPARAMETRIC MIXTURE DENSITY ESTIMATION WITH APPLICATION TO FLOOD-FREQUENCY ANALYSIS,
Texas Univ. at El Paso. Dept. of Mathematics.
For primary bibliographic entry see Field 2E.
W86-04531

BAYESIAN MODELS OF FORECASTED TIME SERIES,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W86-04532

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: II APPLICATION TO THE POTOMAC RIVER,
Haiff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 2E.
W86-04534

SHORT-TERM HYDROELECTRIC SCHEDULING USING THE PROGRESSIVE OPTIMALITY ALGORITHM,
Asian Inst. of Tech., Bangkok (Thailand).
N. J. D. Lucas, and P. J. Perera.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1456-1458, September 1985. 3 fig, 3 ref.

Descriptors: *Computer programs, *Hydroelectric plants, *Reservoir releases, *Storage, *Mathematical models, Costs.

A computer code was developed to schedule the short-term release of water from cascaded hydroelectric plants. It was based on the progressive optimality algorithm. In practice, the code produced local optima. A simple example is presented here to confirm that this can happen. It is further demonstrated that the progressive optimality algorithm does not necessarily converge for nonconvex and discontinuous cost functions, although this claim has been made in the literature. The original theoretical proof of convergence required functions to be strictly convex with continuous first derivatives. This is the weakest sufficient condition the authors have found. (Rochester-PTT)
W86-04542

HYDROLOGICAL EFFECTS OF MOORLAND GRIPPING: A RE-APPRAISAL OF THE MOOR HOUSE RESEARCH,
Institute of Hydrology, Wallingford (England).
M. Robinson.
Journal of Environmental Management JEVMA, Vol. 21, No. 3, p 205-211, October 1985. 2 fig, 2 tab, 25 ref.

Descriptors: *Land use, *Rainfall-runoff relationships, *Drainage, *Drainage ditches, *Drainage effects, Storm runoff, Flood peak, Peat soil, Drainage area, Runoff, Flow measurement, Moor House National Reserve.

The purpose of this paper is to examine the whole period of record collected at Moor House National Nature Reserve, and to reassess the conclusions of earlier hydrological studies of land use changes in the light of more sophisticated analysis techniques and subsequent catchment studies. Measurements at four small peat moorland catchments show that artificial drainage by ditching increased peak flows. This increase was due to a change to faster storm runoff, rather than to a change in runoff volumes. Any effects of the drainage on low flows were small and of similar magnitude to the accuracy of the flow measurements. Severe burning of the peat surface also increased peak flows, although to a smaller extent than the change due to drainage. Burning reduced the storage capacity of the soil and lowered dry weather flows. It also led to a reduction in storm response times, and probably a slight increase in storm runoff volumes. (Geiger-PTT)
W86-04599

ROLE OF RECREATIONAL BOAT TRAFFIC IN INTERLAKE DISPERSAL OF MACROPHYTES: A NEW ZEALAND CASE STUDY,
New Zealand Electricity Dept., Hamilton.
For primary bibliographic entry see Field 5G.
W86-04604

4B. Groundwater Management

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1983 TO SPRING 1984,
Geological Survey, Tucson, AZ. Water Resources Div.
USGS Open-File Report 85-410, 1985. 2 sheets, 4 fig, 1 tab.

Descriptors: *Groundwater, *Groundwater availability, *Arizona, Groundwater basins, Groundwater depletion, Groundwater potential, Geohydrology, Groundwater level, Groundwater management, Groundwater reservoirs.

A summary map shows various aspects of groundwater availability in Arizona. Potential well production, in increments of 0 to 10 gpm, 10 to 500 gpm, and 50 to 2500 gpm (average 1000 gpm) on the primary emphasis of the map; however, data on changes in water level from spring 1983 to spring 1984, status of groundwater inventory, and estimated groundwater pumpage in Arizona in 1983, are also presented. The total water pumpage is also broken down by the following use categories: drainage, public supply, domestic, livestock, industrial and agricultural. (Halterman - PTT)
W86-03910

USING ANCIENT CHANNELS TO REGULATE WATER THROUGH STORAGE: THE EXAMPLE OF THE HEBEI PLAIN,
Hebei Inst. of Geography, Shijiazhuang (China)
For primary bibliographic entry see Field 4A.
W86-03939

CHANGES IN GROUND-WATER RESOURCES AS A RESULTS OF MINE DRAINAGE IN THE SEVEROURALSK BAUXITE AREA,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-03984

USE OF A MODEL FOR DETERMINING OPTIMUM RATES OF ARTIFICIAL RECHARGE OF THE CENOMANIAN AQUIFERS IN BEIRUT, LEBANON,
BURGEAP S.A., Paris (France).
M. C. d'Orval.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 219-228, 9 fig.

Descriptors: *Groundwater management, *Recharge, *Model studies, Injection, Artifical recharge, Groundwater recharge, Beirut, Lebanon, Aquifers.

Digital model simulation was used to study alternative recharge and operating conditions in the Beirut, Lebanon, region, considering the discharge available in the Nahr Beirut for injection purposes and the amounts of water needed to supply the city during the dry season. A schedule for injection was developed. It provided for a total of 12 million cu m/yr to be injected over seven months; November, 0.38 cu m/sec; December, 0.50 cu m/sec; and January to May, 0.77 cu m/sec. In the same area it would be possible to extract a total of 15.8 million cu m/yr spread over five months; June to August, 1.16 cu m/sec; September, 1.38 cu m/sec; and October 1.23 cu m/sec. (Cassar - PTT)
W86-03994

MODEL TO EVALUATE SALT WATER INTRUSION DUE TO DIFFERENT CONJUNCTIVE USE STRATEGIES IN COASTAL AQUIFERS IN SAUDI ARABIA,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04072

NITRATE CONCENTRATIONS IN MUNICIPAL WELLS LOCATED WITHIN A RIVER BED,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
Q. M. Nguyen, and M. W. Gilliland.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 135-137, 6 fig, 1 tab, 7 ref.

Descriptors: *Municipal wells, *Nitrates, *Modelling, *Drawdown, River beds, Alluvial aquifers, Groundwater pollution, Recharge, Wells, Water management, Management, Simulation, Platte River, Central Platte Valley, Nebraska.

Municipalities in the Central Platte Valley of Nebraska utilize the alluvial aquifer of the Platte River for drinking water. Of concern to these municipalities is the potential for nitrate contamination of these well fields. Such contamination could result from periods of low-flow or no-flow in the River, in part caused by increased diversions of River waste for irrigation upstream. Drawdown in the well field during these periods could allow high nitrate groundwater (25 to 50 mg/l NO3-N), to the north of the River to flow into the alluvial well field. This paper describes a management model which could manage the River and groundwater conjunctively for both quantity and quality, summarizing the model conceptually and mathematically, and provides results for three simulations. While not validated with a field test, model predictions are reasonable and accurate to the extent they can be compared to measured data. When validated, the model may be used to evaluate the impact of diversions for irrigation upstream on well field quality. (Lantz - PTT)
W86-04078

USE OF ELECTRICAL RESISTIVITY METHOD TO STUDY VERTICAL HYDROLOGIC BOUNDARIES IN WADI SUDR, SINAI PENINSULA, EGYPT,
King Faisal Univ., Al-Hasa (Saudi Arabia). Coll. of Agriculture.
For primary bibliographic entry see Field 2F.
W86-04097

MULTIPLE COMPLETION MONITOR WELLS,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
D. B. Nakamoto, F. R. McLaren, and P. J. Phillips.
Groundwater Monitoring Review, Vol. 6, No. 2, p 50-55, Spring 1986. 5 fig, 2 tab, 1 ref.

Descriptors: *Monitoring, *Drilling, *Drilling samples, Environmental effects, Cost analysis, Piezometers, Construction methods, Construction materials, Grouting.

The multiple completion monitor well design concept is discussed in terms of drilling methods, construction methods, cost considerations, and potentially adverse effects caused by the interactions between construction materials and groundwater. The air rotary casing hammer method is used to penetrate unconsolidated sediments and the remainder of the hole is drilled by the direct mud rotary method. Intervals for piezometer completions are based upon lithologic descriptions and downhole electrical logging. Piezometers are 2 1/2-inch and 1-inch blank pipes with 2 1/2-inch mill slotted and 1 1/4-inch wire wound perforated pipes. Each perforated pipe interval is within a gravel envelope. Cement grout (4 1/2 gallons water to 94 pounds cement) is used to seal the annular space between perforated intervals. Contracting costs for multiple completion monitor

wells are less than an equal set of single completion monitor wells. For example, a six completion monitor well, 300 ft deep, costs $15,300. Six single completion monitor wells with the same perforated intervals cost $46,800. The cost differences are mainly for drilling extra footage and installing more grout. The effectiveness of cement grout hydraulic seals by measuring differences in hydraulic heads within adjacent piezometers has been demonstrated. The integrity of the cement grout seals is also verified by differing water quality in adjacent piezometers. Cement grout seals have caused one adverse condition: an elevation of pH from 11 to 12. The problem is under investigation and alternate materials are being studied for seals. (Lantz-PTT)
W86-04207

SATURATED THICKNESS FOR DROUGHT AND LITIGATION PROTECTION,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
R. C. Peralta, P. W. Dutram, A. W. Peralta, and A. Yazdanian.
Ground Water GRWAAP, Vol. 24, No. 3, p 357-364, May-June 1986. 2 fig, 5 tab, 13 ref.

Descriptors: *Irrigation water, *Saturated thickness, *Drought, *Groundwater availability, *Litigation protection, Legal aspects, Competing use, Water deficits, Arkansas.

The legal doctrines of reasonable use and correlative rights are the recognized standards for resolving legal conflicts between interfering agricultural groundwater users in Arkansas. Assuring that an adequate saturated thickness exists for all interfering users throughout the groundwater withdrawal season provides water users with a degree of protection from both a successful litigious charge of 'unreasonable use' and a mandated curtailment of groundwater withdrawal in a drought season. The feasibility of maintaining a 'target' saturated thickness and water table elevation by implementing a district-wide sustained groundwater withdrawal strategy has been previously demonstrated. Several models have been reported which create the spatially distributed sustained-yield withdrawal strategies that will maintain those target levels. Using an iterative dynamic groundwater simulation model, initial (springtime) saturated thickness is assumed. The change in saturated thickness resulting from withdrawals during the irrigation season is compared with an acceptability criterion. The assumed springtime saturated thickness is varied until the criterion is satisfied. The result is the minimum springtime saturated thickness needed for groundwater users in a particular cell to achieve: (1) a measure of year-round protection from successful litigation charging unreasonable use, and (2) some assurance that they will not need to curtail or limit groundwater withdrawals during a drought season. This procedure was applied to a 3-mile by 3-mile (5-km by 5-km) cell in the Arkansas Grand Prairie, an important rice- and soybean producing area. The results indicate that a minimum of 13 feet (4 m) of saturated thickness are desirable for the center of the cell to provide for a drought season. (Lantz-PTT)
W86-04280

GROUNDWATER: SAVING THE UNSEEN RESOURCE,
For primary bibliographic entry see Field 5G.
W86-04360

CHARACTERIZATION OF DYE TRACER PLUMES: IN SITU FIELD EXPERIMENTS,
Battelle Memorial Inst., Columbus, OH.
For primary bibliographic entry see Field 2F.
W86-04468

ESTIMATING AQUIFER PERMEABILITY FROM FORMATION RESISTIVITY FACTORS,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 2F.
W86-04469

OPTIMAL CONTROL OF NONLINEAR GROUNDWATER HYDRAULICS: THEORETICAL DEVELOPMENT AND NUMERICAL EXPERIMENTS,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 2F.
W86-04544

4C. Effects On Water Of Man's Non-Water Activities

CHANGES IN GROUND-WATER RESOURCES AS A RESULTS OF MINE DRAINAGE IN THE SEVEROURALSK BAUXITE AREA,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-03984

SIMULATED OIL-SHALE MINE DEWATERING USING A CONFINED MULTIAQUIFER MODEL, PICEANCE BASIN, COLORADO, U.S.A.,
Geological Survey, Denver, CO.
J. B. Weeks.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 151-166, 10 fig, 6 ref.

Descriptors: *Mine drainage, *Groundwater, *Model studies, *Hydrologic models, *Colorado, Oil shale, Aquifers, Piceance Basin, Drainage, Dewatering, Shales.

A multiaquifer digital model was used to simulate the aquifer system in the Piceance basin, Colorado. Aquifer tests and geophysical data were used to evaluate the hydraulic characteristics of the system. The groundwater system was modeled in a steady state and calibrated by comparing the computed potentiometric surface with water level measurements collected from wells in the basin. The annual volume of groundwater recharge used in the model to obtain the steady-state solution was found to be within 10% of that estimated by the water budget. The only difficulty encountered in obtaining the steady-state solution resulted from the choice of initial heads. For the conditions simulated, the convergence of the iterative solution was extremely slow. However, subsequent testing of the model indicates that the rate of convergence to the solution is problem dependent. For steady-state solutions, the rate of convergence increases with decreases in the value of the leakance of the confining layers. The digital model of the aquifer system was used to estimate mine dewatering rates for proposed mines in the Piceance basin. The results of the model study indicate that, after 30 years of dewatering, the discharge from both mines will be 0.77 cu m/sec, which is supplied by intercepted groundwater discharge and water from storage in the aquifers. About 615 million cu m of water is removed from storage during the 30 years of simulated dewatering. The time steps used in modeling the 30 years of dewatering were increased by a factor of 2 between successive steps. The storage coefficient of the upper aquifer was changed by a factor of 100 when the head at any node declined by a specified amount. The rate of convergence was rapid for all transient problems simulated. (Author's abstract)
W86-03988

EFFECTS OF PONDEROSA PINE TREATMENTS ON WATER YIELD IN ARIZONA,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
M. B. Baker.
Water Resources Research WRERAO, Vol. 22, No. 1, p 67-73, January 1986. 3 fig, 2 tab, 34 ref.

Descriptors: *Water yield, *Arizona, *Ponderosa pines, Overstory removal, Watersheds, Vegetation, Oak trees, Pine trees, Water yield improvement, Agricultural watersheds, Agricultural hydrology.

Annual water yields were determined for three levels of overstory removal and three levels of strip cut with thinning applied on ponderosa pine watersheds. Water yield increases from a completely cleared watershed were statistically significant for 7 years, losing significance after recovery and growth of Gambel oak and herbaceous vegetation. Water yield increases were maintained 6 years after a light overstory removal and 10 years following a heavy overstory removal cut. Significant increases were obtained for 3-4 years following two levels of strip cut with thinning, but were then lost on watersheds with a high percentage of southern exposure or low slopes. Water yield increase remained at a 15% level during the first 6 years on a strip-cut watershed with 60% of its area on northern aspects. (Author's abstract)
W86-04161

QUANTITATIVE DETERMINATION OF PARTIALLY HYDROLYZED POLYACRYLAMIDE POLYMERS IN OIL FIELD PRODUCTION WATER,
Marathon Oil Co., Littleton, CO. Denver Research Center.
For primary bibliographic entry see Field 5A.
W86-04435

STREAM ACIDITY IN SOME AREAS OF WALES IN RELATION TO HISTORICAL TRENDS IN AFFORESTATION AND THE USAGE OF AGRICULTURAL LIMESTONE,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W86-04600

EFFECTS OF FOREST FIRE AND OTHER DISTURBANCES ON WILDERNESS LAKES IN NORTHERN MINNESOTA: 1. LIMNOLOGY,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, and H. E. Wright, Jr.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 177-202, April 1986. 12 fig, 4 tab, 31 ref. NSF Grant GB-36213.

Descriptors: *Forest fires, *Lakes, *Environmental effects, *Minnesota, *Limnology, Coniferous forests, Watersheds, Biomass, Phytoplankton, Silica, Nitrogen, Phosphorus, Lake morphology.

Largely virgin forests of the Boundary Water Canoe Area were destroyed by a wildfire in the early spring. As a result, most of the coniferous watersheds of two lakes, in largely granitic terrain, were burned out. The chemical and biological limnology of the two lakes was followed for two years, starting immediately after the fire, and a third lake of comparable size nearby was used as a control. Results show that major ions, silica, and total nitrogen and phosphorus were not significantly different in the three lakes, implying that the runoff from the burned forest did not appreciably affect the two lakes in question. The same conclusion is reached from an analysis of algal biomass and phytoplankton composition. (Lantz-PTT)
W86-04648

4D. Watershed Protection

SEDIMENTATION PROBLEMS IN RIVER BASINS,
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 2J.
W86-03973

TOPOGRAPHIC PARTITION OF WATERSHEDS WITH DIGITAL ELEVATION MODELS,
Hunter Coll., New York. Dept. of Geology and Geography.
For primary bibliographic entry see Field 4A.
W86-04157

EFFECTS OF PONDEROSA PINE TREATMENTS ON WATER YIELD IN ARIZONA,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
For primary bibliographic entry see Field 4C.
W86-04161

MUDDY WATER AND AMERICAN AGRICULTURE: HOW TO BEST CONTROL SEDIMENTATION FROM AGRICULTURAL LAND,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
S. B. Lovejoy, J. G. Lee, and D. B. Beasley.
Water Resources Research WRERAO, Vol. 21, No. 8, p 0165-1068, August 1985. p 1065-1068, 1 fig, 1 tab, 7 ref. Cooperative Agreement No. 58-3A75-2-24.

Descriptors: *Agricultural runoff, *Soil erosion, *Sediment transport, *Simulation analysis, *Model studies, Hydrologic models, Land use, Social aspects, Water policy, Nonpoint pollution sources, Erosion control, Water quality, Sedimentation, Agricultural runoff, Environment policy, Cost Analysis, Evaluation.

The role of agricultural sediment in water quality is well documented. While numerous policies have been proposed and initiated, erosion of agricultural soils continues to be a significant problem. The present analysis concentrates on the outcome of several policy alternatives in terms of sediment delivery and project costs. These results are obtained by combining social science investigations of probable farmer behavior under a variety of scenarios with a hydrologic simulation model ANSWERS (Aerial Nonpoint Source Watershed Environment Response Simulation) which predicts the sediment delivery with different land uses. This integration of social science behavioral research with the hydrologic response simulation model provides a framework to assess the environmental effectiveness of alternative policies aimed at reducing sedimentation. While the results obtained so far are preliminary, this approach offers great promise as a tool for federal, state and local conservation agencies in their efforts to efficiently and effectively use their limited resources to reduce soil loss. (Geiger-PTT)
W86-04303

CHANNEL FORM AND STREAM ECOSYSTEM MODELS,
Arkansas Univ., Fayetteville. Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W86-04537

COMMUNITY RESPONSES TO NON-POINT POLLUTION FROM AGRICULTURE,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-04605

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MANUAL OF METHODS IN AQUATIC ENVIRONMENT RESEARCH, PART 9: ANALYSES OF METALS AND ORGANOCHLORINES IN FISH.
Food and Agriculture Organization of the United Nations, Rome (Italy).
FAO Fisheries Technical Paper No. 212, 1983. 3 p.

Descriptors: *Pollutant identification, *Chemical analysis, *Aquatic animals, *Metals, *Organochlorine compounds, Spectrophotometry, Fish, Crustaceans, Shellfish, Heavy metals, Chlorine compounds.

This manual describes analytical methods for measuring contamination of fish, crustacea, and bivalves with heavy metals, organochlorines, and methyl mercury. Chapter one describes field sampling, sample storage and preparation of subsamples of biological material for analysis. Chapter two describes the analysis of zinc, copper, lead, and cadmium by flame atomic absorption spectrophotometry (AAS), and mercury and methyl mercury by flameless AAS. It includes descriptions of sample preparation, wet ashing with hydrogen peroxide/nitric acid, and photometric measurement. Chapter three describes the analysis of organochlorines and methyl mercury by gas liquid chromatography. It covers the preparation of columns, extraction and fat isolation, cleanup procedures by sulfuric acid and potassium hydroxide, chromatographic determination, and the calculation of results. (Author's abstract)
W86-03996

FIELD SAMPLING AND PREPARATION OF SUBSAMPLES OF AQUATIC ORGANISMS FOR ANALYSES OF METALS AND ORGANOCHLORINES,
Havsfiskelaboratoriet, Lysekil (Sweden).
B. I. Dybern.
In: Manual of Methods in Aquatic Environment Research, Part 9: Analyses of Metals and Organochlorines in Fish, 1983. p 1-13, 2 fig.

Descriptors: *Pollutant identification, *Sampling, *Aquatic animals, Metals, Organochlorine compounds, Fish, Crustaceans, Shellfish, Mollusks, Mussels, Heavy metals, Chlorine compounds, Sample preparation, Sample preservation, Biological samples.

Guidelines are detailed for field sampling and preparing aquatic organisms for determination of metals and organochlorines. Species for study should be easy to identify, available in sufficient quantities, relatively stationary, and geographically widespread. At least 10, but preferably 15 or 20, individuals of the same age and size should be sampled. Fish of 30-50 cm are easiest to handle and take subsamples from. Samples should be transported as quickly as possible in a moist, but not submerged, condition to the freezing facility. Although animals may be analyzed without freezing, they are much easier to dissect and subsample in the frozen condition. Instructions for labeling and packaging are given for larger animals, smaller animals, and molluscs. Preparation of subsamples is done so that material is available for both metals and organochlorine analysis. Larger fish are filleted; tails of larger crustaceans are separated. For smaller crustaceans muscle pieces of all specimens belonging to the same sample are homogenized together. Soft tissue from molluscs is homogenized first, then subsamples taken. The liver and fatty tissue may also be isolated for analysis. Cleaning procedure for dissection equipment are described. (Cassar - PTT)
W86-03997

ANALYTICAL METHODS FOR MEASURING METALS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY,
Chelsea Coll., London (England). Dept. of Chemistry.
J. Dalziel, and C. Baker.
In: Manual of Methods in Aquatic Environment Research, Part 9: Analyses of Metals and Organochlorines in Fish, 1983. p 14-20, 2 fig, 1 tab.

Descriptors: *Pollutant identification, *Chemical analysis, *Aquatic animals, *Metals, Spectrophotometry, Fish, Crustaceans, Shellfish, Heavy metals, Atomic absorption spectrophotometry, Zinc, Lead, Copper, Cadmium, Mercury.

Procedures for determining metals in samples of fish, shrimp, and oyster are described. The basic method for flame atomic absorption spectrophotometry (AAS) (Zn, Cu, Pb, Cd) involves wet ashing with a mixture of nitric acid and hydrogen peroxide to destroy the bulk of the organic matter, followed by aspiration into the air-acetylene flame. The metals Hg, Se, and As are determined by a modified flame AAS procedure. Total Hg is determined by the cold vapor technique after organic mercury has been determined by the wet ashing and complexing with cysteine. (Cassar - PTT)
W86-03998

ANALYTICAL METHODS FOR MEASURING ORGANOCHLORINES AND METHYL MERCURY BY GAS CHROMATOGRAPHY,
S. Jensen, L. Reutergardh, and B. Jansson.
In: Manual of Methods in Aquatic Environment Research, Part 9: Analyses of Metals and Organochlorines in Fish, 1983. p 21-33, 4 fig, 1 tab.

Descriptors: *Pollutant identification, *Pesticides, *Insecticides, *Mercury, *Organochloride compounds, Chlorinated hydrocarbons, Polychlorinated biphenyls, DDT, DDE, DDD, Hexachlorobenzene, Lindane, Mirex, Aldrin, Gas chromatography, Chromatography, Methyl mercury.

A method for determining organochlorines and methyl mercury by gas chromatography can be used for DDT, DDD, DDE, hexachlorobenzene, some HCH isomers (lindane), polychlorinated biphenyls, and other chlorinated compounds such as aldrin and mirex. The substances are detected by electron capture. (Cassar - PTT)
W86-03999

PORTABLE INSTRUMENT FOR SCREENING SPILL AND SOURCE OIL SAMPLES,
Coast Guard Research and Development Center, Groton, CT.
J. R. Jadamec, G. A. Kleinberg, D. A. Marble, and L. A. Wargo.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 105-109, 7 fig, 2 tab, 5 ref.

Descriptors: *Oil Spills, *Pollutant identification, *Oil, *Spectroscopy, Spectral analysis, Oily water, Oil pollution, Field Identification, Luminescence Monitor.

The U.S. Coast Guard Research and Development Center recently completed a laboratory and field evaluation of a portable (battery powered) Field Identification Luminescence Monitor (FILM) developed for oil spill identification. This instrument, a simplified fluorescence spectrometer, features high resolution, portability, operational simplicity, and sample-handling versatility. It is designed to record the fluorescence emission spectrum of oil from 280 to 650 nanometers (nm) directly on Polaroid film for rapid comparisons of spill and suspected source samples directly at the spill site. Samples can be in the form of neat oils, solutions of oil in water, or as deposits on various substrates. Laboratory and field tests indicate that use of this instrument by pollution investigators both reduces the number of samples requiring laboratory analysis and increases the probability that the correct source has been sampled at or in the vicinity of the spill site. This system also can detect other fluorescing materials such as industrial solvents, specific hazardous chemicals, and polyaromatic hydrocarbons. (Author's abstract)
W86-04015

BIOLOGICAL MONITORING OF THE FORTIES OILFIELD (NORTH SEA),
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
J. P. Hartley, and J. Ferbrache.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983. p 407-414, 6 fig, 7 tab, 24 ref.

Descriptors: *Monitoring, *Biological properties, *Oil, *Bioindicators, *Environmental effects, Ecological effects, Hydrocarbons, North Sea.

The Forties Oilfield (the largest in the U.K. sector of the North Sea) has been in production since September 1975. In June 1975, a quantitative survey of the benthic sediments and fauna over the area as made at the start of an environmental monitoring program for the field. The results of a repeat survey carried out after three years of pro-

duction have been reported by Hartley. This paper presents data from a third similar survey in June 1981 and compares the findings with those of the earlier surveys. The benthic fauna of the Forties field is rich and diverse and qualitatively corresponded well in 1981 to previous descriptions. Naturally occurring gradients in both the sediment type and fauna are a feature of this area. Changes in the densities of certain species were noted at some sites in 1981, including increases in certain opportunistic forms. Although no areas of biological effect could be delineated around the four production platforms, the industrial activity in the field may be implicated in the changes found at several stations. The hydrocarbon content of the sediments was low and, with one possible exception, did not appear related to the biological changes noted. The results to date suggest that offshore oilfield in deep water, developed using water-based drill fluids, present relatively few biological problems in the short term. Since no major biological effects have been found after six years of drilling and production, a reduced program of monitoring is recommended to maintain biological surveillance during the life of the field. (Author's abstract)
W86-04033

NATURAL RESOURCES DAMAGE ASSESSMENT STUDY: THE IXTOC I BLOWOUT,

Energy Resources Co., Inc., Cambridge, MA.
For primary bibliographic entry see Field 5C.
W86-04040

SORPTION KINETICS OF TOXIC AND HAZARDOUS ORGANIC SUBSTANCES ON NEW JERSEY COASTAL PLAIN AQUIFER SOLIDS,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W86-04052

DELINEATING GROUNDWATER CONTAMINATION BY HOUSEHOLD WASTEWATER,

Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
D. Mitchell, and R. Ashworth.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 129-131, 2 fig, 2 tab, 7 ref.

Descriptors: *Groundwater pollution, *Wastewater pollution, *Domestic wastes, Wastewater, Fluorescent whitening agents, Soil columns, Leachates, Wells, Springs, Coliforms, Organic carbon.

A laboratory investigation and a confirming field study has been completed whereby groundwater contaminated by inadequately treated septic tank effluent can be easily delineated from other contaminating sources. The methodology involves fluorescent whitening agents (FWA) contained in commercial household laundry products found in virtually all household wastewaters; most domestic wastewater has between 0.2 and 0.4 mg/FWA. A laboratory study of leachate from eight unsaturated 4 inch diameter soil columns treating septic tank effluents demonstrated a good correlation between FWA concentration and leachate water quality. Leachate from lysimeters in two different existing septic tank leachfields were analyzed confirming the relationship between FWA concentrations and the septic tank leachfield water quality. No FWA was detected in well purified leachate but levels as high as 0.05 mg/l were found in leachates with high total organic carbon and high total coliform bacteria concentrations. Several contaminated wells and springs were examined, some with as much as 80 fecal coliform bacteria per 100 ml and total organic carbon in excess of 100 mg/l found free of FWA indicating agricultural or commercial sources no household wastewater. Other similarly contaminated did not contain FWA indicating faulty septic tank systems as the sources. (Author's abstract)
W86-04076

VIRAL AND BACTERIAL CONTAMINATION OF GROUNDWATER BY ON-SITE WASTEWATER TREATMENT SYSTEMS IN SANDY COASTAL SOILS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W86-04077

DEVELOPING INFORMATION ON ALDICARB LEVELS IN LONG ISLAND GROUNDWATER,

Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W86-04080

COMBINED USE OF GENOTOXICITY AND WHOLE EMBRYO TERATOGENICITY SCREENING ASSAYS IN PREDICTING TERATOGENIC RISKS,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-04088

SAMPLING ANALYTICAL CONCERNS IN VOLATILE ORGANIC CONTAMINANT STUDIES,

Illinois State Water Survey Div., Champaign.
M. J. Barcelona, J. A. Helfrich, and J. P. Gibb.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 181-183, 6 tab, 7 ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Chemical analysis, *Water sampling, Sampling, Groundwater movement, Groundwater.

The choices of sampling and analytical methodologies for groundwater and subsurface processes research are frequently made from the standpoint of convenience, expediency or faith. Clearly, an optimal combination of sampling and analysis procedures must be selected to minimize errors involved in the determination of the chemical constituents of interest. Systematic errors (bias) and poor precision severely limit our understanding of net transport processes as well as the relative importance of physical, chemical or biological factors in controlling such processes. Volatile dissolved compounds are of particular interest in groundwater processes research, since they may provide valuable indicators of plume migration, inter-media transfer, solution geochemistry and microbial activity. A systematic evaluation of groundwater sampling mechanisms has been conducted in our laboratories to determine the sources and magnitude of sample collection errors. The determination of common solution parameters was unaffected by most sampling mechanisms with the exception of the peristaltic (suction) pump. The accuracy of overall determinations of dissolved gases (O_2, CH_4) and trihalomethane compounds can be significantly worsened by suction and gas displacement mechanisms. In general, mechanism related bias and imprecision are the result of degassing. Sampling error due to the mechanism of collection alone can exceed the errors involved in analytical procedures. (Author's abstraact)
W86-04090

USE OF THE ELECTRICAL POTENTIAL OF CELL MEMBRANES TO RAPIDLY ASSESS POTENTIAL TOXICANTS,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
J. T. Blankmeyer.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 184-185, 1 tab, 6 ref.

Descriptors: *Electrical properties, *Cell membranes, *Toxicity, *Bioindicators, Amphibians, Invitro tests, Naphthalene, Polycyclic aromatic hydrocarbons, Biological analysis, Water pollution effects.

Isolated frog skin retains most of its in-vivo function for 24 hours. One of the in-vitro functions is to actively transport Na from the pondside of the skin to the blood-side. Since many toxicants are lipid-soluble or affect the characteristics of membranes, we have chosen to test if the skin is a useful assay system for rapid determinations of effects of membrane-active toxicants. Naphthalene was used to assess the feasibility of the system to detect the effect of toxicants on the active transport parameters of epithelia vertebrates. The Potential Difference (PD) and Short Circuit Current (SCC) were used as indicators of the net movement of Sodium, activity of the Sodium-Potassium pump, and the conductivity of the para-cellular leakage pathways. Naphthalene was found to alter the membrane potential and short-circuit current of the frog skin with a linear relationship. Using naphthalene concentrations in the 1 to 10 mg/L range, naphthalene was found to cause rapid increase in the Short Circuit Current, the measure of Active Sodium Transport. It is concluded that the Short Circuit Current is a viable assay method for rapid determination of toxicant effects. (Author's abstract)
W86-04091

IDENTIFICATION OF SUBSURFACE BRINES USING STATISTICAL TECHNIQUE,

National Inst. of Hydrology, Roorkee (India).
A. G. Chachadi, and B. Soni.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 191-193, 4 fig, 7 ref.

Descriptors: *Statistical analysis, *Subsurface water, *Saline water, Statistical methods, Groundwater quality, Chemical analysis, Chloride, Ion exchange, Aquifers, Groundwater.

Statistical techniques have been successfully used to sort out the hydrogeologic process-response relationships from commonly collected groundwater quality data. The purpose of this study is to demonstrate the usefulness of principal components analysis, a multivariate statistical technique, as a tool for mapping areas of distinct chemical features. The chemical analysis data of fifty-four groundwater samples have been used. The locations of the groundwater samples are distributed over an area of about 500 sq. km. in the Gangetic plain. Three components which represent different chemical processes have been identified, and their relative areal impacts have been determined. These components are, (1) localised concentration of chloride and T.D.S. due to scarce precipitation, high rate of evapotranspiration, and convergence of the groundwater flow; (2) dissolution and ion exchange in the semipermeable layer that overlies portions of the aquifer; and (3) regional dissolution of carbonaceous formation. The scores of principal components have been used to identify the saline water areas, and to distinguish the saline and non-saline water samples. A conceptual model has been proposed to represent the physical system. (Author's abstract)
W86-04093

NEW METHODOLOGY FOR ASSESSING MUTAGENICITY OF WATER AND WATER RELATED SEDIMENTS,

Missouri Univ.-Columbia. Environmental Trace Substances Research Center.
W. R. Lower, A. G. Underbrink, A. F. Yanders, K. Roberts, and T. K. Ranney.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 194-196, 13 ref.

Descriptors: *Water pollution effects, *Toxicity, *Sediments, *Biological analysis, *Water Quality, Water pollution, Chemical analysis, Tradescantia, Water analysis.

Methodology not included in the EPA list, 'Ambient Water Quality Criteria,' is available for the rapid and cost-efficient assay of mutagens and physiologically detrimental agents which occur in waters, water related sediments and sludges. Both

mutational and physiological effects resulting from such agents may be investigated simultaneously in the plant Tradescantia. There are three tests which involve separate end points: (1) the stamen hair test assesses somatic mutations at a single locus; (2) the micronucleus test is a measure of a germinal mutation caused by chromosome breakage or meiotic disturbances in pollen mother cells; and (3) variable fluorescence is a measure of perturbation in the electron transport system of photosynthesis. All three tests are suitable for both short term and chronic exposures and for both field and laboratory studies. (Author's abstract)
W86-04094

MINIMIZING PROBLEMS CAUSED BY UNEQUAL DEVELOPMENT OF BIOLOGICAL ACTIVITY WITHIN COLUMN MICROCOSMS USED TO PREDICT THE FATE OF POLLUTANTS IN SUBSURFACE MATERIALS,

Robert S. Kerr Environmental Research Lab., Ada, OK.
G. D. Miller, G. M. Deeley, J. C. Chang, and J. T. Wilson.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 197-198, 2 fig, 2 ref.

Descriptors: *Microcosms, *Subsurface waters, *Groundwater movement, *Organic compounds, *Bioindicators, Phenol, 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, Groundwater pollution, Groundwater.

Microcosms are useful tools to predict the fate of chemical substances in natural systems. They can reveal the potential for occurrence of a particular process in the natural system of interest, and under appropriate circumstances can generate data on the kinetics of the process that can be used to model the real system. In order to generate data that could be used for projections of kinetics, we constructed a microcosm that was as faithful as possible to the subsurface environment. Authentic subsurface material was collected in a way that avoided microbial contamination, then packed into sterile Teflon and glass columns. The material was exposed under aerobic conditions to concentrations of phenol; 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, and 4-nitrophenol in the range of 10-20 microgram/liter. The chemicals were dissolved in sterilized ground water from the same layer of sand used to construct the microcosms. The flow rate in the columns was slow, about 2 cm per day, to simulate ground water flow. After two months, a zone of intense biological activity developed at the head of the columns. This rendered the microcosms useless for any sort of kinetic analysis because it was impossible to determine the width of the active zone, and thus the residence time of the pollutants in that zone. To minimize these problems, new microcosms were constructed, and the solution of chemicals was forced through them as rapidly as possible until the organic chemicals broke through in the column effluent. Then flow through the microcosms was stopped, except for the minimum volume needed for chemical analysis. Upon subsequent incubation, all the material in the columns experienced the same concentration of the pollutants, and the columns as a whole responded to the effects of the pollutants. (Author's abstract)
W86-04095

ABUNDANCE, HETEROTROPHIC ACTIVITY AND TAXONOMY OF BACTERIA IN A STREAM SUBJECT TO POLLUTION BY CHLOROPHENOLS, NITROPHENOLS AND PHENOXYALKANOIC ACIDS,

Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 5C.
W86-04113

COMPARISON OF ALGAL ASSAY SYSTEMS FOR DETECTING WATERBORNE HERBICIDES AND METALS,

Montana State Univ., Bozeman. Dept. of Microbiology.
S. C. Turbak, S. B. Olson, and G. A. McFeters.
Water Research WATRAG, Vol. 20, No. 1, p 91-96, January 1986. 1 fig, 3 tab, 38 ref. EPA Grant No. R805383.

Descriptors: *Algal assays, *Herbicides, *Trace metals, Water pollution, Bottle test, Oxygen Evolution Assay, Bioassay, Water pollution effects, Toxicity, Selenastrum, Atrazine, 2,4,D-glycophosphate, Cadmium, Copper, Chromium, Silver, Zinc.

The EPA Bottle Test was compared to a short-term algal bioassay method (Oxygen Evolution Assay) for detecting waterborne herbicides and metals. Although the Bottle Test proved to be a more sensitive assay system, the responses of the two bioassays correlated well. The Oxygen Evolution Assay may be useful as a rapid preliminary screening method for determining which chemicals should undergo further testing. In both bioassays, differences were observed in the results of experiments conducted in the standard algal growth medium and in nutrient-enriched water samples, suggesting that water chemistry plays an important role in the determination of specific toxicity thresholds for algae. (Author's abstract)
W86-04114

COMPARISON OF POSITIVELY CHARGED MEMBRANE FILTERS AND THEIR USE IN CONCENTRATING BACTERIOPHAGES IN WATER,

Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
P. A. Shields, T. L. Ling, V. Tjatha, D. O. Shah, and S. R. Farrah.
Water Research WATRAG, Vol. 20, No. 2, p 145-151, February 1986. 4 fig, 5 tab, 22 ref.

Descriptors: *Bacteriophage, *Positively charged membrane filters, *Adsorption, *Elution, Membrane filters, Viruses, Bacteriophage concentration, Natural waters.

Virus adsorption-elution studies and physical measurements were performed on four electropositive membrane filters (Virosorb 1MDS, Posidyne N66, Zeta plus C-30, and Seitz S). The relative hydrophobicity of the membrane filters was determined by measuring the contact angle of carbon tetrachloride with the filters and by measuring the rate of rise of hexadecane and water in the filters. Viruses adsorbed to the least hydrophobic filter (Virosorb 1MDS) could be eluted by using a solution of salt (NaCl or NaEDTA) alone to disrupt electrostatic interactions between the viruses and the filter. Solutions containing both salt and detergent were required to elute virus adsorbed to two of the more hydrophobic filters (Posidyne N66 and Zeta plus C-30), indicating that both electrostatic and hydrophobic interactions were responsible for viral adsorption to these filters. A two-step procedure for recovering bacteriophages from water was developed that employed different filters for each step. Virosorb 1MDS was used to adsorb indigenous phage in water samples. Adsorbed virus could be recovered by treating the filter with a solution of 1.0 M NaCl. Phages in this solution could be further concentrated by a second adsorption-elution step that used Seitz S filters. (Author's abstract)
W86-04121

VOLATILE OZONIZATION PRODUCTS OF AQUEOUS HUMIC MATERIAL,

Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 5F.
W86-04122

ACTION OF OZONE ON METHYL OCTADEC-9-ENOATE IN POLAR SOLVENTS: A MODEL FOR AQUEOUS OZONIZATION OF ORGANIC COMPOUNDS,

Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 5F.
W86-04123

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICOCHEMICAL DATA AND MICROSCOPICAL OBSERVATIONS,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2K.
W86-04125

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - I: OZONE CONSUMPTION AND OZONATION PRODUCTS,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5D.
W86-04126

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - II: KINETIC STUDIES OF THE INITIAL REACTION STEP,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5D.
W86-04127

SIMULTANEOUS DETERMINATION OF TOTAL ORGANIC CARBON AND TOTAL NITROGEN IN WATERS BY PYROLYSIS - GAS CHROMATOGRAPHY - MASS SPECTROMETRY,

Government Industrial Research Inst., Nagoya (Japan).
K. Nakajima.
Water Research WATRAG, Vol. 20, No. 2, P 233-235, February 1986. 2 fig, 2 tab, 4 ref.

Descriptors: *Total organic carbon, *Total nitrogen, *Pyrolysis, *Gas chromatography, *Mass spectrometry, Water sampling, Simultaneous determination.

An apparatus with a pyrolysis unit, gas chromatograph and quadrupole mass spectrometer was assembled for the simultaneous deermination of total organic carbon (TOC) and total nitrogen (TN) in waters. The mass numbers used for the determination of TOC and TN were m/e 44 (CO2(+)) and m/e 30 (NO(+)), respectively. The short-term stability (relative standard deviation) was 3.3% for TOC, and 5.0% for TN. The detection limits were 0.076 micrograms/m for TOC and 1.3 micrograms/m for TN. TOC and TN in water samples were determined by this method, and the results agreed well with those obtained by a combustion-infrared method for TOC and a combustion-infrared method for TOC and a combustion-coulometric method for TN. (Author's abstract)
W86-04129

INVESTIGATIONS INTO THE SCOPE AND LIMITATIONS OF THE BISMUTH ACTIVE SUBSTANCES PROCEDURE (WICKBOLD) FOR THE DETERMINATION OF NONIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES,

Unilever Research Port Sunlight Lab. (England).
J. Walters, J. T. Garrigan, and A. M. Paulson.
Water Research WATRAG, Vol. 20, No. 2, p 247-253, February 1986. 1 fig, 5 tab, 8 ref.

Descriptors: *Nonionic surfactants, *Raw wastewater, *Bismuth active substances, Monitoring, Wickbold procedure, Chemical analysis, England, Wastewater treatment.

In Europe, the bismuth active substances (BiAS) procedure of Wickbold has been officially adopted as the means for determining alkoxylated nonionic surfactants - particularly in sewage. The scope and limitations of the BiAS procedure in this application have been demonstrated in a series of experiments in which the influence of procedural variables such as sample pretreatment, number and duration of solvent sublation steps and the ion-exchange clean-up of BiAS extracts prior to their analysis, have been examined. As a result, it is recommended that when BiAS procedures are used to determine nonionic surfactants in environmental samples, whole samples should be used and

the procedure should include four 10-min sublation steps and a cation/anion exchange clean-up of the sublation extracts. BiAS procedures in which the variables are not suitably chosen can result in BiAS levels being more seriously under-estimated in raw-sewage samples than in samples of the corresponding effluents. Their use could therefore lead to the belief that removal of nonionic surfactant by the sewage treatment process is less efficient than it is in practice. (Lantz-PTT)
W86-04131

MONITORING STATISTICS,

National Research Council, Washington, DC.
G. E. Schweitzer, and S. C. Black.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1026-1030, November 1985. 3 fig, 1 tab, 15 ref.

Descriptors: *Statistical methods, *Statistical models, *Data interpretation, *Monitoring, *Groundwater pollution, *Statistical analysis, Data collection, Sampling, Design criteria, Project planning, Resource Conservation and Recovery Act, Love Canal, New York.

Until recently, only limited effort has been directed toward the statistical aspects of designing procedures for sampling under field conditions. An individual sample is required to be representative of the environmental condition it is intended to define. Since soil and groundwater contamination are three-dimensional problems, the size of the individual sample and the number and location of the samples are critical in any attempt to portray environmental conditions. The use of statistics now plays a greater role in the design of sampling programs because of groundwater regulations promulgated by EPA under the Resource Conservation and Recovery Act. The report of an ACS-EPA workshop on environmental sampling for hazardous wastes provides an overview of current designs of field sampling programs. Two of the major questions that arise when risk assessments are conducted at hazardous waste sites relate to the level and extent of contamination and to the way in which contamination compares with background levels. The EPA monitoring programs at Love Canal and the Dallas Lead Study illustrate how statistics have been used to assess monitoring data in addressing these questions. To improve the statistical techniques for guiding the design of monitoring programs, monitoring data must be combined with factors that are based on professional judgement about the likely subsurface behavior of contaminants. Methods need to be developed to use information obtained from limited or small sample sets with more confidence. Statistical analyses of long-term monitoring under varying background conditions also should be examined. (Geiger - PTT)
W86-04137

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5C.
W86-04143

MONITORING OF ENTEROVIRUSES IN THE WATER SUPPLY OF BARCELONA FROM SURFACE WATER OF THE RIVER LLOBREGAT (CONTROLE D'ENTEROVIRUS DAS L'APPROVISIONNEMENT A BARCELONE PAR L'EAU DE SURFACE DU FLEUVE LLOBREGAT),

Sociedad General de Aguas de Barcelona (Spain).
For primary bibliographic entry see Field 5G.
W86-04153

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 1. ESTIMATION TECHNIQUES,

Geological Survey, Reston, VA.
R. J. Gilliom, and D. R. Helsel.
Water Resources Research WRERAO, Vol. 22, No. 2, p 135-146, February 1986. 6 fig, 6 tab, 9 ref, 1 append.

Descriptors: *Trace levels, *Water quality, *Distribution parameters, *Estimating, Metals, Organic compounds, Water pollution, *Statistical analysis, Monte Carlo method, Logarithmic distribution, Regression analysis.

A recurring difficulty encountered in investigations of many metals and organic contaminants in ambient waters is that a substantial portion of water sample concentrations are below limits of detection established by analytical laboratories. Several methods were evaluated for estimating distributional parameters for such censored data sets using only uncensored observations. Their reliabilities were evaluated by a Monte Carlo experiment in which small samples were generated from a wide range of parent distribution and censored at varying levels. Eight methods were used to estimate the mean, standard deviation, median, and interquartile range. Criteria were developed, based on the distribution of uncensored observations, for determining the best performing parameter estimation method for any particular data set. The most robust method for minimizing error in censored-sample estimates of the four distributional parameters over all simulation conditions was the log-probability regression method. With this method, censored observations are assumed to follow the zero-to-censoring level portion of a lognormal distribution obtained by a least squares regression between logarithms of uncensored concentration observations and their z scores. When method performance was separately evaluated for each distributional parameter over all simulation conditions, the log-probability regression method still had the smallest errors for the mean and standard deviation, but the lognormal maximum likelihood method had the smallest errors for the median and interquartile range. When data sets were classified prior to parameter estimation into groups reflecting their probable parent distributions, the ranking of estimation methods was similar, but the accuracy of error estimates was markedly improved over those without classification. (see also W86-04769) (Author's abstract)
W86-04168

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 2. VERIFICATION AND APPLICATIONS,

Geological Survey, Reston, VA.
D. R. Helsel, and R. J. Gilliom.
Water Resources Research WRERAO, Vol. 22, No. 2, p 147-155, February 1986. 1 fig, 9 tab, 4 ref, append.

Descriptors: *Trace levels, *Water quality, *Distribution parameters, *Estimating, *Statistical analysis, *Verification, Root-mean-square, Probability regression, Simulation analysis, Water quality assessment.

Estimates of distributional parameters (mean, standard deviation, median, interquartile range) are often desired for data sets containing censored observations. Eight methods for estimating these parameters have been evaluated using Monte Carlo simulations. To verify those findings, the same methods are now applied to actual water quality data. The best method (lowest root-mean-squared error (rmse)) over all parameters, sample sizes, and censoring levels is log probability regression (LR), the method found best in the Monte Carlo simulations. Best methods for estimating moment or percentile parameters separately are also identical to the simulations. Reliability of these estimates can be expressed as confidence intervals using rmse and bias values taken from the simulation results. Finally, a new simulation study shows that best methods for estimating uncensored sample statistics from censored data sets are identical to those for estimating population parameters. Thus this study and the companion study by Gilliom and Helsel form the basis for making the best possible estimates of either population parameters or sample statistics from censored water quality data, and for assessments of their reliability. (see also W86-04168) (Author's abstract)
W86-04169

CHLORINATED CARBOXYLIC ACIDS IN SOFTWOOD KRAFT PULP SPENT BLEACH LIQUORS,

Svenska Traeforskningsinstitutet, Stockholm.
K. Lindstrom, and F. Osterberg.
Environmental Science and Technology, Vol. 20, No. 2, p 133-138, February 1986. 5 fig, 1 tab, 26 ref.

Descriptors: *Chlorinated carboxylic acids, *Pulp wastes, *Softwoods, Bleaching wastes, Pulp and paper industry, Ultrafiltration, Gas chromatography, Mass spectrometry, Chlorine, Alkali extraction.

Characterization and identification of the chlorinated acidic low molecular matter of kraft pulp mill bleach plant effluents have been carried out. Characterization was performed by ultrafiltration followed by ether extraction and determination of the organically bound chlorine in the various fractions. Identification was performed by capillary gas chromatography-mass spectrometry after isolation and methylation of the acidic components. This study concludes that: (1)The chlorine (C) and alkali extraction (E) stage spent liquors contain about 300 and 30 g/ton of pulp of chlorinated low molecular and ether-extractable acids, respectively (calculated as OgCL); (2) About 30% (100 g/ton) of the ether-extractable acidic OgCl in the C-stage and about 60% (18 g/ton) in the E-stage liquors have been identified; (3) Chlorinated acetic acids are by far the most predominating chloro organic acids so far identified; (4) A new series of chlorinated keto acids has been identified; and, (5) Totally 31 carboxylic acids have tentatively been identified. (Lantz-PTT)
W86-04224

COMPARISON OF METHODS FOR THE CONCENTRATION OF SUSPENDED SEDIMENT IN RIVER WATER FOR SUBSEQUENT CHEMICAL ANALYSIS,

Geological Survey, Doraville, GA. Water Resources Div.
A. J. Horowitz.
Environmental Science and Technology, Vol. 20, No. 2, p 155-160, February 1986. 2 tab, 21 ref.

Descriptors: *Suspended sediments, *Rivers, *Chemical analysis, Centrifugation, Sedimentation, Backflush filtration, Trace metals.

Centrifugation, settling with centrifugation, and backflush-filtration procedures have been tested for the concentration of suspended sediment from water for subsequent trace metal analysis. Either of the first two procedures is comparable with in-line filtration and can be carried out precisely, accurately, and with a facility that makes the procedures amenable to large-scale sampling and analysis programs. There is less potential for post-sampling alteration of suspended sediment-associated metal concentrations with the centrifugation procedure because sample stabilization is accomplished more rapidly than with the settling and centrifugation procedure. Sample preservation can be achieved by chilling. Suspended sediment associated metal levels can best be determined by direct analysis but can also be estimated from the difference between a set of unfiltered-digested and filtered subsamples. However, when suspended sediment concentrations (<150 mg/L) or trace metal levels are low, the direct analysis approach makes quantitation more accurate and precise and can be accomplished with simpler analytical procedures. (Lantz-PTT)
W86-04225

INSIGHT INTO THE MECHANISM OF ACCUMULATION OF ARSENATE AND PHOSPHATE IN HYDRO LAKE SEDIMENTS BY MEASURING THE RATE OF DISSOLUTION WITH ETHYLENEDIAMINETETRAACETIC ACID,

Auckland Univ. (New Zealand). Dept. of Chemistry.

For primary bibliographic entry see Field 5B.
W86-04228

HOLDING EFFECTS ON COLIFORM ENUMERATION IN DRINKING WATER SAMPLES,

Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
For primary bibliographic entry see Field 5F.
W86-04233

SELECTIVE MEDIUM FOR THE ISOLATION OF OPPORTUNISTIC FLAVOBACTERIA FROM POTABLE WATER,

National Hansen's Disease Center, Carville, LA.
For primary bibliographic entry see Field 5F.
W86-04239

SELECTIVE DETECTION AND ENUMERATION OF FECAL COLIFORMS IN WATER BY POTENTIOMETRIC MEASUREMENT OF LIPOIC ACID REDUCTION,

Laboratoire Municipal d'Hygiene, Le Havre (France).
T. Jouenne, G. A. Junter, and G. Carrière.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1208-1212, Nov. 1985. 2 fig, 4 tab, 8 ref. French National Institutes of Health and Medical Research grants 820128 and 830112.

Descriptors: *Coliforms, *Bacterial Analysis, *Water Analysis, Drinking Water, Groundwater, Aquifers, Secondary Wastewater, Surface Water, Escherichia coli, Enterobacter, Klebsiella, Citrobacter.

Water samples of various origins were inoculated into a specific coliform-selective lactose broth provided with lipoic (thioctic) acid, and the time evolution of the redox potential of the cultures was monitored during incubation at 41 C by use of gold versus reference electrodes. Positive potential-time responses, i.e., 100-mV potential shifts recorded within 20 h of inoculation, were related to the initial number of fecal coliforms in the broth determined by control enumeration techniques, and the organisms responsible were isolated and identified by conventional procedures. A total of 30 samples of wastewater, 31 of surface water, 533 of groundwater, and 110 of drinking water were tested successively. A total of 240 natural water samples including 172 groundwater samples, and 1 drinking water sample were positive in the potentiometric test. Most (92%) of detection times were shorter than 15 h, and 94% of these could be attributed to Escherichia coli. Fifteen hours corresponded to the limit for detecting 1 E. coli cell/100 ml of water. About 78% of the potentiometric responses occurring after 15 h were induced by fecal coliforms other than E. coli (Enterobacter cloacae, Klebsiella pneumoniae, and Citrobacter freundii). Calibration curves relating detection times shorter than 15 h to fecal coliform concentrations were constructed for the natural water samples tested. There were minor variations in the average growth rate of the organisms in relation to the contamination level of the water tested. The number of false-positive samples in the potentiometric test was equivalent to that of false-negative samples (groundwater or drinking water). (Author's abstract)
W86-04252

USE OF IMMUNOFLUORESCENCE AND PHASE-CONTRAST MICROSCOPY FOR DETECTION AND IDENTIFICATION OF GIARDIA CYSTS IN WATER SAMPLES,

Health Effects Research Lab., Cincinnati, OH.
J. F. Sauch.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1434-1438, December 1985. 2 fig, 1 tab, 10 ref.

Descriptors: *Giardia, *Microscopic Analysis, *Water Analysis, Pathogens, Fluorescence, Surface Water, Water Conveyance, Human Disease.

A method was developed in which indirect immunofluorescence and phase-contrast microscopy are used for rapid detection and identification of Giardia cysts in raw and finished water supplies. When anti-Giardia cyst antiserum and fluorescein conjugate were applied to known Giardia cysts on membrane filters, the cysts fluoresced bright green when they were illuminated by UV light. This procedure permitted individual cysts to be quickly located even in samples heavily contaminated with other microorganisms and debris. The identity of presumptive Giardia cysts located in this way could then be confirmed by observing characteristic internal morphological features with phase-contrast microscopy. With this method, Giardia cysts were detected and their identities were confirmed in 14/24 samples taken from raw water and in 6/22 finished surface water supplies during several outbreaks in Pennsylvania. This immunofluorescence method is faster and easier than direct phase-contrast microscopy because of the specific high-contrast image produced. (Author's abstract)
W86-04235

EVALUATION OF METHODS FOR CONCENTRATING HEPATITIS A VIRUS FROM DRINKING WATER,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, S. E. Oglesbee, and D. A. Wait.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1457-1463, December 1985. 6 tab, 30 ref. EPA CR-810311.

Descriptors: *Drinking Water, *Enteric Viruses, *Water Analysis, Microbiological Studies, Pathogens.

In this study, widely used concentration methods involving adsorption to and subsequent elution from microporous filters followed by organic flocculation were evaluated for their ability to recover hepatitis A virus (HAV) from seeded drinking water. Cell culture-adapted HAV (strain HM-175) in seeded tapwater was efficiently adsorbed by both electronegative (Filterite) and electropositive (Virosorb 1MDS) filters at pH and ionic conditions previously used for other enteric viruses. Adsorbed HAV was efficiently eluted from these filters by beef extract eluents at pH 9.5. Eluted HAV was further concentrated efficiently by acid precipitation (organic flocculation) of eluents containing beef extract made from powdered, but not paste, sources. By using optimum adsorption conditions for each type of filter, HAV was concentrated >100 fold from samples of seeded tapwater, with about 50% recovery of the initial infectious virus added to the samples. The ability to recover and quantify HAV in contaminated drinking water with conventional microporous filter and organic flocculation methods should prove useful in further studies to determine the role of drinking water in HAV transmission. (Peters-PTT)
W86-04256

CONCENTRATION OF VIRUSES FROM WATER BY USING CELLULOSE FILTERS MODIFIED BY IN SITU PRECIPITATION OF FERRIC AND ALUMINUM HYDROXIDES,

Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
S. R. Farrah, and D. R. Preston.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1502-1504, December 1985. 3 tab, 16 Ref. EPA R810126-01-0.

Descriptors: *Viruses, *Water Analysis, *Microbiological Studies, *Filtration, Bacteriophage, Coxsackie Virus, Polio Virus, Adsorption, Elution, Enterovirus, Echovirus, Pathogens.

Untreated cellulose filters adsorbed only small amounts of poliovirus 1, echovirus 5, coxsackievirus B5, or bacteriophage MS2 that were added to tap water or to solutions of imidazole-glycine buffer at pH 5 to 7. Modification of filters by in situ flocculation of ferric and aluminum hydroxides greatly increased the ability of the filters to adsorb viruses. Viruses adsorbed to the modified filters could be recovered by treating the filters with 3% beef extract (pH 9.5). More than 60% of the enteroviruses and >55% of the MS2 added to tap water or buffer could be recovered in the beef extract eluate. These results indicate that in situ precipitation of metallic salts may permit the production of relatively simple and inexpensive filters for recovering viruses from water. (Peters-PTT)
W86-04258

DEVELOPMENT OF METHODS TO MEASURE VIRUS INACTIVATION IN FRESH WATERS,

James N. Gamble Inst. of Medical Research, Cincinnati, OH.
R. L. Ward, and P. E. Winston.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1144-1148, November 1985. 5 fig, 1 tab, 7 ref. EPA R811183.

Descriptors: *Enteroviruses, *Virus Inactivation, *Water Analysis, Natural Waters, Polio Virus, Antibiotics.

The study concerns the identification and correction of deficiencies in methods used to measure inactivation rates of entire viruses seeded into environmental waters. Viable microorganisms in an environmental water sample increased greatly after addition of small amounts of nutrients normally present in the unpurified seed virus preparation. This burst of microbial growth was not observed after seeding the water with purified virus. The use of radioactively labeled poliovirus revealed that high percentages of virus particles, sometimes >99%, were lost through adherence to containers, especially in less turbid waters. This effect was partially overcome by the use of polypropylene containers and by the absence of movement during incubation. Adherence to containers clearly demonstrated the need for labeled viruses to monitor losses in this type of study. Loss of viral infectivity in samples found to occur during freezing was avoided by addition of broth. Finally, microbial contamination of the cell cultures during infectivity assays was overcome by the use of gentamicin and increased concentrations of penicillin, streptomycin, and amphotericin B. (Author's abstract)
W86-04263

MODELING EXPOSURE ROUTES TO MAN OF TRACE METALS ASSOCIATED WITH ACID PRECIPITATION,

Monitoring and Assessment Research Centre, London (England).
For primary bibliographic entry see Field 5B.
W86-04266

INFLUENCE OF ACID RAIN UPON WATER PLUMBOSOLVENCY,

Glasgow Univ. (Scotland). Dept. of Medicine.
For primary bibliographic entry see Field 5C.
W86-04270

HEALTH RISKS FROM ACID RAIN: A CANADIAN PERSPECTIVE,

Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-04272

TRACE ANALYSIS OF THIOSULFATE IN CORRODED CONCRETE SEWERS BY DIFFERENTIAL-PULSE-ANODIC-STRIPPING VOLTAMMETRY,

Hamburg Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie.
For primary bibliographic entry see Field 5D.
W86-04284

STRONTIUM AND ITS ISOTOPES IN CANADIAN RIVERS: FLUXES AND GLOBAL IMPLICATIONS,

Ottawa Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-04348

ACUTE METAL TOXICOLOGY OF OLFACTION IN COHO SALMON: BEHAVIOR, RE-

CEPTORS, AND ODOR-METAL COMPLEXATION,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-04366

ANALYSE THE HYDROCARBONS IN LIQUID REFINERY WASTES,

Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
W. Kalbfus.
Hydrocarbon Processing IHPRBS, Vol. 65, No. 1, p 77-78, January 1986.

Descriptors: *Aliphatic hydrocarbons, *Effluent streams, *Oil refineries, *Oily water, *Aromatic hydrocarbons, Catalytic cracking facilities, Liquid process wastes, Oil pollution, Benzene, West Germany, Gravimetric method, Napthalene, Infrared spectroscopy.

Effluents from three West German oil refineries with catalytic cracking facilities were analyzed. In all three cases, samples were obtained downstream from the oil separator; they all consisted mainly of liquid process wastes and oil-polluted rainwater. Proportional contents of hydrocarbon groups were evaluated. The individual n-alkanes differed by a maximum factor of three, but there were widely differing concentration ratios among the aromatic hydrocarbon groups. The concentrations of benzene and benzene derivatives were more or less the same, with the absolute values differing by at most a factor of two, whereas in the case of naphthalene and its alkylated derivatives the differences ranged to multiples of 10-20 times. This concentration pattern continued or became even more marked in the case of the more highly condensed aromatics. These comparisons demonstrate how problematic it is to compare total hydrocarbon contents among refineries by the infrared or gravimetric methods. (Rochester-PTT)
W86-04388

METHODS FOR VALIDATION OF PRECIPITATION PH: APPLICATIONS TO TEXAS DATA,

Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
H. M. Liljestrand, J. D. Mohr, and M. A. Stafford.
Journal of Environmental Science and Health JESEDU, Vol. A21, No. 2, p 151-168, 1986. 2 fig, 3 tab, 38 ref. Texas Air Control Board IAC (84-85) - 1566.

Descriptors: *Statistical methods, *Acid rain, *Anions, *Cations, *Hydrogen ion concentration, *Texas, Charge balance, Acidity, Validation procedure, Data interpretation.

Methods for the validation of reported pH values were developed for incomplete precipitation chemistry data sets. The most stringent tests are based on a comparison between the net strong acidity calculated from the conservative inorganic cations and anions and that determined from the measured pH. The strong acidity of a sample in equilibrium with atmospheric carbon dioxide can be determined from an accurate pH measurement. Less severe tests are based on charge and conductivity balances. The proposed methods were applied to Texas precipitation chemistry data to identify unreliable measurements and to determine the spatial distribution of the mean pH for validated data. Reported mean pH values, especially those greater than pH5, are lower than can be validated. For data sets with a complete analysis of the major ionic species, the comparison of net acidities is generally a stronger quality assurance test for the validation of pH measurements than the charge balance. (Author's Abstract)
W86-04389

SPECIFIC CONDUCTANCE AS AN INDICATOR OF TOTAL DISSOLVED SOLIDS IN COLD, DILUTE WATERS,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2K.
W86-04394

NITRIFICATION, NITRATE REDUCTION, AND NITROGEN IMMOBILIZATION IN A TIDAL FRESHWATER MARSH SEDIMENT,

Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2K.
W86-04399

DETERMINATION OF ALKYLETHOXYLATED SULFATES IN WASTEWATERS AND SURFACE WATERS,

Procter and Gamble Co., Cincinnati, OH.
T. A. Neubecker.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1232-1236, December 1985. 3 fig, 4 tab, 6 ref.

Descriptors: *Pollutant identification, *Surfactants, *Gas chromatography, *Wastewater analysis, *Surface water, Anion exchange, Organic compounds, Water analysis, Separation techniques, Domestic wastes, Sulfates, Alkylethoxylated sulfates, Alkylethoxylate.

A novel method was developed for the determination of parts per billion levels of alkylethoxylated sulfates (AES) in wastewaters and surface waters. The analysis scheme involves concentration of the AES on an anion-exchange resin, elution of the resin with methanolic HCl, hydrolysis of the AES to alkylethoxylate (AE), extraction of the AE from the remaining ionic species, derivatization to the corresponding alkyl bromides, and analysis of the alkyl bromides by gas chromatography. Recovery of several AES homologues through this scheme ranges from 68 to 78% with an estimated sensitivity of approximately 1 ppb for each alkyl-chain homologue of AES. AES levels were measured in several wastewater and surface water samples by using this method and the nonspecific methylene blue active substance (MBAS) method. Results indicate that only about 10% of the total MBAS response arises from AES. (Author's abstract)
W86-04430

AROMATIC HYDROCARBONS IN NEW YORK BIGHT POLYCHAETES: ULTRAVIOLET FLUORESCENCE ANALYSES AND GAS CHROMATOGRAPHY/GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSES,

Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04432

QUANTITATIVE DETERMINATION OF PARTIALLY HYDROLYZED POLYACRYLAMIDE POLYMERS IN OIL FIELD PRODUCTION WATER,

Marathon Oil Co., Littleton, CO. Denver Research Center.
P. M. Beazley.
Analytical Chemistry, Vol. 57, No. 11, p 2098-2101, September 1985. 8 fig, 1 tab, 13 ref.

Descriptors: *Chemical analysis, *Hydrolyzation, *Polyacrylamide polymers, Oil recovery, Industrial wastewater, Chromatography, Elution, Wastewater analysis, Polymers.

Partially hydrolyzed polyacrylamide (PHPA) is commonly used for mobility control in surfactant-based enhanced oil recovery processes and for polymer augmented water floods. PHPA can be determined in a concentration range of 1 ppm to 100 ppm in dirty oil field water with a precision of + 1% and a lower limit of detection of 10 ppb. Solutions of high molecular weight PHPA are analyzed by high-performance size exclusion chromatography with 100 angstrom pore size, diol bonded phase silica columns eluted with a 0.1 M sodium perchlorate and 0.005 M pentanesulfonic acid paired ion reagent solution. Ultraviolet detection at a 190 nanometer wavelength is used for quantitation. Polymer solutions must be shear degraded to prevent column plugging. Analyses of water produced by both polymer and polymer plus sulfonate surfactant floods are illustrated. (Lantz-PTT)
W86-04435

DETERMINATION OF SUB-NANOGRAM-PER-LITER LEVELS OF MERCURY IN LAKE WATER WITH ATMOSPHERIC PRESSURE HELIUM MICROWAVE INDUCED PLASMA EMISSION SPECTROMETRY,

National Inst. for Environmental Studies, Tsukuba (Japan).
Y. Nojiri, A. Otsuki, and K. Fuwa.
Analytical Chemistry, Vol. 58, No. 3, p 544-547, March 1986. 3 fig, 1 tab, 29 ref.

Descriptors: *Mercury, *Chemical analysis, *Water analysis, *Lakes, Helium, Microwaves, Emission spectroscopy, Atmospheric pressure, Lake Mashu, Water pollution, Japan.

A highly sensitive method for the analysis of mercury (Hg) was developed utilizing atmospheric pressure helium (He) microwave induced plasma (He-MIP) emission spectrometry. Mercury vapor was generated from water samples by reduction and purging and was collected with a gold amalgamation trap. The Hg vapor, removed by heating the trap, was introduced into the He-MIP. The atomic emission line of 253.7 nanometers (nm) was used for the determination of Hg. The detection limit, defined as 3 times the standard deviation of the blank operations, was 0.5 pg in 50 mL of water sample, corresponding to 0.01 ng/L. The method was applied to the determination of ultratrace levels of Hg in lake water samples. An improvement of absolute detection limit of 1 order of magnitude, compared with previously reported work, was achieved by use of the amalgamation apparatus. The reasons for this improvement are: (1) Separation of the large amount of water mist from the Hg vapor by the amalgamator might enhance the Hg emission in the plasma; (2) Separation of dissolved concomitants and gases might reduce the spectral interference at the Hg emission line, where nitrogen-containing compounds, especially, give a NO band emission; (3) Sharpening of the peak might give a higher concentration of Hg in the plasma excitation source; and, (4) The removal of contaminating Hg in the reducing reagent might reduce the blank. Contamination from marketing reagents corresponded to about 100 pg without purification. The detection limit obtained in this study (0.5 pg) was of the same order as that of methylmercury(II)chloride by the gas chromatography-MIP system. MIP emission spectrometry may have the detection capability of this order with gas-phase Hg introduction. The inorganic Hg concentration in subsurface water from unpolluted Lake Mashu was found to be 0.3 ng/L. (Lantz-PTT)
W86-04436

AMMONIA AND UREA DETERMINATION IN WATER SAMPLES USING AMBERLITE XAD-7 TO CONCENTRATE INDOPHENOL,

Palma de Mallorca Univ. (Spain). Dept. of Biochemistry.
P. Moreno, E. Sanchez, A. Pons, and A. Palou.
Analytical Chemistry, Vol. 58, No. 3, p 585-587, March 1986. 5 fig, 1 tab, 16 ref.

Descriptors: *Ammonia, *Urea, *Indophenol, Resins, Amberlite, Saline water, Water pollution, Water analysis, Chemical analysis.

The indophenol method for ammonia estimation has been modified and adapted by several researchers, with the basic method being the treatment of water samples, in an alkaline medium, with sodium hypochlorite and phenol, in the presence of nitroprusside. The blue indophenol formed with ammonia is then measured colorimetrically. Since indophenol is not the only product of the reaction, the treatment of different types of samples can provide different suites of chromophores, creating interference in the measurement of ammonia. A modification of the indophenol method for the determination of ammonia and urea in the same sample, is described. Indophenol, formed proportionally to the amount of ammonia available, is selectively concentrated in a single purification-concentration step, using simple and recyclable columns of Amberlite XAD-7 resin, increasing the sensitivity of the method. Its application to seawater samples is described. The procedure is applicable to the anal-

ysis of large numbers of samples running simultaneously in routine studies, and eliminates possible artifacts that may alter the precision and sensitivity of the method. (Lantz-PTT)
W86-04437

SOLUTION OF HYDROCARBONS IN A HYDROCARBON-WATER SYSTEM WITH CHANGING PHASE COMPOSITION DUE TO EVAPORATION,

Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W86-04443

CHEMILUMINESCENCE VS. KJELDAHL DETERMINATION OF NITROGEN IN OIL SHALE RETORT WATERS AND ORGANONITROGEN COMPOUNDS,

California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, and C. G. Daughton.
Analytical Chemistry, Vol. 57, No. 12, p 2320-2325, October 1985. 1 fig, 3 tab, 28 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Chemiluminescence, *Kjeldahl procedure, *Nitrogen, *Oil wastes, *Organic compounds, Oil shale, Industrial wastewater, Chemical analysis, Water pollution control, Statistical analysis.

Pyrolysis of oil shale kerogen yields a petroleum-like crude oil and byproducts, including retorted (spent) shale, gases, and wastewaters. Most of the wastewater (retort water) is condensed with the product oil from which it is separated; the remaining water (gas condensate) is condensed from a gaseous stream. Although it is possible that this contamination could be minimized by limiting the oil/water contact time, the retort waters that have been available from pilot-scale facilities are highly contaminated with a complex spectrum of inorganic and organic solutes and suspended matter. The applicability of combustion/chemiluminescence nitrogen analysis to quantifying nitrogen in oil shale wastewaters and various representative chemical classes was demonstrated. Only azoxy compounds and those containing the pyrazole nucleus were not amenable to analysis. The majority of 56 compounds tested yielded from 90% to 110% of their theoretical nitrogen contents; enhanced recovery was found for nitrogen salts. For 12 oil shale wastewaters, combustion/chemiluminescence gave total nitrogen values (1100-28800 mg/L) that did not differ statistically ($P>0.10$) from those obtained by the time-consuming wet-chemical Kjeldahl method. The relative standard deviations for ten replicates of each wastewater were less than 3.5%. No matrix or solvent effects were found. (Lantz-PTT)
W86-04445

COMPARISON OF ULTRAVIOLET AND REDUCTIVE AMPEROMETRIC DETECTION FOR DETERMINATION OF ETHYL AND METHYL PARATHION IN GREEN VEGETABLES AND SURFACE WATER USING HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,

Middle Tennessee State Univ., Murfreesboro. Dept. of Chemistry and Physics.
g. J. Clark, R. R. Goodin, and J. W. Smiley.
Analytical Chemistry, Vol. 57, No. 12, p2223-2228, October 1985. 6 fig, 4 tab, 10 ref.

Descriptors: *Water analysis, *Ultraviolet radiation, *Electrochemistry, *Ethyl parathion, *Methyl parathion, *Vegetables, *Surface waters, High performance liquid chromatography, Pesticides, Sample preparation, Measuring instruments.

Ethyl and methyl parathion have been two popular organophosphorus pesticides applied to a variety of crops including green vegetables. A method was developed for the determination of ethyl and methyl parathion residues on vegetable materials and surface water samples using reverse-phase high-performance liquid chromatography with series UV-electrochemical detection. Techniques were developed for sample preparation, which avoided the usual preliminary column fractionations and which allowed the parathions to be recovered with an average of 95% recovery at concentrations less than 50 nanograms/g for the plant material. Relative standard deviations of about 5% were obtained using five different plant samples. Concentrations less than 10 ng/mL were readily measured in water samples using a column concentration procedure. The selectivity of electrochemical detection made it unnecessary to chromatographically resolve the plant components from the pesticides which were electrochemically active and allowed rapid analysis. Series detection proved useful in distinguishing various components in the samples from pesticides, in distinguishing various pesticides, and in comparing the operating characteristics of the two detectors. (Lantz-PTT)
W86-04446

ORGANIC NITROGEN DETERMINATION IN OIL SHALE RETORT WATERS,

California Univ., Berkeley. Sanitary Engineering Research Lab.
C. G. Daughton, B. M. Jones, and R. H. Sakaji.
Analytical Chemistry, Vol. 57, No. 12, p 2326-2333, October 1985. 2 fig, 3 tab, 32 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Organic compounds, *Nitrogen, *Oil shale, *Oil wastes, Organonitrogen compounds, Ammonia, Chemiluminescence, Chemical analysis, Chromatography, Dialysis, Kjeldahl procedure, Statistical analysis.

Organonitrogen compounds (ONCs) are a predominant class of organic solutes in oil shale process wastewaters. These waters also usually contain high concentrations of ammonia, often an order of magnitude greater than the organic N concentration. Two new approaches were used to separate ammonia from various fractions of organonitrogen compounds in oil shale wastewaters, thereby permitting the application of a rapid, but unselective method for total N determination (combustion/chemiluminescence) to the direct estimation of organic N. The first method uses reverse-phase chromatography to separate polar from nonpolar nitrogenous compounds, while the second uses nonosmotic dissolved-gas dialysis to separate volatile from nonvolatile nitrogenous solutes. For 12 oil shale retort waters, correlation of the resulting measures of organic N against organic Kjeldahl nitrogen values gave correlation coefficients for the nonpolar and nonvolatile nitrogen values of 0.920 and 0.996, respectively. Relative standard deviations averaged 3.9%. Combining the two methods yielded higher estimates of organic N; correlation coefficient of 0.989. Organic N concentrations for the waters measured by all four methods ranged from 15 to 5000 mg/L. These data showed, that on the average, at least one-half to three-fourths of the organic carbon was associated with nitrogen. (Lantz-PTT)
W86-04447

COMPARISON OF MICROCOLORIMETRIC AND MACROTITRIMETRIC METHODS FOR CHEMICAL OXYGEN DEMAND OF OIL SHALE WASTEWATERS,

California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, R. H. Sakaji, and C. G. Daughton.
Analytical Chemistry, Vol. 57, No. 12, p 2334-2337, October 1985. 2 fig, 1 tab, 17 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Microcolorimetry, *Macrotitrimetry, *Chemical oxygen demand, *Oil shale, Oil wastes, Industrial wastewater, Biological oxygen demand, Chemical analysis.

The chemical oxygen demand (COD) test was originally used as a rapid estimator of the biochemical oxygen demand (BOD) of wastewater organic material. The numerical value obtained from a COD test reflects both the organic carbon concentration and the overall oxidative state of the organic material. The COD of a sample is defined by the absolute amount of hexavalent chromium that is reduced during 2 h of digestion by potassium dichromate in a solution of 50% sulfuric acid. Modifications are described for both the microcolorimetric and macrotitrimetric COD procedures. For the former, a prolonged cooling period, followed by extensive mixing, minimizes the spectrophotometric interference from refractive index changes and catalyst-induced precipitate. For the latter, automated titration and absorbance monitoring near the chromate-chromic isosbestic point improves accuracy and reproducibility. The applicability of these modified methods for quantifying the COD of oil shale wastewaters was demonstrated. For 12 oil shale wastewaters, the microcolorimetric method gave COD values (900-150000 mg/L) that did not differ statistically ($P>0.10$) from those obtained by the macrotitrimetric COD method. The relative standard deviations for five replicates of each wastewater were less than 1.3% for the macrotitrimetric method and generally less than 5% for the microcolorimetric method; no matrix effects were evident. (Lantz-PTT)
W86-04448

INTERLABORATORY STUDY ON DETERMINATION OF POLYCHLORINATED BIPHENYLS IN ENVIRONMENTALLY CONTAMINATED SEDIMENTS,

Environmental Monitoring and Support Lab.-Cincinnati, OH.
A. L. Alford-Stevens, W. L. Budde, and T. A. Bellar.
Analytical Chemistry, Vol. 57, No. 13, p 2452-2457, November 1985. 5 tab, 6 ref.

Descriptors: *Polychlorinated biphenyls, *Water pollution, *Sediments, *Chemical analysis, Electron capture detectors, Mass spectrometry, Aroclor, Data analysis, Mathematical analysis, Measuring instruments.

Three samples of sediments environmentally contaminated with polychlorinated biphenyls (PCBs) were analyzed by ten different laboratories using uniform calibration standards and standardized procedures for sample extraction, extract preparation, and chromatography. Six laboratories identified and measured PCBs as commercial Aroclor mixtures with electron capture (EC) detectors, and four used mass spectrometer (MS) detectors. All three sediments contained a mixture of Aroclors 1242 and 1254 but at different concentrations, approximately 0.2, 3 and 50 mg/kg, respectively. Procedural variations were introduced in some laboratories, and large differences in results were reported by participating laboratories, despite written standardized procedures. For EC data, the overall relative standard deviation of measurements of total Aroclor concentrations was 30%; for MS data deviation was 38%. The relatively complex calculations required to obtain Aroclor concentrations were an important source of data variability as well as being tedious and labor-intensive. (Lantz-PTT)
W86-04449

MASS SPECTROMETRIC DETERMINATION OF POLYCHLORINATED BIPHENYLS AS ISOMER GROUPS,

Battelle Columbus Div., OH.
J. E. Gebhart, T. L. Hayes, A. L. Alford-Stevens, and W. L. Budde.
Analytical Chemistry, Vol. 57, No. 13, p 2458-2463, November 1985. 1 fig, 8 tab, 4 ref.

Descriptors: *Mass spectrophotometry, *Polychlorinated biphenyls, *Isomers, Measuring instruments, Chemical analysis, Data interpretation, Chlorination, Aroclor, Gas chromatography, Computers.

A procedure to measure concentrations of polychlorinated biphenyls (PCBs) by using nine selected PCB congeners as concentration calibration standards was developed and applied to well-characterized samples. With this procedure, PCBs were not identified and measured as Aroclors. Instead, a gas chromatograph equipped with a capillary column and interfaced to a computerized mass spectrometer (MS) was used to detect and identify PCBs by level of chlorination. Concentrations were measured for each isomer group and for total

PCBs present. For concentration calibration, one PCB isomer represented all isomers at each level of chlorination, except that decachlorobiphenyl represented isomers containing nine and ten chlorines. One internal standard, chrysene-d sub 12, was used to calibrate MS response. Data interpretation is a practical limitation to implementation of the approach to PCB determinations described in this paper. The approach depends on the use of capillary columns to separate as many of the PCB congeners as possible. Therefore, numerous mass spectra must be inspected to assign each detected PCB to a level of chlorination. Extensive computations are required to obtain quantitative measurements. To improve the cost effectiveness of this approach, automated interpretation and computation are needed. The nature of mass spectral data and the dedicated minicomputer interfaced with contemporary GC/MS systems make automation entirely feasible, but specialized software is needed. (Lantz-PTT)
W86-04450

PERFORMANCE TESTS FOR THE MEASUREMENT OF PH WITH GLASS ELECTRODES IN LOW IONIC STRENGTH SOLUTIONS INCLUDING NATURAL WATERS,

Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 7B.
W86-04451

CHARACTERIZATION OF DYES IN ENVIRONMENTAL SAMPLES BY THERMOSPRAY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY,

Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
R. D. Voyksner.
Analytical Chemistry, Vol. 57, No. 13, p 2600-2605, November 1985. 7 fig, 5 tab, 25 ref. EPA Contract 68-03-3122.

Descriptors: *Dyes, *Environmental tracers, *Mass spectrometry, *Chromatography, Water quality control, Thermospray, Anthraquinone, Groundwater pollution, Wastewater, Gasoline, Dye tracers, Diazo dyes, Azo dyes, Anthraquinone dyes.

Dyes play a significant role in products consumed in the United States. They are used in products such as textiles, paper, leather, and foodstuffs. Also, dyes are required by law to be in leaded gasoline to indicate the presence of lead. In addition, unleaded gasoline can contain dyes to identify gasoline manufacturers and to trace a seepage into soil or groundwater. The use of thermospray HPLC/MS to characterize azo, diazo, and anthraquinone dyes in wastewater and gasoline is demonstrated. Thermospray analysis of these dyes primarily produced (M + H)(+) ions with few fragments. 'Filament on' operation of the interface aided in the production of fragment ions for the azo dyes analyzed. The commercial diazo and anthraquinone dyes analyzed by HPLC/MS proved to be very complex mixtures of nearly 40 alkyl-substituted dye components, making monitoring and identification of a particular dyestuff very difficult. Thermospray HPLC/MS methods are demonstrated to detect dyes down to 10 ppt (parts per trillion) in wastewater, 100 ppb in soil, and 1 ppm in gasoline. The 'filament on' operation of the thermospray interface provided additional fragment ions, aiding the structural elucidation of these dyes. (Lantz-PTT)
W86-04452

DETERMINATION OF ATRAZINE, LINDANE, PENTACHLOROPHENOL, AND DIAZINON IN WATER AND SOIL BY ISOTOPE DILUTION GAS CHROMATOGRAPHY/MASS SPECTROMETRY,

Acurex Corp., Mountain View, CA. Energy and Environmental Div.
V. Lopez-Avila, P. Hirata, S. Kraska, M.
Flanagan, and J. H. Taylor, Jr.
Analytical Chemistry ANCHAM, Vol 57, No. 14, p 2797-2801, December 1985. 2 fig, 4 tab, 8 ref. EPA Contract No. 68-03-3100 and 68-03-3226.

Descriptors: *Atrazine, *Lindane, *Pentachlorophenol, *Diazinon, *Chemical analysis, Gas chromatography, Mass spectrometry, Water pollution, Pesticides, Soil chemistry, Soil analysis, Water analysis.

Described is an isotope dilution GC/MS technique for the analysis of low-parts-per-billion concentrations of atrazine, lindane, pentachlorophenol, and diazinon in water and soil. Known amounts of stable-labeled isotopes such as atrazine-d sub 5, lindane-d sub 6, and diazinon-d sub 10 are spiked into each sample prior to extraction. Water samples are extracted with methylene chloride, while soil samples are extracted with acetone/hexane. Analysis is performed by high-resolution GC/MS with the mass spectrometer operated in the selected ion monitoring mode. Accuracy greater than 86% and precision better than 8% were demonstrated by the use of spike samples. This technique has been used successfully in the analysis of over 300 water and 300 soil samples. Detection limits of 0.1-1.0 ppb were achieved for the test compounds by selected ion monitoring GC/MS. (Lantz-PTT)
W86-04455

CONCENTRATION OF TRACE ELEMENTS IN WATER SAMPLES BY REDUCTIVE PRECIPITATION,

Colorado State Univ., Fort Collins. Dept. of Chemistry.
R. K. Skogerboe, W. A. Hanagan, and H. E.
Taylor.
Analytical Chemistry ANCHAM, Vol. 57, No. 14, p 2815-2815, December 1985. 1 fig, 4 tab, 25 ref.

Descriptors: *Trace elements, *Water sampling, *Reductive precipitation, Chemical analysis, Preconcentration, Borohydride, Precipitation, Cobalt, Nickel, Copper, Iron, Manganese.

The use of borohydride reduction as a means of preconcentrating elements by precipitation as the element or as a boride has been explored. Elements that can be precipitated by this mechanism include Co, Cu, Fe, Mn, and Ni. Only four of these exhibited recoveries less than 90%. Preconcentration by reductive precipitation offers several potential advantages including (1) broad applicability to 23 elements, including 12 of the 13 on the U.S. Environmental Protection Agency priority pollutant list; (2) exclusion of the major and minor elements, such as Ca, Mg, Na, and K, and the analytical interferences associated with them; (3) the possibility of doing direct analyses on the precipitate, followed by dissolution for solution analyses; (4) the high reduction potential of borohydride (E(o) = 1.24V) means that competitive metal complexation should not be significant and interfere with preconcentration; (5) the preparation of the borohydride reagent solution should result in the removal of contaminants by reductive precipitation, so the reagent is self-cleaning; and (6) high preconcentration factors should be easily attainable. (Lantz-PTT)
W86-04456

DETERMINATION OF TRACE ELEMENTS IN RAINWATER BY TOTAL-REFLECTION X-RAY FLUORESCENCE,

GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik.
R. -P. Stoessel, and A. Prange.
Analytical Chemistry ANCHAM, Vol. 57, No. 14, p 2880-2885, December 1985. 4 fig, 3 tab, 17 ref.

Descriptors: *Rain, *Atmospheric deposition, *Water pollution sources, *Trace elements, *Chemical analysis, *Total-reflection X-ray fluorescence, Chemistry of precipitation, Freeze drying, Chromatography, Island of Pellworm, West Germany.

Three quasi-independent analytical procedures for the determination of trace elements in rainwater are presented, which are based on total-reflection X-ray fluorescence (TXRF), a special variant of energy-dispersive X-ray fluorescence. The sample preparation techniques compared are (1) direct analysis, (2) preenrichment of the trace elements in rainwater by freeze-drying and redissolution in dilute nitric acid, and (3) a matrix removal and preconcentration procedure by metal chelation, chromatographic adsorption of the metal complexes, and subsequent elution of the metal chelates prior to TXRF measurement. The elements determined are S, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Pb, Se, Rb, Sr, Mo, Cd, and Ba. For a measuring time of 1000 sec, detection limits down to 5-20 nanograms/L were achieved for the heavy-metal traces. The limits are slightly higher for iron, nickel, copper, zinc, and lead because of fluctuations in the blank values. The procedures were tested on rainwater samples from the Island of Pellworm (German bight) containing comparatively low trace-metal contents. Systematic investigations for the characterization of the analytical procedures with regard to blanks, detection limits, precision, and accuracy are described and discussed. The accuracy was checked by independent analyses of duplicate samples using differential pulse anodic stripping voltammetry. (Lantz-PTT)
W86-04457

DETERMINATION OF SELENIUM SPECIATION IN BIOGENIC PARTICLES AND SEDIMENTS,

Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. A. Cutter.
Analytical Chemistry ANCHAM, Vol. 57, No. 14, p 2951-2955, December 1985. 1 fig, 3 tab, 22 ref. EPRI Grant RP 2020-1.

Descriptors: *Selenium, *Path of pollutants, *Speciation, *Sediments, *Biogenic particles, Natural waters, Plankton, Quantitative analysis, Chemical analysis, Nitric acid, Perchloric acid, Sodium hydroxide.

Selenium can exist in a variety of chemical forms in the suspended particles and bottom sediments of natural waters. Described here is a method that can quantitatively reveal the chemical speciation of selenium in particulate materials such as plankton, planktonic detritus, and sediments. This procedure uses a multistep nitric/perchloric acids digestion to solubilize total selenium and a weak sodium hydroxide treatment to release selenite and selenate. The solubilized selenium species are determined by a selective hydride generation/atomic absorption technique. Accuracy was verified by using a combination of standard reference materials, radiotracers, and existing sediment leach methods. For field and reference samples the average precision (relative standard deviation) for total selenium determinations is 8.8% (n = 8 samples) and 19.3% for selenite + selenate determinations (n = 6 samples). The detection limit for total particulate selenium is 10 nanograms/g using a sample size of 0.2 g. The method has been used on a variety of plankton, planktonic detritus, and sediment samples. (Lantz-PTT)
W86-04458

SPECIATION OF LEAD AND METHYLLEAD IONS IN WATER BY CHROMATOGRAPHY/ATOMIC ABSORPTION SPECTROMETRY AFTER ETHYLATION WITH SODIUM TETRAETHYLBORATE,

New Hampshire Univ., Durham. Dept. of Chemistry.
S. Rapsomanikis, O. F. X. Donard, and J. H.
Weber.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 35-38, January 1986. 3 fig, 1 tab, 24 ref. NSF Grant CEE 81-16960.

Descriptors: *Lead, *Water analysis, *Speciation, *Chromatography, *Atomic absorption spectroscopy, Methyllead, Chemical analysis, Sodium tetraethylborate, Algorithms, Mathematical analysis.

A novel method for speciation and determination of Me3Pb(+) and Me2Pb(2+) in water, is described. The procedure includes in situ ethylation by sodium tetraethylborate (NaBEt4) in water, purging and trapping of alkyllead molecules, and thermal desorption in an electrically heated quartz atomic absorption (AAS) furnace. The absolute

detection limits of Pb for 50 cu cm are approximately 8.7 pg for Me3Pb(+) (0.18 pg/cu cm) and approximately 10.5 pg for Me2Pb(2+) (0.21 pg/cu cm). Major advantages for the technique are avoidance of solvent extraction and sample transfers because ethylation to Me3EtPb and Me2Et2Pb takes place in a closed system. Reaction conditions and apparatus operating parameters were optimized by a Simplex algorithm. (Lantz-PTT)
W86-04459

DETERMINATION OF THE CARBAMATE HERBICIDE PROPHAM BY SYNCHRONOUS DERIVATIVE SPECTROFLUOROMETRY FOLLOWING FLUORESCAMINE FLUOROGENIC LABELING,

Malaga Univ. (Spain). Dept. of Analytical Chemistry.
F. G. Sanchez, and C. C. Blanco.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 73-76, January 1986. 1 fig, 3 tab, 14 ref.

Descriptors: *Herbicides, *Propham, *Isopropyl phenylcarbonate, *Fluorescence, *Spectrofluorometry, Fluorogenic labeling, Chemical analysis, Water analysis, Well water, Mathematical analysis, Pesticides.

Three methods for the determination of propham by fluorogenic labeling with fluorescamine and synchronous derivative spectrofluorometry are described and discussed. The herbicide is hydrolyzed in 1 M NaOH at 100 C for 40 min, and the liberated aniline reacts instantaneously with fluorescamine in an aqueous buffer solution (pH 4.0). Reaction rates, fluorescence phenomena, and synchronous derivative parameters are investigated. To enhance sensitivity, the analysis of the fluorescamine derivative is used following extraction in ethyl acetate. Linear analytical curves are obtained between 24 and 2000 nanograms/mL. The minimum detectable quantity is estimated to be 7.2 nanograms/mL. Well water samples containing low concentrations of carbamate are also analyzed. The method is simple, rapid, and reproducible. Combination of the fluorogenic labeling with the sensitivity of the synchronous derivative technique, enhanced by the organic solvent extraction, gives analytical results comparable to those obtained by thin-layer chromatography. It is a convenient and simple means of analysis of pesticide residues when sophisticated and expensive instrumentation is not available. (Lantz-PTT)
W86-04460

EXTRACTION OF ARSENIC (III) AND ARSENIC (V) FROM NATURAL WATERS FOR NEUTRON ACTIVATION ANALYSIS,

Idaho Univ., Moscow. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-04461

REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITROORGANICS IN MUNITIONS WASTEWATER,

Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, C. L. Grant, and C. F. Bauer.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 170-175, January 1986. 4 fig, 4 tab, 32 ref.

Descriptors: *Munitions wastewater, *Chromatography, *Nitroorganic compounds, TNT, RDX, HMX, 2,4-DNT, Industrial wastewater, Methanol, Acetonitrile, High performance liquid chromatography, Chemical analysis, Statistical analysis.

Concentrations of HMX, RDX, TNT, and 2,4-DNT are determined in munitions wastewater. Aqueous samples are diluted with an equal volume of 76/24 (v/v) methanol-acetonitrile, filtered through a 0.4 micrometer polycarbonate membrane, and analyzed by reversed-phase HPLC using an LC-8 column with 50/38/12 (v/v/v) water-methanol-acetonitrile. The method provided linear calibration curves to at least several hundred micrograms/l. Detection limits were conservatively estimated to be 26, 22, 14, and 10 micrograms/l for HMX, RDX, TNT, and 2,4-DNT, respectively, with corresponding standard deviations of + 3.4, 3.3, 4.4, and 4.6 micrograms/l up to concentrations of 250 micrograms/l. At higher concentrations, the percent relative standard deviation values were approximately + 2% for HMX and RDX and + 4% for TNT and DNT. A ruggedness test involving the major manipulative steps in the procedure, was tested with munition wastewater from several Army ammunition plants and found to perform adequately for load and pack wastewaters, wastewater from HMX/RDX manufacture, and contaminated groundwater. (Lantz-PTT)
W86-04462

INTERLABORATORY EVALUATION OF HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITROORGANICS IN MUNITION PLANT WASTEWATER,

New Hampshire Univ., Durham. Dept. of Chemistry.
C. F. Bauer, C. L. Grant, and T. F. Jenkins.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 176-182, January 1986. 6 fig, 6 tab, 11 ref.

Descriptors: *Nitroorganic compounds, *Munitions wastewater, *Chromatography, DNT, TNT, RDX, HMX, Industrial wastewater, High performance liquid chromatography, Chemical analysis, Statistical analysis.

A reversed-phase HPLC method for the determination of nitroorganic compounds (DNT, TNT, RDX, HMX) in munitions wastewaters was evaluated in a collaborative study. Nine laboratories analyzed four aqueous matrices, including groundwater and treated wastewater, which were spiked with the analytes at levels from 30 to 600 micrograms/l. Recoveries of analytes were similar regardless of matrix: DNT and RDX being recovered quantitatively, and TNT and HMX showing losses of about 5%. Intralaboratory precisions, based on the average of duplicate determinations, were less than 15 micrograms/l, which corresponds to 9% relative standard deviation at the average concentration examined. Interlaboratory precisions were at most 50% larger than intralaboratory values. Valid statistical analysis required rejection of about 10% of the data set as outliers. (Lantz-PTT)
W86-04463

EFFECTS OF FLOW RATE AND PRETREATMENT ON THE EXTRACTION OF TRACE METALS FROM ESTUARINE AND COASTAL SEAWATER BY CHELEX-100,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. J. Paulson.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 183-187, January 1986. 1 fig, 2 tab, 21 ref.

Descriptors: *Trace metals, *Flow rates, *Coastal estuaries, *Estuaries, *Chelex-100, Saline water, Temperature effects, Ultraviolet oxidation, Iron.

During the extraction of previously acidified estuarine samples, altered organic material still retains some capacity to inhibit the extraction of trace metals by Chelex-100. Previous studies have indicated that heating or UV oxidation of samples reduces the capacity of this organic matter to inhibit the extraction of trace metals by Chelex-100. The results of this study using recently collected samples indicate that decreasing the flow rate to 0.2 microliters/min is another effective means of increasing the retention of trace metals by Chelex-100. Additional benefits of the slow-flow column extraction method include improvements in precision and the elimination of pretreatment procedures that could cause contamination or reduce the extractability of Fe. Aged acidified samples require heating of the sample prior to extraction. Controlled contamination can be minimized for most metals by preextraction of the buffer solution. (Lantz-PTT)
W86-04464

ATMOSPHERIC ENVIRONMENT SERVICE LONG RANGE TRANSPORT OF AIR POLLUTANT ACTIVITIES IN THE TERRITORIES,

Atmospheric Environment Service, Edmonton (Alberta).
R. B. Thomson.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 109-115, 1986. 2 fig, 5 tab, 15 ref.

Descriptors: *Distribution patterns, *Acid rain, *Air pollution, *Networks, Sulfur, Spatial distribution, Temporal distribution, Sample preparation, Sampling, Canadian, Network for Sampling Precipitation, Northwest Territories Precipitation Chemistry Network, Data collections.

Measurements of chemical constituents in precipitation in the Northwest Territories and Yukon have been made on a regular basis since 1974 as part of Environment Canada's Background Air Pollution Monitoring Network which expanded in 1976 to become the Canadian Network for Sampling Precipitation (CANSAP). In 1984, the Northwest Territories Precipitation Chemistry Network (NWTPCN) was established jointly by the Pollution Control Division, Department of Renewable Resources, Government of the Northwest Territories (GNWT) and Atmospheric Environment Service (A.E.S.), Environment Canada. This report discusses the precipitation chemistry data collected from CANSAP sites in the Territories as well as the results of two modelling studies. Details of the new Canadian Air and Precipitation Monitoring Network (CAPMoN) and NWTPCN are presented. The values of sulfur deposition obtained from the CANSAP network and those calculated from model output indicate levels are near background. However, good quality precipitation chemistry samples were difficult to collect, and at this time modeling results are limited. Sampling of precipitation chemistry must continue in concert with other methods to provide a comprehensive data bank for further studies. Field programs and sampling networks must be established to enhance both the temporal and spatial information related to long range transport of air pollution. Once such a database is available, atmospheric models can be tested, validated and then used to describe future scenarios to insure adequate environmental guidelines are in place to protect sensitive areas while development proceeds. (Lantz-PTT)
W86-04483

AIRBORNE MERCURY IN PRECIPITATION IN THE LAKE SUPERIOR REGION,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W86-04525

RELATIONSHIPS BETWEEN CHLORINATED HYDROCARBON CONCENTRATIONS AND REARING MORTALITY OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EGGS FROM LAKE MICHIGAN,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-04528

OPTIMIZATION OF THE ICP WORKING CONDITIONS FOR THE ANALYSIS OF WASTE WATERS AND INDUSTRIAL SOLUTIONS,

Institute 'Niproruda', Sofia (Bulgaria).
A. Delijska, and Z. Zadgorska.
Fresenius Zeitschrift fur Analytische Chemie ZACFAU, Vol. 322, p 413-418, 1985. 8 fig, 4 tab, 21 ref.

Descriptors: *Inductively coupled plasma atomic emission spectroscopy, *Spectroscopy, *Metals, *Sulfuric acid, *Salt, Aluminum, Calcium, Cadmium, Copper, Iron, Magnesium, Manganese, Nickel, Lead, Zinc, Chemical analysis.

In order to optimize the working parameters of inductively coupled plasma (ICP) analysis of waste waters and industrial solutions the spectral influences, optimization of aerosol gas flow, and nebuli-

zation and transport effects were examined. Special attention was paid to the influence of high contents of salt and H2SO4 in some samples. The use of a peristaltic pump, dilution or internal standardization permit reliable analytical results to be obtained. A direct ICP method for determination of Al, Ca, Cd, Cu, Fe, Mg, Mn, Ni, Pb, and Zn was developed. The reliability of the method was proved by comparative analysis of routine samples by atomic absorption spectrometry. The relative standard deviation of the proposed method is in the range of s sub r = 0.5-5%, depending on the analyzed element and its concentration. (Rochester-PTT)
W86-04548

SURVEY OF LEGIONELLA PNEUMOPHILA IN WATER IN 12 CANADIAN CITIES,

Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. S. Tobin, P. Ewan, K. Walsh, and B. Dutka.
Water Research WATRAG, Vol. 20, No. 4, p 495-501, April 1986. 3 tab, 47 ref.

Descriptors: *Legionella pneumophila, *Canada, *Surveys, *Potable water, Drinking water, Municipal water, Cooling water, Legionnaire's Disease, Temperature effects, Chlorine, Microbiological studies.

A survey of 12 cities across Canada was conducted in order to determine the prevalence of Legionella species in potable water and cooling tower within buildings. Legionellae were detected in 11.9% of the samples overall: 6.7% from potable water sources and 28.9% from cooling tower water. The maximum concentration of the organism was 45,000/l in one shower-water sample by culture methods. A significant difference in the isolation rate of Legionella pneumophila among cities was observed. The organism was isolated from waters at a temperature of 15-41 C and was most frequently isolated in the 20.29 C range. The concentration of free and total available chlorine in the water was not associated with legionellae recovery except that the organisms were never recovered when the free available chlorine residual exceeded 7.5 mg/l. Although L. pneumophila were low concentrations or absent in most samples, the isolated organisms were usually serogroups 1 or 6, the same serogroups that are most often implicated in legionellosis cases in Canada. (Author's abstract)
W86-04581

DEVICE FOR THE CONTINUOUS MEASUREMENT OF ALGAL PHOTOSYNTHETIC RESPONSE TO LIGHT,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5C.
W86-04583

STATISTICS OF ENUMERATING TOTAL COLIFORMS IN WATER SAMPLES BY MEMBRANE FILTER PROCEDURES,

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and B. Heller.
Water Research WATRAG, Vol. 20, No. 4, p 525-530, April 1986. 5 tab, 19 ref.

Descriptors: *Statistical analysis, *Coliforms, *Potable water, *Membrane filters, Poisson ratio, Fisher's index, Binomial distribution, Water analysis.

A commonly use assumption is that the microbial counts of a given water sample are randomly distributed according to Poisson statistics and, in particular, that replicate analyses of the same sample are so distributed. Using Fisher's index of dispersion, as well as a newly developed test, analysis of prior data on membrane filter total coliform organisms in a variety of water samples indicated that, in many cases, the assumption of Poisson statistics was incorrect, but that the data were consistent with a negative binomial distribution. This finding has significance in the interpretation of total coliform counts for regulatory as well as research purposes, and further research to delineate the responsible mechanisms is required. (Lantz-PTT)
W86-04585

DETERMINATION OF NICKEL AND COBALT IN NATURAL WATERS AND BIOLOGICAL MATERIAL BY REDUCTIVE CHRONOPOTENTIOMETRIC STRIPPING ANALYSIS IN A FLOW SYSTEM WITHOUT SAMPLE DEOXYGENATION,

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
H. Eskilsson, C. Haraldsson, and D. Jagner.
Analytica Chimica Acta ACACAM, Vol. 175, p 78-88, September 1985. 5 fig, 3 tab, 10 ref.

Descriptors: *Cobalt, *Nickel, *Trace metals, *Pollutant identification, *Potentiometers, Water analysis, Seawater, Natural waters, Heavy metals, Electrochemistry, Drinking water, Estuaries, Seawater.

The determination of trace concentrations of Ni and Co by electroanalytical stripping is described. Solutions containing Ni and Co are sucked into the thin-layer cell by a microprocessor-controlled pump. Co and Ni are potentiostatically adsorbed onto a mercury film plated onto the carbon electrode. The metals are reduced from their dimethylglyoxime complexes by a medium of calcium chloride. the microprocessor recourds the potential vs. time behavior of the working electrode. The mercury film is removed by mild oxidation in an iodine/iodide solution and the glassy carbon surface is cleaned with ethanol and sodium hydroxide prior to the next analysis. The Co and Ni concentrations are evaluated by means of a standard addition procedure. The method was applied to drinking, estuarine and sea water samples. The detection limits on the one sigma level after one min of potentiostatic adsorption were 9 and 11 nanograms/liter for Ni and Co, respectively. Ni and Co were determined in reference samples of bovine liver and seawater sediments after acid digestion. In order to obtain correct Co values, it is necessary to reduce Co(III) species formed during acid digestion with sodium tetrahydroborate. (Geiger-PTT)
W86-04591

CHARACTERIZATION OF SUBSURFACE BACTERIA ASSOCIATED WITH TWO SHALLOW AQUIFERS IN OKLAHOMA,

Florida State Univ., Tallahassee. Dept. of Biological Science.
D. L. Balkwill, and W. G. Ghiorse.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 580-588, September 1985. 6 fig, 5 tab, 17 ref. EPA Cooperative Agreement No. CR811148.

Descriptors: *Shallow aquifers, *Subsurface bacteria, *Oklahoma, Microscopic analysis, Light microscopy, Electron microscopy, Growth media, Aerobic bacteria, Anaerobic bacteria.

The bacterial microflora of two shallow aquifers (saturated subsurface zones) in Oklahoma was characterized by direct observation with light and electron microscopy, by plating, and by examination of colony morphology and distribution. Isolated bacterial strains were also examined. Total cell counts varied only slightly from sample to sample, whereas colony counts varied widely. Colony counts on nutritionally rich media were lower than on low-nutrient media, especially in samples from the saturated zone. The variety of colony types growing on nutritionally rich media decreased with increasing depth and saturation. Colony counts of anaerobic bacteria also decreased with depth but were at least 100-fold lower than aerobic counts on most media. Cell morphologies of bacteria grown aerobically on plates included short rods, cocci, and actinomycete-like forms. Direct light microscopic observation of sediments revealed short, rod-shaped, and coccoid bacterial cells; endospores, actinomycete spores, and eucaryotic forms were note observed by light microscopy. Electron microscopic observation of bacteria released from the samples revealed that 85 to 90% of them were coccoid, gram-positive, Arthrobacter-like organisms, some of which were dividing or contained completed division septa; other types of gram-positive and gram-negative bacteria were present in lower numbers. Isolated bacterial strains were able to grow on both nutritionally rich and low-nutrient media. Results suggest that these two shallow aquifers are dominated by aerobic, nutritionally versatile bacteria that can subsist on low concentrations of organic compounds without forming specialized resting cells. (Lantz-PTT)
W86-04664

COMPARISON OF GAUZE SWABS AND MEMBRANE FILTERS FOR ISOLATION OF CAMPYLOBACTER SPP. FROM SURFACE WATER,

Nutrition Inst., Cairo (Egypt).
M. R. el- Sherbeeny, C. Bopp, J. G. Wells, and G. K. Morris.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 611-614, September 1985. 4 tab, 18 ref.

Descriptors: *Gauze swabs, *Membrane filters, *Campylobacter jejuni, *Surface water, Filtration, Seawater, Estuaries, Freshwater, Atlanta, Georgia, Streams.

The epidemiology of Campylobacter jejuni indicates that waterborne transmission is important; the organism has been isolated from seawater, fresh water, and estuarine sites. Membrane filtration, with and without use of an enrichment broth, has been the most common method for isolating C. jejuni from water. Evaluated were two methods for isolating C. jejuni from water: membrane filtration and gauze filtration. The membrane filters evaluated included 0.22- and 0.45 micrometer-pore Millipore filters, 0.2- and 0.4 micrometer-pore Nuclepore filters, and a 0.45-micrometer pore Zetapor filter. The gauze filters included both Moore and Spira swabs. Of the membrane filters evaluated, the 0.45-micrometer-pore Millipore and Zetapor filters were the most sensitive for recovery of C. jejuni from seeded waters. The 0.45-micrometer-pore Millipore filter placed in Oosterom broth was better for recovery of C. jejuni from seeded stationary surface waters than either the Spira or Moore swab. However, use of the Spira swab has the advantage of inexpensive equipment (gauze and plastic jars), but membrane filtration is probably a more sensitive technique, especially when only small volumes of water are available. Moreover, membrane filtration does not require the use of an enrichment broth since the filter can be placed directly on a selective agar plate. Membrane filtration may be more adaptable to quantitative studies of Campylobacter spp. in water that were not done in these studies. The Moore swab was not evaluated in streams; however, its use does present logistical problems in stream sampling that make in undesirable. One must make a return trip to pick it up, and it is subject to vandalism. C. jejuni is a common contaminant of Atlanta area creeks: this study resulted in isolations from 5 of 12 (41%) streams sampled. From four of the five streams, C. jejuni was isolated on two occasions (1 to 3 weeks apart). (Lantz-PTT)
W86-04666

BACTERIAL BIOMASS, METABOLIC STATE, AND ACTIVITY IN STREAM SEDIMENTS: RELATION TO ENVIRONMENTAL VARIABLES AND MULTIPLE ASSAY COMPARISONS,

Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
T. L. Bott, and L. A. Kaplan.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 508-522, August 1985. 2 fig, 13 tab, 69 ref. NSF Grant No. DEB-7921963.

Descriptors: *Biomass, *Bacteria, *Metabolism, *Stream sediments, Biochemical tests, Streams, Adenosine triphosphate, Epifluorescent microscopy, Respiration, Biosynthesis, Dissolved organic matter.

Bacterial biomass, metabolic condition, and activity were measured over a 16-month period in the surface sediments of the following four field sites with differing dissolved organic matter regimes: a woodlot spring seep, a meadow spring seep, a

second-order stream, and a third-order stream. Total bacterial biomass was measured by lipid phosphate and epifluorescence microscopic counts (EMC), and viable biomass was measured by 14-C most probable number, EMC with 2-(p-iodophenyl)-3-(p-nitrophenyl) -5-phenyl tetrazolium chloride reduction, and ATP. Bacterial metabolic condition was determined from the percentage of respiring cells, poly-beta-hydroxybutyrate concentrations, and adenylate energy charge. Activity measures included 14-C-lipid respiration, from which biosynthesis was calculated. Total bacterial biomass (from EMC) ranged from 0.012 to 0.354 micrograms of C/mg of dry sediment, and was usually lowest in the third-order stream. The percentage of cells respiring was less than 25% at all sites, indicating that most bacteria were dormant or dead. Adenylate energy charge was measured only in the third-order stream and was uniformly low. Poly-beta-hydroxybutyrate concentrations were greater in the woodlot spring seep than in the second- and third-order streams. Uptake of algal lysate dissolved organic carbon ranged from undetectable levels to 166 mg of C/sq m/hr. Little community respiration could be attributed to algal lysate metabolism. Phospholipid synthesis ranged from 0.006 to 0.354 pmol/mg of dry sediment/hr. Phospholipid synthesis rates were used to estimate bacterial turnover at the study sites. An estimated 375 bacterial generations/yr, were produced in the woodlot spring seep, and 67/yr were produced in the third-order stream. (Lantz-PTT)
W86-04677

APPLICATIONS OF FLUORESCENT DYE TRACERS IN THE PLANNING AND HYDROLOGICAL APPRAISAL OF SANITARY LANDFILLS,

Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5G.
W86-04679

5B. Sources Of Pollution

ISOTOPE TECHNIQUES IN THE HYDROGEOLOGICAL ASSESSMENT OF POTENTIAL SITES FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES.

International Atomic Energy Agency, Vienna (Austria).
Technical Reports Series No. 228, 1983. 151 p, 23 fig, 11 tab, 118 ref, 1 append.

Descriptors: *Groundwater movement, *Geochemistry, *Isotope studies, Radioactive waste disposal, Geohydrology, Waste disposal, Fate of pollutants, Tracers, Isotopic tracers, Aquifers, Deuterium, Tritium, Oxygen isotopes, Radioisotopes, Carbon radioisotopes, Uranium radioisotopes.

Natural nuclides, stable and radioactive, can be used to study the movement of water in low-permeability rocks being considered as radioactive waste repositories. The short-lived isotopes (tritium) are useful in assessing if a potential site has had recent contact with surface waters. The longer-lived nuclides (C14) and stable nuclides (018 and deuterium) can give information on the slow overall movement of the water in the bedrock. In addition, these nuclides can reveal data on rock porosity and sorption sites and on exchange of isotopes with the rock. The flow pattern in the bedrock is complex. Therefore, no single technique can produce a detailed understanding of all the processes which have led to the composition of the water sample and which have bearing on a final repository. Combined use of isotope techniques has contributed greatly to the understanding of groundwater systems. One particularly important aspect of water movement in a repository site is the presence of a fast pathway among otherwise very slow pathways. Two aspects which should be further studied are (1) diffusional exchange of species between slowly moving or stagnant water in the rock and faster moving water in the flow paths and (2) the rate of exchange in the real environment between those isotopes which are exchanged with the rock-forming minerals. (Cassar - PTT)
W86-03905

DISPERSION AND SELF-PURIFICATION OF POLLUTANTS IN SURFACE WATER SYSTEMS.

United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
UNESCO: Paris, France, 1982. Edited by P. G. Whitehead and T. Lack. 98 p, 23 fig, 11 tab, 118 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Rivers, *Lakes, *Self-purification, Water pollution sources, Wastewater pollution, River flow, Flow, Oxygen balance, Oxygen demand, Aeration, Water quality control, Reservoirs, Oxidation, Sedimentation, Eutrophication, Surface water, Pollutant identification.

Information on processes which control the distribution and behavior of pollutants in water is presented to hydrologists and engineers. Pollution definitions, processes controlling pollution, and pollutant measurements are described in the introductory chapter. Types of pollutants and their sources (point or diffuse) and effects are listed. The main sources are community wastewater, industrial wastewater, agricultural activity, the atmosphere, highway drainage, and landfill leachates. The physical, chemical, and biological aspects of processes affecting water quality in rivers and in lakes are discussed. Among these topics are physical and hydraulic behavior, self-purification and the oxygen balance, prediction of water quality, and biotic changes by pollutants. (Cassar - PTT)
W86-03906

ACID DEPOSITION: EFFECTS ON TERRESTRIAL ECOSYSTEMS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
D. S. Shriner.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE83-001967, Price codes: A02 in paper copy, A01 in microfiche. CONF-821058--1, (1983). 3 p. Electric Power Research Institute Project RP 1908-2, DOE Contract W-7405-eng-26.

Descriptors: *Acid rain, *Air pollution, *Agriculture, Air pollution effects, Forestry, Ecosystems, Economic aspects, Nutrients, Cycling nutrients, Environmental effects.

Acidic precipitation is frequently cited as a potential threat to agricultural and forest productivity. To date, however, conclusive evidence of agricultural losses due to ambient levals of acidic precipitation has been lacking. Potential mechanisms for an effect, however, exist. They include the direct effect on aerial portions of the plant. Visible injury thresholds for vegetation exposed to acid precipitation lie between pH 2.0 and 3.6. Visible injury appears to be related to total loss of hydrogen ions. Concern for forest ecosystems pertains to both direct effects of acid on the plants, and indirect effects on nutrient cycling and availability. (Halterman - PTT)
W86-03908

RESULTS OF 4-M3 LNG SPILLS ONTO WATER,

Lawrence Livermore National Lab., CA.
D. L. Ermak, H. C. Goldwire, W. J. Hogan, R. P. Koopman, and T. G. McRae.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE82-016253, Price codes: A03 in paper copy, A01 in microfiche. UCRL--87640, (1982). 29 p, 4 tab, 8 ref. DOE Contract W-7405-ENG-48.

Descriptors: *Environmental effects, *Ecological effects, *Natural gas, Hazardous materials, Hazards, Accidents, Ecosystems, Aquatic environment, Vaporization.

Lawrence Livermore National Laboratory (LLNL) is conducting safety research under the sponsorship of the U.S. Department of Energy (DOE) to determine the possible consequences of liquified natural gas (LNG) spills. The LLNL program includes both the collection of data from various size experiments and development of an ensemble of computer models to make predictions for conditions under which tests cannot be performed. In spills of 40 cu m of liquified natural gas onto water done at the Naval Weapons Center (NWC), China Lake, California in 1980 and 1981, data was collected on gas cloud dispersion and combustion and rapid phase transition (RPT) explosions. Analysis of the data from these tests, including comparisons between the predictions of various models and the data, are presented. The results suggest that large-scale spills may be more hazardous than would have been predicted based on earlier small-scale tests. (Author's abstract)
W86-03909

INVESTIGATION OF THE WATER QUALITY AND POLLUTION IN THE RIVERS OF THE PROPOSED WATER TRANSFER REGION,

Academia Sinica, Beijing (China). Inst. of Geography.
W. Jinghua, and L. Yongke.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 361-371, 4 fig, 4 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Water quality, *China, Diversion, Environmental effects, Canals, Irrigation, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the water quality of the rivers involved was investigated. At present, the water quality of the Chang Jiang is good. Some pollution, such as phenol and heavy metals, is observed downstream from some cities. Similarly, the Huai He drainage basin is only subject to pollution in the vicinity of industrial cities and towns. Although the Huang He River gets high pollution loads from several cities, self-purification rates are very high. The Hai He basin is polluted by industrial cities, resulting in high phenol, chromium and mercury concentration. The most fundamental measure to solve the problem of protecting the source of the water transfer is to strengthen the control over the pollution sources. River pollution monitoring should be improved, and monitoring points should be established along the main conveyance routes. (Halterman - PTT)
W86-03944

RADIOACTIVE AND CHEMICAL WASTE MIGRATION IN THE SNAKE RIVER PLAIN AQUIFER, IDAHO NATIONAL ENGINEERING LABORATORY,

Geological Survey, Reston, VA.
J. B. Robertson.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with examples of their Application, The UNESCO Press: Paris, France, 1982. p 97-122, 13 fig, 12 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Radioactive waste, *Model studies, Solute transport, Groundwater movement, Aquifers, Chemical wastes, Industrial wastes, Waste disposal, Idaho National Engineering Laboratory, Snake River.

The groundwater regime in the Idaho National Engineering Laboratory area was simulated with a numerical model to better understand migration patterns of radioactive and chemical waste at the site. Predictions of chloride, tritium, and Sr90 under various conditions were made up to the year 2000. However, the effects of several important, unpredictable variables, such as the recharge from the Big Lost River, require that the results, especially long-term results, be interpreted with care. Other sources of error are vertical dispersion, possible large withdrawals, and errors in parameters. However, general extent of the plumes can be plotted. In general the tritium plume was similar to that of chloride, except in the western section, where the source of tritium is larger. Recharge from the Big Lost River tends to accelerate the

southerly movement of the plume and divert it more to the southeast. (Cassar - PTT)
W86-03983

ASSESSMENT OF EXPLOITABLE GROUNDWATER RESOURCES IN FISSURED-KARSTIC FORMATIONS IN THE SERGA RIVER VALLEY (SERGINSKOE AQUIFER, URAL),

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2A.
W86-03986

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).

American Petroleum Inst., Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04001

DISPERSION OF CHEMICALLY TREATED CRUDE OIL IN NORWEGIAN OFFSHORE WATERS,

Sentralinstitutt for Industriell Forskning, Oslo (Norway).
For primary bibliographic entry see Field 5G.
W86-04003

ENHANCED OIL BIODEGRADATION: A NEW OPERATIONAL TOOL TO CONTROL OIL SPILLS,

Elf Aquitaine, Pau (France).
For primary bibliographic entry see Field 5G.
W86-04016

ECOLOGICAL MAPPING AND CLEANUP OF OIL SPILLS ONSHORE,

Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
T. Klokk, A. Danielsen, E. Sendstad, and P. Tommeraas.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas, p. 165-169, 7 fig, 9 ref.

Descriptors: *Ecological effects, *Oil spills, *Cleanup operations, *Mapping, Oil pollution, Environmental effects, Oil, Norway.

An ecological mapping project aims at mapping in advance areas along the Norwegian coast most likely to be exposed to oil spills from off shore oil activities. Up to now, the southernmost parts of the coast as well as those parts along the northern coast most likely to be subject to oil spills from possible wells at the Haltenbanken, Traenabanken and Tromsoflaket have been mapped. Oil originating from a blowout at the northern oilfields is likely to reach the coast in a few days. This stresses the necessity and demand for locality information in a surveyable and operative form. The maps provide information about areas with respect to natural resources, and their value for nature conservation reasons, industrial utilization, or development. Among parameters recorded on the maps are geomorphological beach types and important geological, zoological and botanical localities. Further, seabird species, seals, local fishing places and important resorts or outdoor life areas are mapped. The mapping of areas for pelagic fish species, as well as localities for fish farming and storage in the sea of live catches, has been a subject of major concern. The geomorphological types are correlated to anticipated self-cleaning ability. A matrix for prioritizing localities with respect to cleanup actions also is presented. This implies quantifying each locality with regard to its biological, commercial, and outdoor life importance and self-cleaning ability. (Author's abstract)
W86-04018

SHORELINER EXPERIMENTS AND THE PERSISTENCE OF OIL ON ARCTIC BEACHES,

Woodward-Clyde Consultants, Victoria (British Columbia).
E. H. Owens, J. R. Harper, C. R. Foget, and W. Robson.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 261-268, 7 figs, 5 tabs, 14 refs.

Descriptors: *Oil spills, *Cleanup operations, *Experimental data, Beaches, Cold regions, Oil pollution, Oil.

Experiments associated with the oiling of beaches in an arctic environment show that fetch and wave-energy conditions at the shoreline are primary factors in determining the persistence of stranded oil. Five intertidal sections of coast were oiled, each of which differed in terms of shoreline exposure and fetch. The oil loadings of the test beaches that were oiled artificially were in the same ranges as those from an adjacent nearshore spill, so that the experimental results can be assumed to replicate real-world oiling conditions. On the most exposed beach (fetch 90 kilometers) all oil was removed naturally after 80 days of exposure to open-water conditions. At a semi-exposed location, 85 to 95 percent of the oil was removed within 40 days, and at the most sheltered test sites (fetch less than 2 km) between 5 and 30 percent of the oil remained after an observation period of 160 open-water days. Data collection to determine fates of oil at the different sites over a four-year period is continuing. In this relatively low-energy wave climate environment, with an open-water season of about 60 days, most exposed beaches would be cleaned naturally to levels less than 500 milligrams/kilogram within 100 days, but where the fetch is less than 10 to 25 km the expected persistence of oil stranded in the intertidal zone could be greater than 10 years. (Author's abstract)
W86-04023

REVIEW OF THE STATE-OF-THE-ART OF OIL SPILL FATE/BEHAVIOR MODELS,

Raytheon Co., Portsmouth, RI. Submarine Signal Div.
For primary bibliographic entry see Field 5G.
W86-04026

FATE OF TWO LARGE OIL SPILLS IN THE ARABIAN GULF,

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
W. J. Lehr, and M. S. Belen.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 377-380, 6 fig, 9 ref.

Descriptors: *Oil spills, *Modelling, *Distribution patterns, *Fate of pollutants, Environmental effects, Oil, Oil recovery, Coastal impact, Arabian gulf, Bahrain, Qatar, Case studies, Path of pollutants.

In August and October 1980, two large oil spills occurred in the Arabian Gulf. The first, from an unidentified source, involved about 20,000 barrels of crude oil and impacted the entire north and west coasts of the island nation of Bahrain. The second occurred when the Ron Tapmeyer platform in the Hasbah offshore oil field blew out, releasing an estimated 50,000 barrels of thick crude into the Gulf. The spill subsequently covered large sections of the coastline of Qatar. The fate of the oil from these spills is examined with respect to the unique conditions found in the region. A computer model is used for trajectory analysis of the spills and hypothesizing the possible origin of the first spill. Methods of cleanup and problems with the weathered oil are mentioned. The environmental damage caused by the Bahrain spill is assessed. (Author's abstract)
W86-04030

HASBAH 6 (SAUDI ARABIA) BLOWOUT: THE EFFECTS OF AN INTERNATIONAL OIL SPILL AS EXPERIENCED IN QATAR,

Shell International Petroleum Mij., The Hague (Netherlands).
For primary bibliographic entry see Field 5C.
W86-04031

MULTIVARIATE ANALYSIS OF PETROLEUM HYDROCARBON WEATHERING IN THE SUBARCTIC MARINE ENVIRONMENT,

Science Applications, Inc., La Jolla, CA. Environmental Sciences Div.
J. R. Payne, B. E. Kirstein, G. D. McNabb, J. L. Lambach, and C. Oliviera.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 423-434, 10 fig, 5 tab, 20 ref.

Descriptors: *Hydrocarbons, *Multivariate analysis, *Cold regions, *Fate of pollutants, *Oil spills, Weathering, Arctic, Marine environment, Modelling, Oil, Cold regions.

When crude oil or petroleum products are released to the marine environment, immediate alterations in chemical and physical properties occur as a result of a variety of weathering processes. A three-year oil weathering study of Prudhoe Bay crude oil has been completed under ambient subarctic conditions at the National Oceanic and Atmospheric Administration's lower Cook Inlet field laboratory in Kasitsna Bay, Alaska. Quantitative data from outdoor wave-tank and flow-through aquaria systems were collected on seasonal and time-series measurements of compositional changes in the oil and water column due to evaporation, dissolution, and water-in-oil emulsification, as well as alterations in rheological properties of the slick. These data are used for mathematical model development and verification of computer predicted oil weathering behavior from a variety of spill scenarios. The oil-weathering mathematical models developed in this program are based on measured physical properties data, and they generate material balances for both specific compound and pseudo-compounds (distillation cuts) in crude oil. These models are applicable to open-ocean oil spills, spills in estuaries and lagoons where the water column is finite, and spills on land. The oil weathering processes included in the mathematical model are evaporation, dispersion of oil into the water column, dissolution, water-in-oil emulsification (mousse formation), and oil slick spreading. In most cases, very good agreement is obtained between predicted and observed weathering behavior. The material balance and weathered-oil composition predictions generated as a function of time have been very useful in providing information for contingency planning, estimating potential damage assessments and preparing environmental impact reports for outer continental shelf drilling activities. (Author's abstract)
W86-04034

BIOS PROJECT: AN UPDATE,

Environmental Protection Service, Edmonton (Alberta).
P. J. Blackall, and G. A. Sergy.
In: Proceedings of the 1983 Oil Spill conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 451-455, 2 fig, 2 tab, 7 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Oil spills, *Dispersants, *Distribution patterns, *Cleanup operations, Oil recovery , Oil pollution, Chemical analysis, Biological properties, Oil, Baffin Island Oil Spill(BIOS).

The Baffin Island Oil Spill (BIOS) Project, formally begun in March 1980, now is entering the fourth and final year of the planned field work. The primary objectives of this internationally funded project are to: (1) determine if the use of chemical dispersants in the arctic nearshore will reduce or increase the environmental effects of spilled oil, (2) assess the fate of oil, and (3) compare the relative effectiveness of other shoreline protection and cleanup techniques. This paper provides an over-

view of studies sponsored by the BIOS Project during the first three field seasons. Highlighted are the major oil releases which involved a total of 40 cubic meters of medium gravity crude oil. In addition, the preliminary results of the pre- and post-spill physical, chemical, and biological studies are presented. The physical program studies predicted the proper time and location for the oil releases and monitored the subsequent physical fate and behavior of the oil. The chemical program studies monitored the pre- and post-spill hydrocarbon levels in the water, sediments, and tissue of selected macrobenthic species, and also the environmental chemistry of the study area. The biological program studies to date have characterized the macrobenthic floro and fauna, the microorganisms, and the shorter-term effects of the oil releases on the subtidal biota. The potential ramifications of the BIOS Project's results on future oil spill countermeasure strategies are discussed. (Author's abstract)
W86-04035

LONG-TERM FATE OF DISPERSED AND UNDISPERSED CRUDE OIL IN TWO NEARSHORE TEST SPILLS,

Bowdoin Coll., Brunswick, ME.
For primary bibliographic entry see Field 5C.
W86-04037

ISOLATION AND GROWTH OF 'NATURALLY OCCURRING' BACTERIA FROM GROUND WATER,

Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 2F.
W86-04049

BIODEGRADATION OF HALOAROMATIC SUBSTRATES IN A SHALLOW ANOXIC GROUND WATER AQUIFER,

Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5D.
W86-04050

SORPTION OF ORGANIC SOLUTES: COMPARISON BETWEEN LABORATORY-ESTIMATED RETARDATION FACTORS AND FIELD OBSERVATIONS,

Stanford Univ., CA. Dept. of Civil Engineering.
G. Curtis, P. Roberts, and M. Reinhard.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 35-38, 4 fig, 4 tab, 12 ref. Contract No. CR-808851.

Descriptors: *Sorption, *Organic compounds, *Experimental data, *Path of pollutants, *Retardance, Aquifers, Groundwater, Retardants, Carbon tetrachloride, Bromoform, Tetrachloroethylene, 1,2-Dichlorobenzene, Hexachloroethane.

This work presents the results of laboratory experiments developed to measure sorption distribution coefficients for five organic solutes and aquifer materials. The aquifer material was excavated from the site of a field experiment, where the transport of halogenated organic solutes under natural conditions is being studied. The solutes used in the field study, carbon tetrachloride, bromoform, tetrachloroethylene, 1,2-dichlorobenzene and hexachloroethane, were also used in the laboratory experiments. Isotherms measured for these solutes in the concentration up to 0.08 g.m(-3) were linear and had near zero intercepts. Retardation factors inferred from the isotherms for carbon tetrachloride, bromoform and tetrachloroethylene were within the range of retardation factors observed in the field. The rank order of the distribution coefficients was in agreement with the solutes' octanol water partition coefficients. (Author's abstract)
W86-04051

SORPTION KINETICS OF TOXIC AND HAZARDOUS ORGANIC SUBSTANCES ON NEW JERSEY COASTAL PLAIN AQUIFER SOLIDS,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
J. Katz, and C. G. Uchrin.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 44-46, 4 fig, 11 ref.

Descriptors: *Sorption, *Kinetics, *Organic pollutants, *Aquifers, *Path of pollutants, Soil chemistry, Soil properties, Chloroform, Benzene, 1,1,2-trichloroethane, Trichloroethylene, New Jersey.

Studies examining the sorptive characteristics of selected organic pollutants to representative soil samples from New Jersey aquifers are described. The soil from the Cohansey aquifer is a sand with a small organic fraction. Equilibrium studies examining lindane exhibited a linear adsorption isotherm with an association constant 0.013 l/g. Desorption isotherms indicated a pronounced hysteresis, indicating that the sorption process for this system is not completely reversible. (Author's abstract)
W86-04052

EVALUATION OF PARTITIONING PROCESSES FOR ORGANIC CONTAMINANTS IN GROUND WATER,

Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
C. T. Miller, and W. J. Weber.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 47-49, 4 fig, 2 tab, 7 ref.

Descriptors: *Sorption, *Groundwater pollution, *Organic compounds, Groundwater, Evaluation, Sorption kinetics, Sorption equilibria, Water pollution, Path of pollutants.

Extensive contamination of the ground water resources of the U.S. by organic pollutants has precipitated a need to evaluate the movement and fate of these substances. This, in turn, has led to the development of models for simulating contaminant transport and transformation processes in ground water systems. One of the most important of these processes for organic contaminants is sorption on aquifer soils. Sorption is a dominant process for many organic solute soil systems, one which may retard the movement of the solute to a rate which is orders of magnitude less than that of the water itself. Accurate description of sorption is a requisite for transport analysis in such systems. Description of sorption processes must include the characterization of equilibrium, the approach to equilibrium and sorptive hysteresis which may occur in the sorption-desorption of organic solutes in ground waters. (Author's abstract)
W86-04053

GROUNDWATER CONTAMINATION AT CONROE WASTE DISPOSAL SITE,

Rice Univ., Houston, TX.
T. H. Wang, C. M. Curran, P. B. Bedient, and M. B. Tomson.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 50-52, 3 tab.

Descriptors: *Groundwater pollution, *Path of pollutants, *Organic wastes, *Inorganic compounds, *Texas, Aromatic hydrocarbons, Phenolics, Heterocyclic compounds, Groundwater, Water pollution, Conroe Waste Disposal Site.

Ground water contamination at the Conroe waste site, Texas, has been investigated for the past two years. The concentrations of trace level organics (TLOs), inorganics, and metals in ground water were analyzed. Major organic constituents detected were polynuclear aromatic hydrocarbons, phenolics, and nitrogen- and sulfur-heterocyclic compounds. Depth to water, conductivity, chloride, pH, and dissolved oxygen were monitored to indicate possible degradation and migration of contaminants in ground water. Various water sampling, laboratory procedures, and GC identification methods for TLOs were evaluated. A Teflon bailer was used in water sampling for its rigidity and inertness. Sep-Pak extraction procedures have the advantages of simplicity and versatility in the sample preparation and have shown better reliability and less cross contamination than conventional liquid-liquid extraction procedures. The reproducibility and recovery efficiency of fourteen target organic compounds selected in this study were from good to excellent. Leaching of TLOs from soil into ground water was examined. The results indicated that the amount of TLOs absorbed by soil was significantly higher than the amount leached into ground water. The major organic compounds found in the water soluble fraction of Conroe pit soil were pentachlorophenol and higher molecular weight alkanes. Based on the analytical data and overall variation of results due to field sampling, extraction procedure, and GC analysis, we conclude that the concentrations of TLOs in ground water have remained unchanged for the past two years. (Author's abstract)
W86-04054

IRREVERSIBLE SORPTION OF TRACE LEVEL ORGANICS BY GROUND WATER HUMIC SUBSTANCES: A NEW MECHANISM OF TRANSPORT,

Rice Univ., Houston, TX.
C. C. West, M. B. Tomson, and G. G. Waggett.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 53-54, 12 ref.

Descriptors: *Sorption, *Path of pollutants, *Organic compounds, *Groundwater movement, *Humic material, Hexachlorobenzene, Soil chemistry, Groundwater, Soil columns.

Soil column experiments exhibited mediated transport of hexachlorobenzene (HCB) by a ground water humic material (HM). The retardation equation was modified to include transport of a dissolved HCB/humic complex in the mobile aqueous phase in an attempt to account for the mediated transport. Results indicate that dissolved organic matter can form an irreversibly bound complex with hexachlorobenzene which is mobilized in soil column and represents a new mechanism by which ground waters can be contaminated. (Lantz - PTT)
W86-04055

ORGANIC SOLUTE TRANSPORT IN GROUNDWATER DISCHARGE ENVIRONMENTS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. L. Winters, and D. R. Lee.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 55-58, 9 fig, 4 tab, 10 ref.

Descriptors: *Organic compounds, * Path of pollutants, *Groundwater pollution, *Solute transport, Groundwater movement, Trace organics, Groundwater, Water pollution, Tritium, Napthalene, Municipal wastes, Aquifers.

The advective flux of organic pollutants to surface waters from contaminated groundwater was measured using an in situ column technique. These columns are 20-cm diameter, 30-cm long cylinders that are inserted vertically in shallow-water sediments known to be receiving groundwater. A tracer mixture, e.g., tritium and naphthalene, is injected into a screened disc at the column base. A sampling tube near the column top permits tracer monitoring over time. This study was prompted by the observation that trace organics travel hundreds of meters from municipal waste sites through sandy aquifers to nearby surface waters yet no device existed to monitor this pollutant influx. The in situ column was field tested by determining the sorption behavior of 14C-labelled naphthalene at concentrations less than 0.01% of its water solubility. Results show that it is practical using in situ columns to determine retardation factors for selected organics in groundwater discharge environments such as stream beds. Preliminary tracer test data show naphthalene retardation about one-fifth

that predicted from its n-octanol/water partition coefficient and the organic carbon fraction of the sediments. (Author's abstract)
W86-04056

GEOCHEMICAL INVESTIGATIONS INTO GROUNDWATER POTENTIAL CONTAMINANTS RESULTING FROM UNDERGROUND COAL GASIFICATION (UCG),

Ground Water Sampling, Inc., Englewood, CA.
A. M. Behi, and G. G. Hunkin.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 65-68, 4 fig, 9 ref.

Descriptors: *Groundwater pollution, *Underground coal gasification, *Organic compounds, *Inorganic compounds, *Geochemistry, Organic wastes, Benzene, Toluene, Phenols, Aquifers, Chemical analysis, Groundwater, Sulfate, Ammonia, Barium, UCG.

UCG is a process by which subbituminous coal is pyrolyzed in situ and the product gas is recovered above the ground. The process involves thermal decomposition of coal and other rock material immediately surrounding the coal stratum. Ash, tar, charcoal and pyrometamorphic materials are produced, and inorganic minerals along with organic gases are liberated and released into the surrounding coals, which are fractured, saturated and form a component of the groundwater system. The vaporized organic gases condense to form pollutants including phenols and pyrines, which are subsequently absorbed by the reactive surfaces of the decomposed coal products. Aromatics, such as benzene and toluene, move faster in groundwater than the heavier molecular weight organics. Both parameters show erratic distribution in post-burn groundwater samples. Phenols were not found in high concentrations. Several years after test gasifications were terminated, most of the parameters, excluding sulfate, have returned to pre-test levels. If the high sulfate condition can be dealt with, long term detrimental effects can be discounted. Groundwater contamination from UCG operations is site specific and depends on original coal chemistry, overburden rock composition, aquifer characteristics, and hydrologic and geologic controls. Chemical studies showed high post-test concentrations of sulfate, ammonia, conductivity, barium, total organic carbon, chemical oxygen demand, calcium, and organics. All these parameters, except sulfate, decrease to pre-test levels with time. (Lantz - PTT)
W86-04058

DISTRIBUTION OF SELECTED TRACE ORGANICS IN THE LEACHATE PLUME OF A MUNICIPAL LANDFILL,

Stanford Univ., CA. Dept. of Civil Engineering.
M. Reinhard, J. W. Graydon, N. L. Goodman, and J. F. Barker.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 69-71, 3 fig, 20 ref. Contract No. R-808851.

Descriptors: *Leachates, *Municipal landfills, *Organic compounds, *Groundwater pollution, *Plumes, Landfills, Waste dumps, Aromatic hydrocarbons, Aliphatic acids, Aromatic acids, Trichloroethylene, 1,4-dichlorobenzene, North Bay, Ontario.

In the leachate plume of the municipal landfill of North Bay, Ontario, the distribution of trace organics, such as petroleum-derived aromatic hydrocarbons, chlorinated solvents, and aliphatic and aromatic acids, has been analyzed. Chloride was used as a conservative tracer. The input into the 800 m long plume was evaluated at a multi-level observation well near the boundary of the landfill by analyzing 5 samples over a two-year period. The chloride concentration remained relatively constant (+ or - 20%) relative to the aromatic hydrocarbon concentrations, which varied by almost an order of magnitude. However, the concentration ratios of the individual hydrocarbon compounds remained relatively constant. The measured concentrations were in the low microgram/L range, approximately three orders or magnitude below the solubility limit of the compounds. Trichloroethylene (Cl3EY) has been detected at the microgram/L level beneath the plume, and at the bottom of the aquifer, but not in the anaerobic plume, while 1,4-dichlorobenzene was detected throughout the plume indicating both stability and mobility of this compound under anaerobic conditions. The petroleum-derived aromatic hydrocarbons showed a mixed behavior, suggesting that selective and variable attenuation may have been effective. (Author's abstract)
W86-04059

FACTORS INFLUENCING THE SURVIVAL OF VIRUSES IN GROUND WATER,

Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
M. V. Yates, C. P. Gerba, and L. M. Kelley.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 72-73, 2 fig, 2 tab, 8 ref.

Descriptors: *Groundwater, *Viruses, *Groundwater pollution, MS-2, Bacterial viruses, Poliovirus, Echovirus, Biological analysis, Chemical analysis.

Although ground water accounts for only approximately 20% of the nation's water supply, 50% of all waterborne disease outbreaks in the United States are due to contaminated ground water. More than half of these cases of illness are believed to be caused by enteric viruses. Little, however, is known about the persistence of these organisms in ground water. This study investigated the persistence of a bacterial virus, MS-2, and two animal viruses, Poliovirus-1 and Echovirus-1, in ground water samples collected from throughout the United States. Each virus was innoculated into separate, sterile polypropylene containers of ground water and incubated in the laboratory at the characteristic temperature of the source. Duplicate experiments were performed using the natural ground water and ground water that had been filtered to remove bacteria. Subsamples were assayed at predetermined intervals over a 30-day period. Several chemical characteristics were determined for each ground water tested. Ground water temperature was the only water characteristic found to be significantly correlated with the persistence of all three viruses. There were no consistent trends found in the ability of any of the viruses to persist in the presence or absence of the indigenous bacteria. (Author's abstract)
W86-04060

SALINE CONTAMINANTS IN THE GROUNDWATERS OF EASTERN SAUDI ARABIA,

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
R. al-Layla, and R. L. Dejong.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 85-87, 15 ref.

Descriptors: *Groundwater pollution, *Coastal aquifers, *Saline water intrusion, Saline water, Intrusion mechanisms, Groundwater, Saudi Arabia.

Intensive development along a coastline, with consequent rapidly increasing use of local groundwater supplies in the absence of adequate surface resources, invariably leads to intrusion of saline water into the coastal aquifers and the destruction of their water supply potential. Conditions along the Gulf Coast of Saudi Arabia are favorable towards such a chain of events, although for a number of reasons no large-scale intrusion has yet been observed. This paper reviews the basic intrusion mechanisms, and describes the development patterns as well as the hydrogeologic setting of the Eastern Province. On this basis conclusions are drawn concerning existing, and potential saline intrusion problems along the Arabian Gulf coast and suggestions are made for corrective and preventive measure to be taken. (Author's abstract)
W86-04062

MODELING GROUND WATER TRANSPORT AT CONROE CREOSOTE WASTE SITE,

National Center for Ground Water Research, Norman, OK.
R. C. Borden, P. B. Bedient, and T. Bouvette.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 88-90, 4 fig, 2 tab, 7 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Monitoring, *Water quality, Groundwater pollution, Modeling, Organic compounds, Inorganic compounds, Conroe, Texas, Conroe Creosote Waste Site.

Results from three years of monitoring water quality including organic and inorganic compounds at Conroe, Texas waste site were used to direct simple 1-D and 2-D transport modeling efforts. The U.S. Geological Survey Method of Characteristics Model was used to simulate ground water flow and chloride transport from the Conroe site. Sensitivity analyses were performed on parameters which most affect the plume pattern, including hydraulic conductivity, and the height of the waste pond. 'Best fit' combinations of parameters are produced to show the difficulties of matching field data to numerical model results. Retardation of organic and simple, linear decay due to microbial activity were investigated from available coefficients derived for the Conroe site. Sensitivity of the various coefficients is evaluated in a simple 1-D mode, but such results should be useful in extrapolating such reactions to more realistic 2-D situations. (Author's abstract)
W86-04063

GEOHYDROLOGY SURROUNDING A POTENTIAL HIGH LEVEL NUCLEAR WASTE REPOSITORY IN THE PALO DURO BASIN, TX,

Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
For primary bibliographic entry see Field 2F.
W86-04064

ADVECTION AND RETARDATION IN AN EXPERIMENTAL PLUME OF SORBING AND NON-SORBING SOLUTES,

Stanford Univ., CA. Dept. of Civil Engineering.
D. L. Freyberg.
In: Second International Conference on Ground WAter Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 95-97, 4 fig, 1 tab, 4 ref. Contract No. CRT-808[illegible].

Descriptors: *Plumes, *Experimental Data, *Sorption, *Path of pollutants, Advection, Retardance, Groundwater, Chloride, Tracers, Carbon tetrachloride, Modeling, Organic compounds.

Values of the zeroth and first spatial moments of the plumes of four sorbing and one non-sorbing solute have been estimated from a spatially and temporally detailed data set collected during the first 410 days of an ongoing groundwater experiment. While still preliminary, these estimates indicate that chloride is behaving as a tracer, with no loss of mass in solution, and is moving with a mean velocity of 9.5 cm/day along a straight line trajectory parallel to the local hydraulic head gradient. Of the four organic solutes, only carbon tetrachloride is behaving as a linearly-retarded, sorbing solute. The other organics are characterized by decreasing mass in solution and decreasing mean velocity, although they are following the same trajectory as the chloride and carbon tetrachloride plumes. Estimated retardation factors for carbon tetrachloride range from 1.6 to 2.1. (Author's abstract)
W86-04065

CONTRIBUTIONS TO THE FATE OF UNDERGROUND ORGANIC CONTAMINANTS DURING UNDERGROUND PASSAGE,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
P. Friesel, G. Milde, and B. Steiner.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 98-100, 5 tab, 10 ref.

Descriptors: *Groundwater pollution, *Fate of pollutants, *Groundwater movement, *Modeling, *Water pollution control, Projections, Sorption, Water pollution, Groundwater.

To devise protection measures for groundwater catchment areas and to establish dimensions of treatment systems including underground passage or sand filtration for surface waters, in which more and more organic micropollutants are found, a systematic approach to investigate elimination processes in soils and similar systems has become a practical necessity. At present a more promising strategy for prediction purposes seems to lie in the development of concepts for the mechanisms of elimination. For these the main geological and compound parameters can be measured or estimated. Evaluation of recovery rates of elimination processes during underground passages in natural systems did not give results useful for prediction purposes. Better results might be attained if the complexity of each system could be accounted for, and processes could be modeled with the necessary resolution. However, this would be tedious and costly. With respect to sorption processes the methods of estimation are at hand, in the future more data should be collected on sorptive behavior of compounds with differing properties. With these, compound class specific equations to calculate the organic carbon:dissolved carbon partition coefficient can be developed. They may allow the development of equations more universally applicable by incorporation of further compound parameters beside water solubility; for this purpose theoretical approaches, e.g., the solvophobic theory, may be useful. At least for the numerous cases of environmental pollution by chlorinated hydrocarbons - solvents, PCB, TCDD - the impact on groundwaters can be assessed with the methods available. (Lantz-PTT)
W86-04066

ASSESSING THE QUALITY OF GROUNDWATER NEAR A COASTAL PLAIN USED FOR AGRICULTURE AND DISCHARGE OF SEWAGE,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, and S. Lau.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 101-104, 1 fig, 3 tab, 12 ref.

Descriptors: *Groundwater quality, *Groundwater pollution, *Waste disposal, *Wastewater disposal, Biological analysis, Chemical analysis, Bacteria, Viruses, Chloride, Water treatment.

The purpose of this investigation was to obtain representative groundwater samples by pumping out large volumes of well water and to analyze these samples for indicator bacteria, human enteric viruses and selected chemicals. Moreover, to assess the probability that the practice of discharging sewage effluent into the unlined ditch could result in the contamination of the groundwater with sewage-borne bacteria and viruses. The quality of groundwater from a new well dug near the coastal plain on Oahu was determined by pumping out 271,500 gallons of water over 1.5 days and analyzing 9 representative samples. No fecal coliforms (<1/100 ml) and only 1.6 fecal streptococcus/100 ml were recovered in the 9 samples. In addition, no human enteric virus was recovered in the four 100-gallon samples, indicating that the groundwater was not contaminated with sewage. One and three foot soil percolates collected under the ditch which transported sewage near the well were similarly analyzed and the results indicated that it would be most unlikely for sewage-borne bacteria and viruses in the effluent to percolate through the soil profile to contaminate the groundwater. The groundwater was also analyzed for 11 chemicals. The concentration of total dissolved solids (750 mg/l) was the only measurement which exceeded the maximum contaminating level (MCL) for drinking water, although the concentration of chloride (241 mg/l) closely approximated its MCL. Blending of this groundwater with high groundwater is a viable alternative of increasing the volume of potable water required for urban expansion. (Lantz-PTT)
W86-04067

ONE-DIMENSIONAL MATHEMATICAL MODEL OF VIRUS TRANSPORT,
Holzmacher, McLendon and Murrell, Melville, NY.
P. W. Grosser.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 105-107, 4 fig, 7 ref.

Descriptors: *Viruses, *Groundwater pollution, *Path of pollutants, Groundwater movement, Modeling, Septic tanks, Pumping, Aquifers.

Considerable field work has been performed regarding the fate and transport of viruses within groundwater systems. This paper presents a one-dimensional groundwater flow-mass transport model representing the migration of viruses from a septic system to a private water supply well. Ultimately, the model is designed to determine adequate separation distances between sewage disposal systems and water supply wells. Inputs to the model consist of separation distance between well and septic system, pumping rate of well, aquifer characteristics, adsorption coefficient for the virus and inactivation coefficient for the virus. The model outputs are relative virus concentrations at various points downstream of the septic system at different times until steady state is reached. Published values of adsorption coefficients and viral inactivation coefficients for soils and water quality conditions similar to those encountered on Long Island, New York, were utilized as model inputs. From this data and subsequent sensitivity analyses, reasonable conclusions can be drawn regarding the extent of virus transport in the subsurface conditions of Long Island. This paper primarily focuses on the development of the mathematical representation of the mass transport, adsorption and viral inactivation processes and their natural variability. (Author's abstract)
W86-04068

APPLICATION OF MULTI-PHASE FLOW THEORY AT A CHEMICAL WASTE LANDFILL, NIAGARA FALLS, NEW YORK,
Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W86-04069

MODELLING OF NITROGEN REMOVAL IN THE VADOSE ZONE,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
G. E. Ho, K. Mathew, and P. W. G. Newman.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 112-114, 1 fig, 2 tab, 10 ref.

Descriptors: *Denitrification, *Vadose water, *Modelling, *Nitrogen removal, Secondary wastewater, Wastewater treatment, Ammonium, Biodegradation, Infiltration, Bacteria, Groundwater.

Ammonium in secondary wastewater is removed in the vadose zone when wastewater is applied to spreading basins with alternate flooding and drying. The processes involved in the removal of ammonium nitrogen are adsorption of ammonium by the soil, oxidation of the adsorbed ammonium to nitrate by nitrifying bacteria in the subsequent drying period thus freeing adsorption sites in the soil for further ammonium adsorption, and reduction of nitrate to nitrogen gas by denitrifying bacteria during flooding. The extent of nitrogen removal is governed by the rate of infiltration, the lengths of the flooding and drying periods, the adsorption capacity of the soil for ammonium and the rates of nitrification and denitrification. A model incorporating these processes has been developed, which can be used to explain why nitrogen removal does not take place in some wastewater rapid-infiltration systems, why nitrogen conversion stops after the nitrification state in some cases, and to calculate the extent of nitrogen removal as a function of soil type and operating conditions. The model shows that the approach to steady state after a change in operating conditions is reached only slowly. The model parameters have been obtained experimentally under laboratory conditions. A case study of nitrogen removal from wastewater by rapid infiltration in Perth, Western Australia is discussed. (Author's abstract)
W86-04070

TRANSPORT OF HALOGENATED ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
N. J. Hutzler, J. C. Crittenden, J. L. Oravitz, C. J. Meyer, and A. S. Johnson.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 115-118, 5 fig, 9 ref. Contract No. R809464-01-0.

Descriptors: *Organic compounds, *Path of pollutants, *Groundwater movement, *Halogens, Modeling, Advection, Dispersion, Mass transfer, Adsorption, Equilibrium, Trichloroethylene, Groundwater.

A one-dimensional model incorporating the mechanisms of advective flow, axial dispersion, liquid-phase mass transfer, local adsorption, equilibrium, and diffusion into aggregates is developed and solved using orthogonal collocation. The model is used to simulate the breakthrough of trichloroethylene in a packed column of sandy loam soil. Parameters for the model are derived from literature correlations, the column geometry, soil adsorption isotherms, kinetics studies, and breakthrough curves. The results show that dispersion and particle aggregation play a significant role in the spreading of chemical in one-dimensional flow. (Author's abstract)
W86-04071

IMPROVED NUMERICAL MODELLING OF CONTAMINANT TRANSPORT IN SATURATED AQUIFERS,
North Carolina Univ. at Charlotte.
R. Janardhanam, and J. Frampton.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 122-124, 4 fig, 4 ref. Contract No. S-82-8.

Descriptors: *Modeling, *Aquifers, *Groundwater quality, *Path of pollutants, *Mathematical analysis, Saturated aquifers, Waste disposal, Groundwater pollution, Groundwater movement, Groundwater.

Contaminated discharge and run-off from landfills pose a problem to the groundwater quality. A strong need exists to evaluate the impact of present and proposed waste disposal sites on groundwater purity and the resulting effect on the public. The use of numerical models in the determination of the spread of contaminants will allow us to make advance predictions. The mathematical representation of the phenomena of mass transfer in porous media consists of two equations, a flow equation and a transport equation; the flow transport being represented by the stream function. Galerkin finite element technique is used to simulate the transport of contaminants in a two dimensional rectangular confined aquifer. The pollutant is assumed to discharge continuously from the top boundary of the aquifer. The spread of the contaminants at different

time steps are determined to calculate concentration isopleths. For a high degree of accuracy, a refined mesh near the contaminant source is recommended. (Author's abstract)
W86-04073

GROUNDWATER POLLUTION IN NORTHWEST ARKANSAS,

Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
H. M. Jeffus.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 125-126, 2 fig, 1 tab.

Descriptors: *Groundwater pollution, *Remote sensing, *Wastewater disposal, *Waste disposal, Radar, Coliforms, Aerogenes, Streptococcus, Bacteria, Water pollution prevention, Groundwater, Arkansas.

Radar imagery photographs of northwest Arkansas revealed that the near surface formations are heavily fractured with the fracture traces, or linears, easily traceable on the photographs. A superimposition of the linear traces on well and spring locations reveals that the springs and most higher producing wells are on these linears. Since the linears provide an easy path for surface contaminants to enter these wells and springs, it was reasoned that most would be contaminated. An investigation of 70 wells in an area 10 miles by 10 miles revealed that 80 percent were contaminated with coliform bacteria. Enumeration of aerogenes, fecal coliform and fecal Streptococci found a range of 1 to 2,080,000 organisms per 100 milliliters. A correlation was determined between high nitrate and high phosphate with a heavier concentration of bacteria. Sources of the contaminants were determined to be septic tank leach fields, confined live stock feeding, solid waste disposal landfills and spreading of agricultural wastes on pastureland. Possibilities or corrective action are: reduced spreading of manure on fields and pastures, better design of septic tank absorption fields, on-site chlorinators for domestic water supplies and in some cases, extension of treated water supplies to rural areas. These same conditions of shallow well contamination in fractured limestone probably exists in western Arkansas, eastern Oklahoma, southern Missouri and south-east Kansas. (Author's abstract)
W86-04074

PHYSICAL TRANSPORT PROCESS FOR HYDROCARBONS IN THE SUBSURFACE,

Underground Resource Management, Inc., Austin, TX.
J. R. Kovski.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 127-128, 2 ref.

Descriptors: *Hydrocarbons, *Groundwater movement, *Path of pollutants, *Groundwater pollution, Physical properties, Viscosity, Density, Groundwater.

The transport of hydrocarbons in the subsurface is a very complex combination of physical, chemical, and biological processes. While the chemical and biological processes are very important in the longterm transport of hydrocarbons, the shortterm transport of hydrocarbons is dominated by the physical process. An understanding of the physical transport process will allow more efficient recovery of the hydrocarbon, leaving less in the subsurface to be acted upon by the chemical and biological processes. This paper examines the physical process which controls the rate and extent of movement of hydrocarbons in the subsurface. The physical process of transport is dependent upon such factors as hydrocarbon viscosity, hydrocarbon density, hydrocarbon release rate, the hydrocarbon release volume, the water table depth, the groundwater gradient, water table fluctuation, subsoil grain size, and rainfall pattern. These factors are examined, and their impacts on rate and extent of hydrocarbon movement are addressed. (Author's abstract)
W86-04075

VIRAL AND BACTERIAL CONTAMINATION OF GROUNDWATER BY ON-SITE WASTEWATER TREATMENT SYSTEMS IN SANDY COASTAL SOILS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. L. Moe, C. G. Cogger, and M. D. Sobsey.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 132-134, 4 tab, 6 ref. Contract No. NA81AA-D-00026.

Descriptors: *Groundwater pollution, *Wastewater treatment, *Sand, *Coasts, Shore, Septic tank effluents, Septic tanks, Viruses, Coliforms, Streptococci, Wastewater, Groundwater.

Contamination of groundwater by enteric viral and bacterial pathogens is an important public health concern for on-site wastewater treatment systems, especially in highly developed and populated coastal areas with permeable soils and seasonally high water tables. Viral and bacterial contamination of groundwater by on-site wastewater treatment systems was studied in an experimental field site on the NC. coast. A low pressure dosing system applied septic tank effluent (STE) at three hydraulic loading rates to two, adjacent drainfields with the same sandy soil but different water table depths. In seasonal experiments known amounts of bovine enterovirus type 1 (BE-1) were added to the STE. Groundwater samples from the fields were analyzed for BE-1 twice weekly before, during and after virus dosing periods of three weeks. Fecal coliforms, fecal streptococci, coliphages and several chemical constituents were also measured periodically. Concentrations of BE-1, coliphages, fecal coliforms and fecal streptococci were reduced from their levels in STE in both fields; however, reductions were several log10 greater in the field with the deeper water table. BE-1 was detected in groundwater by the second day of virus dosing and persisted as long as 30 days postdosing. There was no consistent pattern of increased microbial concentrations in groundwater at greater hydraulic loading rates of STE. Seasonal experiments showed temperature and overload effects on the system. The results demonstrate the importance of unsaturated flow for efficient removal of enteric viruses and bacteria by septic systems. (Author's abstract)
W86-04077

NITRATE CONCENTRATIONS IN MUNICIPAL WELLS LOCATED WITHIN A RIVER BED,

Nebraska Univ. at Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-04078

FINITE ANALYTIC METHOD FOR SOLUTION OF ONE-DIMENSIONAL TRANSIENT TRANSPORT EQUATIONS,

Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
B. K. Panigrahi, and J. C. Hwang.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 138-141, 7 fig, 1 tab, 5 ref.

Descriptors: *Mathematical analysis, *Transport equations, *Path of pollutants, *Finite analytic method, Solute transport, Convection, Dispersion, Groundwater.

A new numerical method called finite analytic method is proposed to solve the ground water solute transport problems. This method differs from the others in that it incorporates local analytical solutions to a numerical scheme for the linear or nonlinear partial differential equation describing the global problem. The proposed method is used to solve three cases of one-dimensional convective-dominated solute transport problems in ground water system. They are less, moderately and highly convective dominated transport problems with grid peclet number equals to 1, 10 and 100 respectively. The corresponding dispersion coefficients are 0.25, 0.025, and 0.0025 respectively. The other physical parameters considered for the solution scheme are seepage velocity of 0.5, spatial grid length of 0.5 and a time interval of 0.4. The results are compared with the exact solution, Crank-Nicholson finite difference scheme and Galerkin finite element method. The new scheme is capable of producing reliable and stable solutions. (Author's abstract)
W86-04079

DEVELOPING INFORMATION ON ALDICARB LEVELS IN LONG ISLAND GROUNDWATER,

Cornell Univ., Ithaca, NY. Center for Environmental Research.
K. S. Porter, A. T. Lemley, H. B. Hughes, and R. L. Jones.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 142-145, 3 fig, 4 tab, 10 ref.

Descriptors: *Groundwater pollution, *Aldicarb, *Chemical analysis, Groundwater, Pesticides, TEMIK, Drinking water, Wells, Degradation.

Since the discovery of aldicarb residues in Long Island groundwater in 1979, well over 10,000 soil and water samples on Long Island have been analysed. Work reported herein couples this extensive data base with further field and laboratory studies to develop a sound scientific assessment of the expected duration and distribution of aldicarb residues in Long Island groundwater. Preliminary results from the shallow groundwater field site and monitoring wells indicate that the average concentration of aldicarb residues on Long Island is dropping. The decline of residues in areas where relatively deep groundwater is present is less apparent due to the continuing recharge of residues into groundwater from the unsaturated zone. Preliminary results from laboratory studies indicate that the half-life of aldicarb residues is approximately 2-3 years in Long Island groundwater. Laboratory studies show that estimates of half-lives obtained from distilled water hydrolysis studies using actual soil and water samples from the specific locations. (Lantz - PTT)
W86-04080

SPRINGS ARE MORE EFFICIENT AND RELIABLE THAN WELLS FOR MONITORING GROUND WATER QUALITY IN MOST LIMESTONE TERRAINS - A CONSEQUENCE OF TRANSPORT PROCESSES OCCURRING IN CONDUITS,

National Park Service, Mammoth Cave, KY.
J. F. Quinlan, and R. O. Ewers.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 146-148, 2 fig, 9 ref.

Descriptors: *Groundwater quality, *Wells, *Springs, *Monitoring, *Groundwater management, Water quality, Water pollution control, Groundwater movement, Infiltration, Groundwater.

In mature karst areas, where carbonate bedrock is above the water table, infiltration water percolates vertically until it intercepts a cave system in which most flow is: (1) nearly horizontal, (2) in conduits, (3) convergent, generally dendritic or trellised, (4) generally in the uppermost fringe of the phreatic zone, and (5) to a spring (or group of springs) that drains an entire groundwater basin. The flow in a large conduit is in many ways analagous to flow in a surface river. The trunk flow of both is fed by tributaries and by diffuse flow through the surrounding rock or sediment; but most of the flow to a conduit is at a higher velocity than it is to a surface river, and it is through vertical joints and bedding planes rather than pores. The only sure way to sense the active flow from a site to be monitored is to intercept the conduit system that

drains it. And unless one can prove (generally by dye-tracing) that a particular cave stream drains all of the site, springs, rather than observation wells, are the most efficient, reliable, and economical places to monitor for pollutants in most limestone terrains where carbonate rock is in the vadose zone. This is because the probability of a randomly located drill hole intersecting such a conduit is almost nil. A plan to guarantee sensing of the conduit system should include: (1) location of springs along streams and in sinkhole bottoms, (2) dye-tracing to show the presence or absence of flow routes, and (3) judicious selection of springs as leachate-monitoring and background-monitoring sites, as discussed in the text. The plan may include monitoring of cave streams and mapping of the potentiometric surface and of groundwater basin boundaries. (Author's abstract)
W86-04081

EFFECT OF STOCHASTIC INPUTS AND PARAMETERS IN SOLUTE-TRANSPORT MODELING,

Oklahoma State Univ., Stillwater.
J. Wagner, W. Pettyjohn, K. Goff, B. Huffman, and D. Saunders.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 149-154, 8 fig, 44 ref. Contract No. CR-811116.

Descriptors: *Aquifers, *Water quality modeling, *Modeling, *Stochastic hydrology, *Path of pollutants, *Groundwater pollution, *Solute transport, Parametric hydrology, Monte Carlo Method, Mathematical studies, Statistical analysis, Groundwater, Pollutants.

Successful planning, design and regulatory evaluations should be based on both deterministic and stochastic techniques, but most scientists and engineers treat solute-transport calculating as if they were only deterministic. In conventional solute-transport predictions, random variables and uncertain model parameters are replaced by their expected values and the resulting deterministic model is solved. An approach of this type can often be misleading. With stochastic analysis, it becomes possible to make statements such as: At the point of interest, the concentration interval of 5.0 to 10.0 mg/l includes the expected value with a probability of 0.95. The use of Monte-Carlo methods to introduce stochastic variables into a deterministic analytical solute-transport model is demonstrated. This approach can account for uncertainties in boundary conditions, such as input flow rates and concentrations, as well as uncertainties in model transport coefficients, such as hydraulic conductivity and hydrodynamic dispersion coefficients. The results of this stochastic modeling approach include not only the expected value of concentration at a point of interest, but also the frequency distribution for the concentration based on uncertainties in the model input and transport parameters. The frequency distribution can be used to assess the risk posed by the release a chemical substance into the subsurface environment. Information gained by a stochastic analysis can also be used to decide whether parameters on a deterministic model have been evaluated with sufficient precision for use in a simulation. Finally, the introduction of randomness or uncertainty into a model must reflect what is physically happening in the process to the extent possible. (Author's abstract)
W86-04082

SEAWATER INTRUSION IN THE SAN JUAN ISLANDS,

San Diego State Univ., CA. Dept. of Natural Science.
W. J. Wallace.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 155-157, 5 fig, 19 ref.

Descriptors: *Saline water intrusion, *Groundwater pollution, *Washington, *Wells, Encroachment, Monitoring, Spectral analysis, San Juan Islands.

A study of seawater intrusion into the groundwater of three islands in San Juan County, Washington was done throughout 1980, with subsequent monitoring through summers including 1983. The indigenous human population depends solely upon groundwater. Subsequently, hundreds of wells have been drilled which eliminated the problem of new drilling to provide water study samples. Fifty-one in and out of use wells provided the sample base which were monitored monthly for possible seawater intrusion using the chloride ion concentration as an indicator. Atomic absorption was used when more detailed analyses were necessary. Data from neighboring individual wells showing seawater intrusion were used to develop a general horizontal picture of seawater intrusion patterns. A few of the conclusion thus far are: (1) A deep well which has been drilled into fractured rock shows less variance in water composition with time. Wells drilled deep into gravels, however, show considerably more variation; (2) If a well water is to be analyzed only annually as a check against possible sea water intrusion then late fall is the best time, since water use is high, precipitation low, and the water table is lowered; (3) Physical monitoring of a well's dynamic water level is not in itself a means to be solely trusted to identify sea water intrusion since it does not always rise and fall with the tide; (4) The Ghyben-Herzberg relation which assumes simple hydrostatic conditions in a homogeneous, unconfined coastal aquifer does not describe the sea water/fresh water lens in the San Juan area studied; and (5) From the year's analytical data horizontal maps delineating areas of sea water intrusion can be drawn. Vertical profile diagrams present significantly greater problems. (Lantz - PTT)
W86-04083

SUBSURFACE TRANSPORT OF URBAN RUNOFF POLLUTANTS,

Arizona Univ., Tucson.
L. G. Wilson, C. P. Gerba, M. W. Bolton, and J. B. Rose.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 158-160, 4 fig, 2 tab, 3 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Urban runoff, *Vadose water, *Runoff pollution, Gravity groundwater, Groundwater pollution, Water pollution, Metals, Microorganisms, Organic matter, Tucson, Arizona, Water sampling.

Five injection tests were conducted on an experimental dry well at a site near Tucson, Arizona. Primary goals of the tests were to determine flow patterns in the vadose zone, and attenuation of urban runoff pollution (metal, microorganisms, and organic matter) in vadose zone/groundwater flow systems. A perched groundwater system and a water table mound were observed by neutron moisture logging with lateral flow velocities averaging 500 ft/day. Metals were detected breaking through in a vadose zone sampling well. Microbial tracers were also observed in the vadose zone sampling wells, but peak values were markedly reduced below input values. The initial concentration of organic matter breaking through in the sampling well was 58% of the input values. No organic matter of microorganisms were detected in pumped groundwater samples. It was generally concluded that (1) dry well injection of urban runoff may develop perched groundwater systems capable of spreading injected water within the radius of influence of nearby wells, and (2) given the pollutant loading rates of the test, groundwater was not deteriorated. (Author's abstract)
W86-04084

FINITE ELEMENT METHOD WITH REGION WISE ITERATION SCHEME FOR SOLVING GROUNDWATER SOLUTE TRANSPORT EQUATION,

Oak Ridge National Lab., TN.
G. -T. Yeh, and J. C. Hwang.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 161-164, 5 fig, 10 ref.

Descriptors: *Mathematical analysis, *Finite element method, *Path of pollutants, *Groundwater movement, *Groundwater pollution, Computer programs, Groundwater, Galerkin Finite Element Method.

By using subregion iteration with the orthogonal weighting finite element method for computating large-field problems of groundwater solute transport, CPU memory requirement can be drastically reduced. The convergence rate is enhanced over the pointwise iteration method. The use of orthogonal weighting functions assures convergence because the resulting coefficient matrix is always irreducible and diagonally dominant. Such properties of a matrix are closely tied to the sufficient conditions for the convergence of an iteration method. Computer runs for test problems were carried out for 10 x 10, 30 x 30 and 50 x 50 grid systems with 2,3 and 4 subregions. The CPU memory and CPU time were monitored during each run. The numbers of iterations required for convergence in each time step were also recorded. The results are useful information for the determination of the number of subregions required for a given computer memory capacity and for the estimation of the CPU time using the subregion iteration method. (Author's abstract)
W86-04085

SOME CONCEPTS PERTAINING TO INVESTIGATIVE METHODOLOGY FOR SUBSURFACE PROCESS RESEARCH,

Robert S. Kerr Environmental Research Lab., Ada, OK.
W. J. Dunlap.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 167-172, 5 fig, 7 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Groundwater pollution, *Soil columns, Core drilling, Aquifers, Groundwater, Microcosm systems, Subsurface water, Investigative methodology.

Problems of investigative methodology comprise a critical and often preponderant element of research to delineate and quantitate processes which govern the transport and fate of pollutants in subsurface environments. Examination of several recent research studies illustrates that both laboratory and field (in-situ) methodologies are useful in subsurface processes research, but also clearly shows that such research involves formidable methodological problems which result primarily from the nature of terrestrial subsurface environments. Such environments are usually remote and relatively inaccessible. This causes major methodological problems in acquiring authentic, uncontaminated samples of water and/or solids for analysis and microcosm construction. Subsurface environments are also highly structured and often exhibit significant heterogeneity across relatively short distances, which causes difficulties in determining proper locations for sample acquisitions and in simulating subsurface environments in the laboratory. Finally, slow rates of movement and long residence times of water and pollutants within subsurface environments are responsible for methodological problems associated with the need to detect and characterize processes occurring at very slow rates. Advances in a number of diverse areas, including particularly geophysical methods, analytical procedures, microcosm technology, and drilling, coring, and well completion techniques, are required for needed improvements in methodology for subsurface processes research. (Author's abstract)
W86-04086

STATISTICAL EXAMINATION OF SMALL-SCALE SPATIAL VARIABILITY OF VOLATILE ORGANIC COMPOUNDS AND INORGANIC ANIONS IN GROUNDWATER,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. E. Barbash, and J. F. Barker.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston,

Texas. (1985). p 177-180, 6 fig, 2 tab, 11 ref.

Descriptors: *Statistical analysis, *Organic compounds, *Inorganic compounds, *Groundwater pollution, Spatial distribution, Groundwater movement, Volatile organic compounds, Landfills, Aquifers, Groundwater.

One approach to the study of processes governing the fate of chemical contaminants in groundwater is the detailed examination of previously contaminated systems. A chi-square analysis of the distributions of nine volatile organic compounds (VOCs) and three inorganic anions in the groundwater in unconsolidated sediments beneath an abandoned landfill near Ottawa, Ontario indicates that the small-scale (1 m) spatial variability of contaminant concentrations is significantly higher for VOCs than for inorganic species. While concentration versus-depth profiles for inorganics are relatively 'smooth,' corresponding VOC profiles are highly irregular, with concentrations in points spaced one meter apart often differing by one to four orders of magnitude. Differences in spatial heterogeneity between three VOCs and the inorganic species were statistically significant close to the inferred source area, but non-significant in wells further down-gradient. The description of the spatial distribution of contaminants in unconsolidated aquifers may therefore require a much higher density of sampling points for VOCs than for inorganic species. (Author's abstract)
W86-04089

IN-SITU DETERMINATION OF DISPERSION COEFFICIENTS AND ADSORPTION PARAMETERS FOR CONTAMINANTS USING A PUSH-PULL TEST,

Insitu Consulting, Laramie, WY.
A. C. Bumb, I. J. Drever, and C. R. McKee.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 186-190, 6 fig, 19 ref.

Descriptors: *In-situ tests, *Groundwater movement, *Mathematical analysis, *Path of pollutants, Dispersion, Adsorption, Aquifers, Groundwater pollution.

This paper describes a practical in-situ test procedure for measuring dispersion coefficients and adsorption parameters. The procedure involves injection of a relatively small volume of groundwater spiked with the solute of interest and subsequent production of fluid. Laboratory experiments are required to define the form of the adsorption equation, and to determine the volume and concentrations to be injected. The dispersion coefficient is determined by history matching the effluent composition of a non-adsorbing species, for which total anions is an alternative, against the computer results. The adsorption parameters are then determined by history-matching the effluent composition against the computer results. A computer program has been developed which uses any one of several adsorption equations. A boundary condition used in previous studies is shown to be in error, and the current boundary condition is presented. (Author's abstract)
W86-04092

SIMPLIFIED GROUNDWATER SAMPLING TECHNIQUES AT LANDFILLS,

Beling Consultants, Inc., Moline, IL.
R. L. Schaffer, and J. F. Merchie.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 208-209.

Descriptors: *Groundwater, *Water sampling, *Landfills, *Water analysis, Groundwater pollution, Monitoring, Wells, Statistical analysis, Sampling.

The Department of Water, Air and Waste Management (WAWM) for the State of Iowa established protocol for groundwater sample collection at landfills. A 'non-protocol' collection technique was used at the Clinton County Area Solid Waste Agency (CCASWA), East Landfill Site, in Clinton, Iowa, to reduce labor costs. When three (3) successive semi-annual sample analyses exceeded the lead concentration standard at a single monitoring well for the municipal landfill, WAWM requested a comprehensive and costly site investigation. Subsequently, a reduced scope of investigation was negotiated between WAWM and CCASWA. WAWM agreed that, if the reduced scope investigation could prove (1) that non-protocol sampling was environmentally conservative, and (2) there was no tendency for increased lead concentration with respect to time, then the CCASWA could continue non-protocol sampling, so long as groundwater contamination levels were below the threshhold limits. A statistical analysis of the difference between the collection techniques indicated the non-protocol technique is environmentally conservative compared to the protocol collection technique, with a 90% degree of confidence. Regression analysis of the laboratory tests of non-protocol-collected samples indicated there was no tendency for increased lead concentration with time. (Author's abstract)
W86-04098

INDICES IDENTIFYING SUBSURFACE MICROBIAL COMMUNITIES THAT ARE ADAPTED TO ORGANIC POLLUTION,

Florida State Univ., Tallahassee. Center for Biomedical and Toxicological Research.
G. A. Smith, J. S. Nickels, J. D. Davis, R. H. Findlay, and P. S. Vashio.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 210-213, 1 fig, 3 tab, 19 ref.

Descriptors: *Subsurface water, *Organic compounds, *Groundwater pollution, *Microbiological studies, *Microenvironment, Groundwater, Water analysis, Biological analysis.

The subsurface microbiota and their extracellular excretion products are of primary importance in the maintenance of the ground water resources particularly when the water is polluted. With the development of quantitative biochemical assays for biomass, community structure, and metabolic activities of the microbes of the subsurface sediments, it proved possible to search for assays that correlated with exposure to pollution. The subsurface sediments from an abandoned creosote waste deposit showed that exposure to pollution increased the total microbial biomass as measured by the extractable phospholipid; shifted the community structure by decreasing the proportion of gram positive bacteria that form glycerol teichoic acids and induced distinctive changes in the ester-linked phospholipid fatty acids. Pollution of the subsurface sediments caused a shift in the nutritional status to a more balanced growth condition in the unsaturated zone reflected in an increased rate of phospholipid formation relative to the formation of the endogenous storage polymer beta hydroxyalkanoate measured after a short exposure to 14C-acetate. In the saturated zone, contamination induced unbalanced growth. (Author's abstract)
W86-04099

MODELS FOR POLLUTED STREAMS SUBJECT TO FAST PURIFICATION,

Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Water Research WATRAG, Vol. 20, No. 1, p 1-8, January 1986. 2 fig, 4 ref.

Descriptors: *Model studies, *Mathematical models, *Water pollution, *Organic compounds, Assimilative capacity, Wastewater, Self-purification, Biological oxygen demand, Dissolved oxygen, Wastewater outfalls, Rivers.

The classic Streeter-Phelps models for stream analysis, though in use for the last five decades, are of little value for an accurate prediction of polluted streams' BOD and DO sag parameters, because they do not account for bioflocculation taking place after the sewage outfalls into streams as a result of which, settleable BOD, a significant component of the total BOD, is removed in short distances. The extremely fast BOD assimilation in rivers Ganga and Yamuna of the Indogangetic plain modelled for the physico-chemical linear removal of the settleable BOD and exponential decay of the nonsettleable BOD, has been utilized for evolving models for accurate prediction of DO sag parameters and BOD in point and nonpoint systems of waste outfalls. Case examples have been presented for illustrating the computation of compound DO sag resulting from multi-waste outfalls, and to show the superiority of a point system over the nonpoint system of waste disposal. (Lantz-PTT)
W86-04101

COMPARISON OF TWO RIVER QUALITY MODELS,

Birmingham Univ. (England). Dept. of Civil Engineering.
R. W. Crabtree, I. D. Cluckie, C. F. Forster, and C. P. Crockett.
Water Research WATRAG, Vol. 20, No. 1, p 53-61, January 1986. 4 fig, 6 tab, 18 ref, 1 append.

Descriptors: *Model studies, *Rivers, *Water quality, Comparison studies, Modelling, Blackwater model, Thames Water Authority, England.

Two deterministic river quality models are evaluated and compared by applying them to the R. Blackwater. The first model, Qual-II is a general purpose universal model developed by the United States Environment Protection Agency and the second a version of the Water Research Centre river quality model (Blackwater model) developed specifically for the R. Blackwater by Thames Water Authority but is no longer in use. After model calibration, the general Qual-II model produced a closer prediction than the Blackwater model, when compared with observed data. The main reason for the differences in the model results was considered to be the treatment of non-point input sources. The results suggest that if modelling resources are limited, the Qual-II model can be applied rather than a river specific model. (Author's Abstract)
W86-04108

NITROGEN-ISOTOPE STUDY OF THE SOURCE OF NITRATE CONTAMINATION IN GROUNDWATER OF THE PLEISTOCENE COASTAL PLAIN AQUIFER, ISRAEL,

Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
N. Kaplan, and M. Magaritz.
Water Research WATRAG, Vol. 20, No. 2, p 131-135, February 1986. 1 fig, 3 tab, 24 ref.

Descriptors: *Groundwater pollution, *Fertilizers, *Nitrates, *Isotope studies, Nitrogen isotope, Coastal aquifers, Israel, Radioisotopes, Wastewater irrigation.

An elevated level of NO3(-) (mean value for 1981 was 53 mg/1 NO3(-) as NO3(-)) occurs in phreatic groundwater in the Coastal Plain sandy aquifer, Israel. NO3(-) in water with a wide range of concentrations has delta 15N in the range c.f +4.7 to +11.4 parts per thousand, suggesting derivation from oxidation of soil organic matter and (in specific cases) from animal wastes. Only one sample has delta 15N=-0.3 parts per thousand that would indicate derivation through fertilizer application. Water from sewage treatment plant used for irrigation, or for filtration into the aquifer, is highly enriched in 15N (+19.2 to +28.8 parts per thousand), reflecting ammonia volatilization. The isotopic data are consistent with the models previously published, which suggest that the main sources of NO3(-) contamination in groundwater in the region are: oxidation of organic matter during cultivation of virgin land and swamp reclamation. (Author's abstract)
W86-04119

COMPARISON OF POSITIVELY CHARGED MEMBRANE FILTERS AND THEIR USE IN CONCENTRATING BACTERIOPHAGES IN WATER,

Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
For primary bibliographic entry see Field 5A.
W86-04121

STATIC SHAKE-FLASK BIOTRANSFORMATION OF ENDOTHALL,

North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-04132

BEHAVIOR OF METHYLTIN COMPOUNDS UNDER SIMULATED ESTUARINE CONDITIONS,

New Hampshire Univ., Durham. Dept. of Chemistry.
O. F. X. Donard, and J. H. Weber.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1104-1110 November 1985. 3 fig, 2 tab, 24 ref.

Descriptors: *Fate of pollutants, *Estuaries, *Simulation analysis, *Metal organic pesticides, *Model studies, *Methyltin compounds, Tin, Pollutant identification, Industrial wastes, Models, Heavy metals, Fulvic acids, Separation techniques.

A 2 to the third power factorial design is used to study the behavior of MeSnCl3, Me2SnCl2, and Me3SnCl under laboratory-simulated estuarine conditions. The quaternary system includes methyltin ions ([illegible] ng/liter as Sn), ionic strength (0-35 g of NaCl/liter), fulvic acid (0-25 milligrams/ liter), and hydrous iron oxides (0-1000 milligrams/liter). Analysis of methyltin compounds involves hydride generation, separation by chromatographic packing material, atomization in a heated quartz furnace, and detection by atomic absorption spectroscopy. Removal of organotin compounds from solution after filtration at 0.4 micrometers is from 83 to 100% for MeSnCl3, from 28 to 66% for Me2SnCl2, and from 15 to 28% for Me3SnCl. Increasing ionic strength inhibits the removal of MeSnCl3 and Me2SnCl2. Fulvic acid concentration contributes to increased removal of organotin compounds in saline waters but prevents adsorption of Me2SnCl2 under freshwater-simulated conditions. Higher iron oxide concentration enhances removal of MeSnCl3 and Me2SnCl2 but has little effect on Me3SnCl. This discusses mechanisms involved and relates them to estuarine processes. (Author's abstract)
W86-04133

SEASONAL VARIATION IN WEATHERING AND TOXICITY OF CRUDE OIL ON SEAWATER UNDER ARCTIC CONDITIONS,

Tromsoe Univ. (Norway). Dept. of Chemistry.
L. K. Sydnes, T. H. Hemmingsen, S. Skare, S. H. Hansen, and I. B. Falk-Petersen.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1076-1081 November 1985. Project Nos. 312, 406, and 505.

Descriptors: *Toxicity, *Oil, *Seawater, *Arctic, *Weathering, Degradation, Diatoms, Echinoderms, Marine animals, Marine plants, Arctic zone, Oil spills, Oil pollution, Oxidation, decomposition, Fate of pollutants, Seasonal variation, Skeletonema costatum, Strongylocentrotus droebachiensis, Strongylocentrotus droebachiensis.

Laboratory experiments were carried out to assess how the natural variation in solar energy influx in an arctic area would affect the formation of photoproducts with respect to oxygen content, water solubility, and toxicity. Experiments, lasting for 14 days, were carried out each month from February 1983 to January 1984. Studies on the weathering of Ekofisk crude oil in seawater showed that the oil composition is affected mainly by evaporation during October to February. During the rest of the year the composition is considerably influenced by photooxidation and subsequent dissolution of polar oxidation products in the water phase. The phototoxicity of the seawater samples to the marine diatom Skeletonema costatum was tested immediately after weathering. The toxicity of the seawater samples was evaluated in sea urchin eggs from Strongylocentrotus droebachiensis and S. pallidus. Results of the biological tests clearly show that the toxicity of the water-soluble oil fraction depends on the conditions persisting during the weathering period. Polar oxidation products present in the water phase are toxic and may represent a hazard to marine organisms in the Arctic spring and summer. (Geiger - PTT)
W86-04134

SCAVENGING OF AIRBORNE POLYCYCLIC AROMATIC HYDROCARBONS BY RAIN,

Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands). Lab. for Ecology, Water and Drinking Water.
P. C. M. van Noort, and E. Wondergem.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1044-1048 November 1985. 2 fig, 6 tab, 16 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Air pollution, *Acid precipitation, *Fate of pollutants, *Chemistry of precipitation, Precipitation, Rain, Organic compounds.

The variation of the concentrations of some polycyclic aromatic hydrocarbons in rain with time during three precipitation events was determined. On all occasions these concentrations were found to decrease during the precipitation events. The apparent removal rate constants on a precipitation amount base for two of the three events were calculated to be 1.46 and ca. 3/mm. For the third event the concentration decrease did not allow the calculation of the apparent removal rate constant. Furthermore, concentrations of polycyclic aromatic hydrocarbons in rain sampled simultaneously at ground level and at an altitude of 200 m were determined. These measurements demonstrate that concentrations of phenanthrene and fluoranthene in rainwater at ground level are noticeably higher than those at 200 m. No significant differences in concentrations of benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h) anthracene, benzo(ghi)-perylene, and indeno(1,2,3-cd)pyrene in rain at the two altitude were found. It is concluded on the basis of these findings that at least on the event, with sampling at two altitudes, the main process responsible for the presence of phenanthrene in rain is below-cloud gas-phase scavenging and that for the other compounds except fluoranthene and benz(a)anthracene it holds that in-cloud scavenging is the main process; for fluoranthene and benz(a)anthracene below-cloud gas-phase scavenging and in-cloud scavenging are about equally important. (Author's abstract)
W86-04135

ORGANIC EMISSIONS FROM SHALE OIL WASTEWATERS AND THEIR IMPLICATIONS FOR AIR QUALITY,

Colorado Univ. at Boulder. Dept. of Chemistry.
S. B. Hawthorne, R. E. Sievers, and R. M. Barkley.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 992-997, October 1985. 4 tab, 29 ref.

Descriptors: *Organic compounds, *Oil shale, *Industrial wastewater, *Air pollution, *Fate of pollutants, Organic wastes, Shales, Wastewater, Phenols, Aromatic compounds, Hydrocarbons, Path of Pollutants, Henry's Law.

The emission of organic compounds from shale oil wastewaters used to cool hot, retorted, spent oil shale and for codisposal with retorted shale was investigated. The major classes of compounds emitted are aromatic nitrogen-containing compounds, ketones, phenols, and nitriles, the same as those previously reported to be emitted from wastewaters exposed to air at room temperature. A gas-stripping method was modified to allow the determination of several Henry's law constants (H) simultaneously. Measured values of H for these solutes in the wastewaters (.0001-.00001 atm cu m/mol) generally agreed with values determined for solutes in pure water, indicating that the wastewater matrix has little effect on H. Air samples collected in regions likely to be affected by atmospheric emissions from the shale oil industry had no detectable levels of the major organic species that are emitted from shale oil wastewaters, indicating that these species may be useful in tracing pollutant air masses resulting from shale oil production. (Author's abstract)
W86-04138

MICROBIAL TRANSFORMATIONS OF SUBSTITUTED BENZENES DURING INFILTRATION OF RIVER WATER TO GROUNDWATER: LABORATORY COLUMN STUDIES,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
E. P. Kuhn, P. J. Colberg, J. L. Schoor, O. Wanner, and A. J. B. Zehnder.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 961-968, October 1985. 7 fig, 27 ref.

Descriptors: *Biotransformation, *Microbial degradation, *Fate of pollutants, *Benzenes, *Infiltration, Biodegradation, Organic compounds, Hydrocarbons, Path of pollutants, Groundwater pollution, Aquifers, Anaerobic conditions, Groundwater movement, Aerobic conditions, Simulation analysis.

The microbial transformations of dimethyl- and dichlorobenzenes have been studied in laboratory aquifer columns simulating saturated-flow conditions typical for a river water/groundwater infiltration system. The behavior of all compounds in the laboratory was qualitatively the same as that observed at a field site. Both dimethyl- and dichlorobenzes were biotransformed under aerobic conditions, the dimethylbenzenes faster than the chlorinated analogues. Evidence is presented that dimethyl-benzenes are degraded by denitrifying bacteria under anaerobic conditions. Dichlorobenzenes were not transformed under these conditions. Significant differences in the rate of transformation between isomers were found. The dimethylbenzenes and p-dichlorobenzene appeared to be utilized by bacteria as sole carbon and energy sources. Transfer of rate constants determined in the laboratory at elevated substrate concentrations to the field was difficult. (Author's abstract)
W86-04139

CLIMATOLOGICAL VARIABILITY,

Argonne National Lab., IL.
D. G. Streets, B. M. Leaht, J. D. Shannon, and T. D. Veselka.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 887-983, October 1985. 2 fig, 4 tab, 13 ref.

Descriptors: *Model studies, *Climatic data, *Acid rain, *Sulfur, *Fate of pollutants, Sulfate, Models, Path of pollutants, Air pollution, Climatology, Deposition, Meteorological data collections, Cost analysis, Sulfur dioxide.

This articles examines how a control strategy for acid deposition might vary when optimized under different assumptions about future meteorological conditions. The Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model was used to simulate long-term deposition of sulfur oxides in the United States from 1976 to 1981. To calculate source-receptor matrices, electric utility emissions within each state were mapped in a horizontal grid on the same spatial scale as precipitation. The deposition (wet, dry, and total) of total sulfur dioxide (sulfur dioxide plus sulfate) as equivalent sulfate was computed for nine sensitive receptor regions. Source-receptor matrices were determined for each annual period and for an average data set covering the 6-yr period. Wet deposition and total deposition matrices were constructed, making 14 matrices in all. Results showed that wet deposition is more variable than dry deposition and that receptor areas remote from major source regions show more variation than receptor areas near source regions. The higher the deposition reduction required, the greater the susceptibility of the optimum strategy to climatological variation. Strategies designed to achieve an absolute level of wet deposition are considerably more sensitive to

meteorological variability than those designed to achieve a specified percentage of reduction in wet deposition. (Geiger - PTT)
W86-04140

MIGRATION OF WOOD-PRESERVING CHEMICALS IN CONTAMINATED GROUNDWATER IN A SAND AQUIFER AT PENSACOLA, FLORIDA,

Geological Survey, Menlo Park, CA.
D. F. Goerlitz, D. E. Troutman, E. M. Godsy, and B. J. Franks.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 955-961, October 1985. 4 fig, 8 tab, 10 ref.

Descriptors: *Phenols, *Creosote, *Groundwater pollution, *Sand aquifers, *Fate of pollutants, *Pensacola, *Florida, Industrial wastes, Path of pollutants, Biotransformation, Sorption, Aquifers, Organic compounds, Industrial wastewater, Biodegradation, Pentachlorophenol, Reservoirs, Naphtalene.

Operation of a wood-preserving facility for nearly 80 yr at Pensacola, Florida, contaminated the near-surface groundwater with creosote and pentachlorophenol (PCP). The major source of aquifer contamination was unlined surface impoundments that were in direct hydraulic contact with the groundwater. Episodes of overtopping the impoundments and overland flow of treatment liquor and waste were also significant to the migration and contamination of the groundwater. Solutes contaminating the groundwater are mainly naphthalene and substituted phenols. Sorption did not influence retardation of solutes in transport in the groundwater. Phenol and the mono substituted methyl-phenols appear to be undergoing biotransformation. PCP was not found in significant concentrations in the groundwater possibly because the solubility of PCP is approximately 5 milligrams/liter at pH 6, near the average acidity for the groundwater. (Author's abstract)
W86-04141

NUMERICAL MODELING OF IMMISCIBLE ORGANIC TRANSPORT AT THE HYDE PARK LANDFILL,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
M. Osborne, and J. Sykes.
Water Resources Research WRERAO, Vol. 22, No. 1, p 25-33, January 1986.

Descriptors: *Numerical analysis, *Model studies, *Hyde Park Landfill, *Groundwater movement, Path of pollutants, Mathmatical models, Darcys Law, Simulation analysis, Niagara Falls, New York, Chemical wastes.

A two-dimensional two-phase mathematical model based on Darcy's law and conservation of mass for each liquid is presented. The numerical model is based on a generalized method of weighted residuals in conjunction with the finite element method and linear quadrilateral isoparametric elements. To alleviate numerical problems associated with hyperbolic equations, upstream weighting of the spatial terms in the model have been incorporated. The theoretical and numerical accuracy of the model is verified by comparison of simulation results with those from an existing one-dimensional two-phase flow simulator. The finite element model is used to simulate the migration of an immiscible organic solvent in groundwater, from a chemical waste disposal site located north of Niagara Falls, New York. The effects of uncertainty regarding porous media heterogeneities and anisotropy are examined, and it is concluded that the extent of immiscible contaminant migration is greatly sensitive to these parameters (Author's abstract)
W86-04158

POROUS FLOW MODEL FOR STEADY STATE TRANSPORT OF RADIUM IN GROUNDWATER,

Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics.
M. R. Davidson, and B. L. Dickson.
Water Resources Research WRERAO, Vol. 22, No. 1, p 34-44, January 1986. 5 fig, 1 tab, 43 ref, 1 append.

Descriptors: *Porous flow model, *Steady state transport, *Radium, *Groundwater movement, Groundwater pollution, Uranium, Thorium, Aquifers, Flow pattern, Adsorption.

The quasi-steady variation of uranium and radium isotopes from the decay of 238-U, 235-U, and 232-Th has been determined along an idealized, one-dimensional aquifer which is a distributed source of activity and from which the transfer of radionuclides to solution occurs by alpha recoil and chemical exchange. The model includes the effects of dispersive flow and retardation by adsorption. The importance of these effects on the variation of U and Ra activity ratios along the model aquifer is shown. Predicted limiting activity ratios (for large flow times) of 226-Ra/223-Ra, 224-Ra/228-Ra, and 226-Ra/228-Ra are 21.4, 1.5, and (approximately 1.7-2.0) (U/Th sub s), respectively (where U/Th sub s) is the activity ratio 238-U/232-Th in the aquifer rocks), although in many cases, an aquifer may not be long enough for the ratios involving 226-Ra to achieve their limiting values. (Author's abstract)
W86-04159

ORIGIN AND DISTRIBUTION OF SULFATE IN A FRACTURED TILL IN SOUTHERN ALBERTA, CANADA,

Department of Agriculture, Lethbridge (Alberta). Groundwater Section.
For primary bibliographic entry see Field 2K.
W86-04160

RIVER LOADS UNDERESTIMATED BY RATING CURVES,

Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.
Water Resources Research WRERAO, Vol. 22, No. 1, p 74-76, January 1986. 3 fig, 8 ref.

Descriptors: *River loads, *Rating curves, *Statistical analysis, Sediment load, Solute load, Pollution load, Least squares method, Simulation analysis, Mathematical studies.

Statistical considerations show that the sediment, solute, or pollutant load of a river is likely to be underestimated by methods in which unmeasured concentrations are estimated from discharge using a least squares regression for the logarithm of concentration. The degree of underestimation increases with the degree of scatter about the rating curve and can reach 50%. A simple correction factor, of 2.65 sq s, is proposed and tested successfully on simulated and real data sets. (Author's abstract)
W86-04162

FUNDAMENTAL PROBLEMS IN THE STOCHASTIC CONVECTION-DISPERSION MODEL OF SOLUTE TRANSPORT IN AQUIFERS AND FIELD SOILS,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, W. A. Jury, and V. K. Gupta.
Water Resources Research WRERAO, Vol. 22, No. 1, p 77-88, January 1986. 78 ref. NSF Grant Nos. CEE-79-20778-03 and CEE-79-8004499.

Descriptors: *Stochastic Hydrology, *Convection, *Solute transport, *Aquifers, *Soils, Convection-dispersion equation, Groundwater movement, Mathematical studies, Field tests, Path of pollutants.

The stochastic convection-dispersion equation (CDE) and its application to field scale subsurface solute transport are investigated with respect to their physical and mathematical foundations. It is shown that even the best-developed stochastic CDE models involve physical approximations and mathematical assumptions which stand in need of much more rigorous theoretical study and detailed field experimentation. The stochastic convection-dispersion model does not yet resolve clearly the mathematical conditions necessary in order to relate the mean solute concentration calculated with a field scale stochastic CDE to measured values of the solute concentration calculated with a field experiment. The 'scale effect' in respect to solute dispersion coefficients has been studied only under conditions in which results of little predictive value can be obtained. Without the clarification of these and other fundamental issues raised in the present paper, it seems prudent to conclude that additional theoretical research on field scale solute dispersion is needed and that the stochastic convection-dispersion model does not yet warrant unqualified use as a quantitative predictive tool in the management of solute movement in aquifers and field soils. (Author's abstract)
W86-04163

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 1. ESTIMATION TECHNIQUES,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04168

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 2. VERIFICATION AND APPLICATIONS,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04169

SOLUTE DISPERSION IN MULTIDIMENSIONAL PERIODIC SATURATED PORUS MEDIA,

Mississippi Univ., University. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W86-04170

STOCHASTIC MODELING OF THE SPACE-TIME STRUCTURE OF ATMOSPHERIC CHEMICAL DEPOSITION,

Washington Univ., Seattle. Geophysics Program.
G. D. Egbert, and D. P. Lettenmaier.
Water Resources Research WRERAO, Vol. 22, No. 2, p 165-179, February 1986. 11 fig, 2 tab, 18 ref, 1 append.

Descriptors: *Acid rain, *Stochastic hydrology, *Model studies, *Air pollution, *Rainfall, *Chemistry of precipitation, *Time series analysis, Stochastic models, Isotropy, Anisotropy, Hydrogen ion concentration, Sulfates, Spatial distribution.

A multivariate space-time stochastic model suitable for the analysis of weekly atmospheric chemistry wet deposition measurements is described. The model is heirarchical, with weekly ion concentration fields represented as the sum of a persistent long-term mean field, and yearly and weekly variation fields. A simple method of moments estimation scheme is proposed which exploits the heirarchical nature of the model to separate spatial structure at weekly, yearly, and persistent time scales. Estimation of both isotropic and anisotropic covariance functions are considered. The model was applied to precipitation, sulfate concentration, and pH measurements made in the Northeastern United States during 1980-1981. While significant spatial correlation was found at weekly and longer (long-term mean) time scales, there was little or no temporal correlation. The observed spatial correlation was substantially anisotropic, particularly for precipitation and sulfate concentration fields. The anisotropy, as well as correlation length scales, showed strong seasonal variations. Substantial differences were apparent in the spatial structure of pH and sulfate, with sulfate more closely linked to precipitation. An application of a multivariate version of the model showed that the spatial structure of the sulfate fields is not due solely to the spatial

structure of the precipitation fields. (Author's abstract)
W86-04171

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL: 1. FUNDAMENTAL CONCEPTS,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2G.
W86-04177

INVESTIGATIONS ABOUT THE FATE OF HEAVY METALS IN LAKES: 1. THE ROLE OF FERROUS OXIDIZING BACTERIA TO COPRECIPITATION OF HEAVY METALS (UNTERSUCHUNGEN ZUM VERHALTEN VON SCHWERMETALLEN IN GEWASSERN: 1. DIE BEDEUTUNG EISENOXIDIERENDER BAKTERIEN DUR DIE KOPRAZIPATION VON SCHWERMETALLEN),

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
V. G. Gunkel.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 489-515, February 1986. 11 fig, 1 tab, 34 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Lakes, *Iron bacteria, Plankton, Berlin, West Germany, Siderocapsa treubii, Biomass, Stratification, Iron, Manganese, Aluminum, Zinc, Nickel, Copper, Oxygen deficit.

Occurrence of planktonic iron oxidizing bacteria is given for two urban lakes in Berlin (West) with different man made charge. Dominant genus of iron oxidizing bacteria is Siderocapsa Treubii in these lakes, besides Ochrobium tectum regularly occurs during the year. Planctomyces bekefii and Metallogenium personatum are periodically found with low quantity. Siderocapsa treubii reaches high densities up to 17,000 colonies/ml, whereas Ochrobium tectum occurs with less than 1,000 colonies/ml. In summer during stratification of the lakes Siderocapsa shows a vertical stratification of number of colonies and of biomass. The stratification is more significant when the hypolimnion becomes anoxic. The maximum of Siderocapsa treubii occurs in the oxic area directly above the anoxic water body. At the same time an increase in colony number and biomass of Siderocapsa is found during period of redox chemical mobilization of iron and manganese. These results indicate that distribution of Siderocapsa treubii in the lake is not influenced by magnitude of oxygen content of water. The stratification of Siderocapsa treubii is a consequence of sedimentation in stratified lakes as well as of a rise of colonies from the anoxic water body after solution of deposition on cells. This leads to an internal iron and manganese cycling in lakes. The method of Energy Dispersive X-Ray Microanalysis with Scanning Electron Microscopy (SEM-EDS) is applied to ferric hydroxide crusts of Siderocapsa treubii. The crusts mainly consist of iron, sometimes small amounts of manganese are detectable. Aluminum and zinc occur in all samples with high concentrations, while titan, nickel and copper sometimes occur with small amounts. Obviously these metals are adsorbed to the ferric hydroxide crusts. (Lantz-PTT)
W86-04188

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: MODEL DEVELOPMENT AND PARAMETER SENSITIVITY,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, N. J. Hutzler, and D. G. Geyer.
Water Resources Research WRERAO, Vol. 22, No. 3, p 271-284, March 1986. 8 fig, 2 tab, 38 ref. EPA Contract No. R809464-01-0 and NSF Grant No. CEE-8200213.

Descriptors: *Organic compounds, *Groundwater movement, *Model studies, *Groundwater pollution, *Path of pollutants, Hydrologic models, Soil columns, Mathematical studies, Sensitivity analysis, Soil absorption capacity, Saturated soils.

A model which includes the transport and retardation mechanisms of advective flow, axial dispersion, liquid-phase mass transfer, diffusion into immobile liquid, and local adsorption equilibrium, was developed to describe the migration of nondegradable, organic chemicals through a column of saturated, aggregated soil. A range of simplifying assumptions were explored to assess the relative importance of the various mechanisms. Solutions to the model were either adapted from the literature or derived from mass balances and mass transfer principles. The most general form of the model required the development of numerical solutions. Soil column breakthrough predictions in terms of relative concentration as a function of total column pore volumes fed can be characterized by seven independent dimensionless parameters: the Peclet number, the Stanton number, a pore diffusion modulus, a surface diffusion modulus, an adsorbed solute distribution ratio, an immobile fluid solute distribution ratio, and the Freundlich parameter 1/n. For a strongly adsorbed chemical in long soil columns, a fifteen fold decrease of the Peclet number, a fivefold decrease of the Stanton number, or a onefold decrease in either the pore diffusion modulus or the surface diffusion modulus have an equivalent effect on the spreading of the breakthrough curve. The breakthrough curve tends to sharpen for favorably adsorbed chemical species ($1/n<1.0$) and spread when adsorption is unfavorable ($1/n>1.0$). The movement of chemical is retarded as the solute distribution ratios increase. A sensitivity analysis of model parameters, which were derived from literature correlations, column geometry, soil adsorption isotherms, and breakthrough curves, showed that adsorption capacity, adsorption intensity, and aggregate geometry have the greatest effect on chemical retardation and spreading, while liquid-phase mass transfer has little effect. (See also W86-04191) (Lantz-PTT)
W86-04190

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: EXPERIMENTAL RESULTS,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
N. J. Hutzler, J. C. Crittenden, and J. S. Gierke.
Water Resources Research WRERAO, Vol. 22, No. 3, p 285-295, March 1986. 7 fig, 5 tab, 19 ref. EPA Grant No. R809464-01-0.

Descriptors: *Organic compounds, *Groundwater movement, *Model studies, *Groundwater pollution, *Path of pollutants, Hydrologic models, Soil columns, Mathematical studies, Sensitivity analysis, Soil absorption capacity, Groundwater pollution, Saturated soils.

Measured breakthrough and elution curves for trichloroethene, bromoform, and chloride in columns of a sandy loam soil were compared to various models describing one-dimensional chemical transport through saturated soil columns. The local equilibrium model and the segregated flow model approximate the retardation of organic chemicals but do not account for the amount of spreading seen in the breakthrough and elution data. A dispersed flow, local equilibrium model (DFLEM) could simulate the breakthrough of the organic chemicals and tracer, but only if the axial dispersion coefficient was adjusted to match the breakthrough data. Existing correlations for axial dispersion based on soil and fluid properties could not predict the apparent dispersion seen in the miscible displacement experiments. A dispersed flow, pore and surface diffusion model (DFPSDM) could also simulate the chemical breakthrough if an aggregate radius were adjusted to fit the data. Neither the adjusted radii nor the apparent dispersivities could be related to the hydraulic characteristics of the column or to soil properties. Both models were able to reasonably predict the elution of chemicals from the column when either an aggregate radius or an apparent dispersivity were estimated from the breakthrough data. Neither the DFLEM nor the DFPSDM were able to predict the increased asymmetry or the leftward shift of the breakthrough data when the average pore water velocity was increased from 12.0 to 36.6 cm/h. While the DFPSDM appears to be more phenomenologically correct, this work suggests that an additional kinetic mechanism should be included in the model. (See also W86-04190) (Lantz-PTT)
W86-04191

MODELING CONTAMINATION OF SHALLOW UNCONFINED AQUIFERS THROUGH INFILTRATION BEDS,

Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. W. Ostendorf.
Water Resources Research WRERAO, Vol. 22, No. 3, p 375-382, March 1986. 5 fig, 1 tab, 17 ref, append.

Descriptors: *Unconfined aquifers, *Infiltration, *Path of pollutants, *Hydrologic models, Groundwater pollution, Simulation analysis, Flow pattern, Chloride, Nitrogen, Boron, Detergents, Wastewater treatment, Massachusetts.

The transport of a simply reactive contaminant through an infiltration bed and underlying shallow, one-dimensional, unconfined aquifer with a plane, steeply sloping bottom in the assumed absence of dispersion and downgradient dilution, is modeled. The effluent discharge and ambient groundwater flow under the infiltration beds are presumed to form a vertically mixed plume marked by an appreciable radial velocity component in the near field flow region. The near field analysis routes effluent contamination as a single linear reservoir whose output forms a source plane for the one-dimensional, far field flow region downgradient of the facility; the location and width of the source plane reflect the relative strengths of ambient flow and effluent discharge. Modeled are far field contaminant transport, using an existing method of characteristics solution with frame speeds modified by recharge, bottom slope, and linear adsorption, and concentrations reflecting first-order reaction kinetics. The near and far field models simulate transport of synthetic detergents, chloride, total nitrogen, and boron in a contaminant plume at the Otis Air Force Base sewage treatment plant in Barnstable County, Massachusetts, with reasonable accuracy. (Lantz-PTT)
W86-04201

CONSTRAINTS ON THE VALIDITY OF EQUILIBRIUM AND FIRST-ORDER KINETIC TRANSPORT MODELS IN STRUCTURED SOILS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 2G.
W86-04203

EFFECTIVE AND INEXPENSIVE GAS-DRIVE GROUND WATER SAMPLER,

GHR Environmental, Inc., New Bedford, MA.
W. R. Norman.
Groundwater Monitoring Review, Vol. 6, No. 2, p 56-60, Spring 1986. 3 fig, 1 tab, 5 ref.

Descriptors: *Groundwater pollution, *Water sampling, *Drilling, *Cost analysis, Groundwater management, Piezometric heads, Aquifers, Geohydrology, Measuring instruments.

Groundwater scientists engaged in the assessment of contaminant occurrence and migration are faced with a number of practical problems. These problems include, but are not limited to: (1) escalating drilling costs, (2) labor costs for proper sampling of monitoring wells, (3) collection of groundwater samples that are representative of aquifer conditions, and (4) accurate delineation of hydrogeologic regimes and the areal and vertical distribution of groundwater contaminants. In response to these problems, a number of groundwater sampling devices have been developed. One device is a gas-driven groundwater sampler developed for multilevel installation. Use of these samplers have been shown to decrease project costs and allow easy collection of high quality samples. However, the currently available samplers are relatively expensive, some of them operate on a closed check valve system, which does not allow determination of

piezometric heads in aquifers with fluctuating water tables and they are not adaptable to design changes in the field necessitated by site specific hydrogeologic conditions. An effective gas-driven sampler has been designed, which accomplishes the same objectives as the commercially available models, but is on the average, one-tenth the cost of currently available samplers. It offers the advantages of being more cost-effective than commercially available models, has an open check valve system to allow measurements of water table fluctuation and is easily adaptable in the field to meet site-specific hydrogeologic conditions. (Lantz-PTT)
W86-04208

FACTORS WHICH AFFECT SOIL-PORE LIQUID: A COMPARISON OF CURRENTLY AVAILABLE SAMPLERS WITH TWO NEW DESIGNS,

W. J. Hornby, J. D. Zabcik, and W. Crawley.
Groundwater Monitoring Review, Vol. 6, No. 2, p 61-66, Spring 1986. 9 fig, 27 ref.

Descriptors: *Soil water, *Soil porosity, *Water sampling, *Measuring instruments, *Soil-pore liquid samples, Monitoring, Groundwater pollution, Aeration zone.

The primary use of soil-pore liquid (SPL) monitoring is to detect pulses of contaminants moving through the unsaturated zone to groundwater. This type of pollutant detection monitoring is required at hazardous and some non-hazardous waste land treatment facilities throughout the United States. Presently available suction and free drainage SPL samplers were compared with two new SPL sampler designs for use in unsaturated zone monitoring programs. Comparisons and recommendations for appropriate SPL monitoring equipment were based on factors that influence sample quality. These factors are: (1) The nature of the matrix being sampled, (2) The nature of constituent being monitored, (3) Seasonal and site managerial influences on water movement, and (4) Site condition influence on available options for installation of monitoring equipment. (Lantz-PTT)
W86-04209

SAMPLING FOR TOXIC CONTAMINANTS IN GROUND WATER,

Kennedy/Jenks Engineers, San Francisco, CA.
G. W. Bryden, W. R. Mabey, and K. M. Robine.
Groundwater Monitoring Review, Vol. 6, No. 2, p 67-72, Spring 1986. 3 fig, 8 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Water sampling, Literature review, Groundwater management, Water quality control.

In the course of developing numerous groundwater monitoring programs, standardized protocols for groundwater monitoring well sampling, using proven technology and drawing from a consensus of research by leading groundwater specialists, have been instituted. This paper is an overview of findings from literature review and practical experience. Groundwater sampling techniques are related to the practical application of sampling for toxic contaminants in groundwater. Choices are addressed that must be made in choosing equipment for a particular project by going through a step-by-step procedure for collecting a groundwater sample from a typical monitoring well. Groundwater sampling topics that are discussed include: choice of equipment for purging and sampling a well, monitoring for purged groundwater indicators and quality assurance/quality control. (Lantz-PTT)
W86-04210

LOW-COST APPARATUS FOR ON-SITE MONITORING OF METHANE IN GROUND WATER,

Allegheny Coll., Meadville, PA. Dept. of Geology.
S. S. Harrison.
Groundwater Monitoring Review, Vol. 6, No. 2, p 73-76, Spring 1986. 4 fig, 1 tab, 2 ref.

Descriptors: *Monitoring, *Groundwater pollution, *Cost-analysis, *Methane, Gas volume monitoring apparatus, Laboratory equipment, Pressure-measuring instruments, Pennsylvania, New York.

An upsurge in oil- and gas-well drilling in northwestern Pennsylvania and western New York has been accompanied by several incidents of contamination of groundwater by methane. Determining which well is causing the contamination is extremely difficult if more than one gas or oil well is present in the area. The fact that the solubility of methane decreases as the pressure on groundwater decreases provides a quantitative basis for monitoring changes in the amount of methane in the groundwater. Quantitative measurements of the volume of methane given off by groundwater pumped from a well as the water enters atmospheric pressure permits detection of temporal changes in the gas content which are too subtle to be detected visually. These gas volume changes may, in some cases, be correlated with variations in the pressure of methane in the annulus of nearby individual gas/oil wells and may then provide a means of pinpointing the gas/oil well that is causing the methane contamination. The basic principle of the gas-volume monitoring apparatus (GVMA) described in this paper is that as a measured amount of groundwater enters atmospheric pressure the gas which comes out of solution is trapped and measured. The GVMA can be constructed of materials costing less than $100 and requires no special skills to assemble or operate. (Lantz-PTT)
W86-04211

NEW VALVED AND AIR-VENTED SURGE PLUNGER FOR DEVELOPING SMALL-DIAMETER MONITOR WELLS,

Battelle Project Management Div., Richland, WA. Office of Hazardous Waste Management.
R. Schalla, and R. W. Landick.
Groundwater Monitoring Review, Vol. 6, No. 2, p 77-80, Spring 1986. 5 fig.

Descriptors: *Monitoring wells, *Surge plungers, *Valves, Drilling fluids, Drilling, Prototypes, Sand, Cost analysis, Decontamination, Hazardous materials, Wells, Groundwater potential.

To properly develop 2-inch diameter monitor wells, large volumes of water, drilling fluids and fine-grained materials must be removed from the sandpack and surrounding formation over short periods of time. A valved and air-vented surge plunger has been designed which can be used to effectively develop 2-inch diameter wells. The valving and air-venting concepts for surge plungers are not new, but the design concepts had to be refined to facilitate their efficient use in 2-inch diameter wells. Prototypes of the surge plunger have been field tested. The tests indicate that the design is both effective and durable as a result of its dimensions, configurations and materials. The surge plunger has advantages over other popular methods of well development, particularly air-lifting. These advantages include the following: (1) Auxiliary equipment or tools are not required, such as an air compressor and hand tools, (2) Air is not introduced into the formation unless the unit is lowered into the screened interval, (3) Setup, shutdown and decontamination time can be done in minutes by one person, (4) Discharge of hazardous fluids can be piped directly and safely into drums using a 'T' bypass, and (5) Large volumes of water can be removed in a short period of time. The preceding advantages are in addition to the fact that surging is a very effective means of developing wells. (Lantz-PTT)
W86-04212

WASTE TREATMENT/DISPOSAL SITE EVALUATION PROCESS FOR AREAS UNDERLAIN BY CARBONATE AQUIFERS,

Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5G.
W86-04219

ANALYSIS OF A CONTAMINATED BEDROCK AQUIFER BY MEANS OF A PACKER AND ATTEMPTS AT REMEDIATION USING A PACKER,

Olin Chemical Group, Charleston, TN.
K. D. Hiltgen, and S. E. Anderson.
Ground Water Monitoring Review, Vol. 6, No. 2, p 122-125, Spring 1986. 3 fig, 2 tab, 1 ref.

Descriptors: *Bedrock, *Aquifers, *Packers, *Groundwater pollution, Dolomite, Path of pollutants, Geologic fractures, Pumps, Water pollution control.

A dolomite bedrock aquifer in the Northeast has been contaminated with volatile organic compounds. These compounds have made their way into pumping wells, which contain total volatile organic concentrations averaging 2 to 4 ppm. The source of these organics has not been positively identified. Television video logs show considerable vertical fractures in the upper 20 feet of the bedrock aquifer. Below this, where bedrock is more consolidated, there are a few areas of caverns and large crevices, some of which are 10 feet thick. It was first thought that perhaps the organics were entering the well through a few of the crevices that could be grouted off from the remainder of the aquifer. An inflatable packer was fabricated, so that isolated sections of the well could be sampled. Using video logs as guides, vertical sections of the well were sampled and the centerline of the plume was determined. The packer was comprised of two steel rim supports that supported innertubes. The two packers were separated with 4 ft of steel rod. Placed on top of the lower section was a standard submersible well pump that could pump a flow rate of 10 gpm. The packer assembly was lowered into the well with a winch and then at selected locations the packer was inflated with air to 50 psig. The submersible pump was turned on and allowed to pump the section for 30 minutes to adequately purge the area and obtain a representative sample. The results of the sampling showed the maximum concentrations to be at 95 feet below the surface. The entire aquifer is 125 feet thick. This means the lower third contains the organics. To determine what vertical section supplies the most water, the well was divided into thirds and a material balance was run, using three different compounds. From the analysis, it was determined that a packer placed at the 70 foot level and only pumping from that section will reduce organics concentration by a factor of 10 and reduce flow only by 20%. (Lantz-PTT)
W86-04220

CHLORINATED CARBOXYLIC ACIDS IN SOFTWOOD KRAFT PULP SPENT BLEACH LIQUORS,

Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5A.
W86-04224

KINETICS OF ALUMINUM FLUORIDE COMPLEXATION IN ACIDIC WATERS,

Maine Univ. at Orono. Dept. of Chemistry.
B. J. Plankey, H. H. Patterson, and C. S. Cronan.
Environmental Science and Technology, Vol. 20, No. 2, p 160-165, February 1986. 6 fig, 4 tab, 22 ref. EPRI Contract No. RP-2365-01.

Descriptors: *Kinetics, *Aluminum flouride, *Acid rain, *Acidic water, Aluminum, Path of pollutants, Water pollution effects, Hydrogen ion concentration, Temperature effects.

Acidic deposition has an important effect on the transport and speciation of soluble aluminum. Toxicity of aqueous aluminum seems to be strongly dependent on aluminum speciation and the presence of complexing ligands such as flouride. A study of the complex formation kinetics of AlF(2+) in the environmentally significant pH range 2.9-4.9 is reported. Five important paths for AlF(2+) formation are described. Two of these are independent of (H+), one is dependent on 1/(H+), and one is dependent on (H+). The pH and temperature dependencies of the overall rate of reaction are discussed along with environmental implications for areas subjected to acidic deposition. (Lantz-PTT)
W86-04226

WATER SOLUBILITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,

Syntex Research, Inc., Palo Alto, CA.
L. Marple, R. Brunck, and L. Throop.
Environmental Science and Technology, Vol. 20, No. 2, p 180-182, February 1986. 2 tab, 11 ref.

Descriptors: *Solubility, *2,3,7,8-Tetrachlorodibenzo-p-dioxin, *Chemical analysis, Carbon radioisotopes, Radio labelling, Dioxin, Gas chromatography, Mass spectrometry, Octanol-water partition coefficient, Yalkowsky's equation, Statistical analysis.

Vacuum deposition of a solid film onto a glass surface and equilibration of this film with water are the basis of a method that was used to measure the water solubility of 2,3,7,8-tetrachlorodibenzo-p-dioxin. Films of both 14-C radiolabeled and unlabeled dioxin were prepared so that solubilized material could be measured by radioactivity as well as by capillary gas chromatography (GC)/mass spectrometry(MS) techniques. The averages of solubility values for radiolabeled and unlabeled dioxin were 3.9 times 10 the -11 M (12.5 parts per trillion) and 6.0 times 10 to the -11 M (19.3 parts per trillion), respectively. The solubility values lie within the values predicted from Yalkowsky's K sub ow solubility equation of best fit for chlorinated hydrocarbons and the available estimates for the octanol-water partition coefficient, K sub ow. (Lantz-PTT)
W86-04227

INSIGHT INTO THE MECHANISM OF ACCUMULATION OF ARSENATE AND PHOSPHATE IN HYDRO LAKE SEDIMENTS BY MEASURING THE RATE OF DISSOLUTION WITH ETHYLENEDIAMINETETRAACETIC ACID,

Auckland Univ. (New Zealand). Dept. of Chemistry.
J. Aggett, and L. S. Roberts.
Environmental Science and Technology, Vol. 20, No. 2, p 183-186, February 1986. 4 fig, 5 tab, 8 ref.

Descriptors: *Path of pollutants, *Arsenic compounds, *Phosphates, *Accumulation, *Lake sediments, Rate of dissolution, Lake Ohakuri, New Zealand, Ethylenediaminetetraacetic acid, Iron, Aluminum, Calcium, Manganese, Silicon, Hydrogen ion concentration.

The mechanism of accumulation of arsenic and phosphate on sediments in Lake Ohakuri in the North Island of New Zealand has been examined by comparing the rates of dissolution of the anions with the rates of dissolution of the matrix elements iron, aluminum, calcium, manganese, and silicon, when samples were reacted with ethylenediaminetetraacetic acid (EDTA) at the natural pH of the sediments. On the basis of dissolution rate data alone it has been concluded that solid calcium and manganese species are not involved in the accumulation process. The same conclusion has been reached for aluminum oxides after additional consideration of the relative molar amounts of aluminum, arsenic, and phosphate dissolved. A very close correlation was observed between the rates of dissolution of the anions and that of iron. This, together with the observation of that iron not dissolved by EDTA was subsequently dissolved by Tamm's reagent, suggests that the most important mechanisms of accumulation involves some interaction between hydrous iron oxides and the anions. From the constancy of the iron:arsenic and iron:phosphate ratios during dissolution it has been concluded that arsenic and phosphate are incorporated into these sediments by coprecipitation at the time of formation of the hydrous oxides rather than by adsorption on existing surfaces. (Lantz-PTT)
W86-04228

AIRBORNE DIOXINS AND DIBENZOFURANS: SOURCES AND FATES,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. M. Czuczwa, and R. A. Hites.
Environmental Science and Technology, Vol. 20, No. 2, p 195-200, February 1986. 6 fig, 1 tab, 24 ref. DOE Grant 80-EV-10449.

Descriptors: *Air pollution, *Dioxins, *Dibenzofurans, *Path of pollutants, *Water pollution sources, Lake Ontario, Lake Erie, Siskiwit Lake, Polychlorinated dibenzo-p-dioxins, Polychlorinated dibenzofurans.

Polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) were found in urban air particulates and Great Lakes sediments. In all samples, octachlorodibenzo-p-dioxin predominated. Combustion of municipal and chemical wastes appear to be the most likely source of these compounds. When these data were compared with dioxins and dibenzofurans found in combustion sources, evidence was found for the loss of the less chlorinated dioxins and dibenzofurans. Using principal components analysis, it was found that the most likely source of PCDD and PCDF to a western Lake Ontario site was pentachlorophenol production. Historical fluxes of dioxins and dibenzofurans to sediment cores from Lake Erie and Siskiwit Lake (Isle Royale) suggest that the incineration of chloro aromatics has been an important source of dioxins and dibenzofurans. (Lantz-PTT)
W86-04230

SELECTIVE RECOVERY OF GOLD AND OTHER METAL IONS FROM AN ALGAL BIOMASS,

New Mexico State Univ., Las Cruces. Dept. of Chemistry
D. W. Darnall, B. Greene, M. T. Henzi, J. M.
Hosea, and R. A. McPherson.
Environmental Science and Technology, Vol 20, No. 2, p 206-208, February 1986. 2 fig, 20 ref.

Descriptors: *Gold, *Silver, *Mercury, *Biomass, Algae, Water pollution effects, Path of pollutants, Chlorella vulgaris, Hydrogen ion concentration, Copper, Zinc, Bioaccumulation, Biosorption.

In determining the abilities of microorganisms to remove metal ions from water, a number of investigators have shown that different metal ions bind to cell walls of bacteria, fungi, and algae. It has been observed that the pH dependence of binding of Au(3+), Ag(+), and Hg(2+) to the algae Chlorella vulgaris is different than the binding of other metal ions. Between pH 5 and 7,a variety of metal ions bind strongly to the cell surface. Most of these algal-bound metal ions can be selectively desorbed by lowering the pH to 2; however, Au(3+), Hg(2+), and Ag(+) are all bound strongly at pH 2. To elute these ions from the algal surface, addition of a strong ligand at different pHs is required. Algal-bound gold and mercury can be selectively eluted by using mercaptoethanol. An elution scheme is demonstrated for the binding and selective recovery of Cu(2+), Zn(2+), Au(3+), and Hg(2+) from an equimolar mixture. (Lantz-PTT)
W86-04231

SHORT-TERM STABILITY OF TRACE METALS IN ESTUARINE WATER SAMPLES,

Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 2L.
W86-04232

RELATIONSHIP OF GEOLOGY, PHYSIOGRAPHY, AGRICULTURAL LAND USE, AND GROUND-WATER QUALITY IN SOUTHWEST GEORGIA,

Florida Sinkhole Research Inst., Orlando.
B. F. Beck, L. Asmussen, and R. Leonard.
Groundwater GRWAAP, Vol. 23, No. 5, p 627-634, September-October 1985. 5 fig, 25 ref.

Descriptors: *Groundwater Pollution, *Path of Pollutants, *Agricultural Runoff, *Nitrates, *Georgia, Well Water, Chemical Properties, Hardness, Alkalinity, Physical Properties, Cropland, Confined Aquifers, Fertilizers, Safe Drinking Water Standards.

A study was conducted to assess the groundwater quality in a sandy aquifer in southwest Georgia and to determine whether variations in quality are related to variations in agricultural land use. Water samples were collected from 34 wells in the Claiborne aquifer. Land use/cover is principally forest, wetland, or agriculture. The aquifer is exposed surficially to the northwest but dips beneath confining beds to the southeast. Well water was analyzed in the field for pH, electrical conductivity, alkalinity, hardness, and temperature, and in the laboratory for Cl, NH4, NO3, total N, total P, ortho-P, SO4, K, Na, Ca, Mg, and Fe. Hardness gradually increases from 5 mg/l updip to 162 mg/l downdip and bicarbonate alkalinity follows the same trend. Higher than normal nitrate concentrations (4-6 mg/l) were found in ground water in the exposed updip portion of the aquifer in areas where agricultural land use for cropland is high. However, in forest-covered areas, ground water in the exposed portion of the aquifer contains nitrate concentrations similar to the confined areas (<1 mg/l). Other chemical constituents measured do not show a discernible pattern of variation. One well near a fertilizer storage facility contained nitrate concentrations exceeding the Safe Drinking Water Standards, and other wells in the agricultural portion of the outcrop belt may seasonally exceed these limits. It appears that some contamination has been occurring for many years, although it has not reached a deleterious level. (Peters-PTT)
W86-04240

MIGRATION OF CHLOROPHENOLIC COMPOUNDS AT THE CHEMICAL WASTE DISPOSAL SITE AT ALKALI LAKE, OREGON - 2. CONTAMINANT DISTRIBUTIONS, TRANSPORT, AND RETARDATION,

Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
R. L. Johnson, S. Brillante, L. M. Isabelle, J. E.
Houck, and J. F. Pankow.
Groundwater GRWAAP, Vol 23, No. 5, p 652-666, September-October 1985. 11 fig, 2 tab, 25 ref.
EPA Grant 808272.

Descriptors: *Path of Pollutants, *Chlorophenols, *Chlorinated Hydrocarbons, *Groundwater Pollution, *Alkali Lake, Oregon, Phenols, Sorption, Land Disposal, Chemical Wastes, Soil Density, Soil Porosity, Soil Properties.

The behaviors of five chlorophenols and three chlorophenoxyphenols (CPPs) have been investigated at the chemical waste disposal site at Alkali Lake, Oregon. All of the compounds demonstrated similar trends in areal distribution hydraulically downgradient from the site. The transport distances for the di- and trichlorohenols were influenced greatly by their ionization in the high pH (10) ground water. In batch equilibrium experiments, these compounds were found to have equilibrium partition coefficient values of 0.0 for the soil and ground water taken from the site. While also largely ionized at pH 10, a tetrachlorophenol, pentachlorophenol, and the CPPs demonstrated substantial sorption in the batch equilibrium experiments as well as retardation relative to the di- and trichlorophenols at the site. While the trend in observed retardation of the chlorophenolics is correct, the magnitudes of the relative retardations are less than predicted from the batch experiment results. This is probably the result of irregularities in the hydraulic conductivity values downgradient of the site. These results show, for the first time, well-behaved concentration contours embodying compound-dependent retardation in the transport of sorbing and nonsorbing organic compounds from an existing waste disposal site. (Peters-PTT)
W86-04242

RIPARIAN LOSSES OF NITRATE FROM AGRICULTURAL DRAINAGE WATERS,

North Carolina Agricultural Research Service, Raleigh.
T. C. Jacobs, and J. W. Gilliam.
Journal of Environmental Quality, Vol. 14, No. 4, p 472-478, October-December 1985. 3 fig, 4 tab, 25 ref.

Descriptors: *Agricultural Runoff, *Agricultural Watershed, *Nitrate, *Groundwater Runoff, Cropland, Surface Drainage, Drainage Effects, Subsurface Drainage, North Carolina, Denitrification, Tile Drainage.

Nitrate concentrations in shallow groundwaters beneath cultivated fields in the North Carolina Coastal Plain and in the drainage waters from those fields were examined to determined the fate of nitrogen lost to drainage waters. From a watershed where well- and moderately well-drained soils dominate agricultural fields, 10 to 55 kg/ha/yr NO3-N moved from the fields in subsurface drainage water. However, most fields are bordered by forested buffers between the cultivated areas and streams which consist of poorly and very poorly-drained soils covered by dense vegetation. A substantial part of the nitrate in the drainage water appears to be denitrified in the buffer strip and assimilation by vegetation is insignificant. Buffer strips of <16 m are effective for inducing significant losses of nitrate before drainage water reaches the stream. A field containing subsurface drainage tubing which emptied into open ditches moved nitrogen into surface water than fields without subsurface drainage improvements. From a Lower Coastal Plain watershed, a dense clay layer below the surface horizon reduced subsurface drainage resulting in total losses from the field of only 6 to 12 kg/ha/yr NO3-N, mostly in surface runoff. The extensive floodplain of the natural stream had a high capacity to reduce large quantities of N but the low total loss from the watershed is largely a result of low input to the drainage water from nonpoint sources. (Author's abstract)
W86-04260

MODELING EXPOSURE ROUTES TO MAN OF TRACE METALS ASSOCIATED WITH ACID PRECIPITATION,

Monitoring and Assessment Research Centre, London (England).
B. G. Bennett.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 89-92, November 1985. 1 tab, 11 ref.

Descriptors: *Model studies, *Acid rain, *Trace metals, Time-dependent modeling, Path of pollutants, Mercury, Environmental effects.

Pollutant metals released to the environment disperse and interact in various ways before arriving at sensitive receptors. Modeling of pollutant behavior may be by time-dependent or time-independent means. Modeling of exposure routes implies the formulation of a simplified arrangement of system components and the expression of relationships between concentrations and exposures in the environment and in the receptor. There are two basic approaches to modeling. One may use either a time-dependent or a time-independent method. The method of choice is determined by the underlying data base. The time-independent, exposure commitment method requires a less extensive data base and can begin with general associations between environmental concentrations or fluxes. Such assessments for representative background conditions have been performed for most of the metals associated with acid precipitation. Examples are given here for cadmium and mercury. (Lantz-PTT)
W86-04266

ALUMINUM IN ACIDIC SURFACE WATERS: CHEMISTRY, TRANSPORT, AND EFFECTS,

Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 93-104, November 1985. 9 fig, 2 tab, 69 ref.

Descriptors: *Acid rain, *Acidic water, *Chemical analysis, *Path of pollutants, Water pollution effects, Mineral acids, Aluminum, Watersheds, Surface waters, Hydrogen ion concentration, Toxicity, Organic compounds.

Ecologically significant concentrations of Al have been reported in surface waters draining 'acid-sensitive' watersheds that are receiving elevated inputs of acidic deposition. It has been hypothesized that mineral acids from atmospheric deposition have remobilized Al previously precipitated within the soil during soil development. This Al is then thought to be transported to adjacent surface waters. Dissolved mononuclear Al occurs as aquo Al, as well as OH(-), F(-), SO4(2-), and organic complexes. Although past investigations have often ignored non-hydroxide complexes of Al, it appears that organic and F complexes are the predominant forms of Al in dilute (low ionic strength) acidic surface waters. The concentration of inorganic forms of Al increases exponentially with decreases in solution pH. The concentration of organic forms of Al, however, is strongly correlated with variations in organic carbon concentration of surface waters rather than pH. Elevated concentrations of Al in dilute acidic waters are of interest because: Al is an important pH buffer; Al may influence the cycling of important elements like P, organic carbon, and trace metals; and Al is potentially toxic to aquatic organisms. An understanding of the aqueous speciation of Al is essential for an evaluation of these processes. (Lantz-PTT)
W86-04267

POTENTIAL IMPACT OF ACID PRECIPITATION ON ARSENIC AND SELENIUM,

North Carolina Univ. at Chapel Hill. Dept. of Pathology.
For primary bibliographic entry see Field 5C.
W86-04268

EFFECTS OF ACIDIFICATION ON THE MOBILITY OF METALS AND METALLOIDS: AN OVERVIEW,

Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
For primary bibliographic entry see Field 5C.
W86-04269

SOLUTE-TRANSPORT SIMULATION OF BRACKISH-WATER INTRUSION NEAR BALTIMORE, MARYLAND,

F. H. Chappelle.
Ground Water GRWAAP, Vol. 24, No. 3, p 304-311, May-June 1986. 8 fig, 11 ref.

Descriptors: *Brackish water, *Groundwater pollution, *Simulation models, *Solute transport, *Baltimore, *Saline water intrusion, Maryland, Aquifers, Patapsco River, Patuxent aquifer, Plumes, Model studies.

The Patuxent aquifer presently contains a circular plume of brackish-water contamination that is about 5 miles in diameter. This plume is centered on the Patapsco River estuary and is characterized by chloride concentrations that range up to 5,000 mg/l. Borehole data demonstrates that erosional channels provide conduits for brackish water to seep from the Patapsco River into the Patuxent aquifer, when aquifer water levels are lower than river water levels. A two-dimensional areal solute-transport model of the Patuxent aquifer was used to estimate the future movement of the brackish-water plume based on alternative strategies of aquifer use. Model simulations suggest that the plume will not spread rapidly if present pumping patterns are continued. Furthermore, sharply curtailing pumpage in the Baltimore area will probably not reduce the size of the plume, although this strategy may slightly decrease the spreading rate. While the plume is presently remaining nearly stationary, new pumping centers southeast of Baltimore could cause brackish water to migrate in that direction, significantly increasing the size of the plume. (Lantz-PTT)
W86-04274

CHROMIUM MIGRATION THROUGH SLUDGE-TREATED SOILS,

California Univ., Santa Cruz. Dept. of Earth Sciences.
S. J. Dreiss.
Ground Water GRWAAP, Vol. 24, No. 3, p 312-321, May-June 1986. 8 fig, 4 tab, 29 ref. EPA Agreement No. 68-03-2976.

Descriptors: *Chromium, *Path of pollutants, *Land disposal, *Sludge disposal, Tannery wastes, Industrial wastes, Nitrates, Soil water, Santa Cruz, California.

A five-year project was initiated in September 1980 by the EPA and the Tannery Council of America, to investigate the feasibility of using land treatment to dispose of chromium tanning sludges. These sludges contain high concentrations of Cr, in the range of 21,000 to 35,000 ppm on a dry weight basis. Chromium could migrate in soil waters at a land treatment site as either a soluble Cr(VI) species, HCrO4(-) or CrO4(2-), or as Cr(III) or Cr(VI) in soluble complexes with organic or inorganic substances. Field measurements of Cr fluxes at an experimental test site near Santa Cruz, California indicate that Cr in tannery sludges exhibits a very low mobility. Less than 0.1% of the total Cr applied to a test plot was transported through the upper soil zone during a three-month period. However, the sludge applications introduced high concentrations of nitrates and major cations. Estimates of contaminant fluxes based on measured concentrations in soil water collected with porous cup samplers contain large uncertainties. In addition to potential errors in moisture flux computations, chemical reactions in the cups can significantly alter the composition of soil water samples. (Lantz-PTT)
W86-04275

CONTAMINANT MOVEMENT UNDER PUMPAGE-RECHARGE CONDITION IN STEADY GROUNDWATER FLOW SYSTEM,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. D. Gupta, and P. R. O. Shrestha.
Ground Water GRWAAP, Vol. 24, No. 3, p 342-350, May-June 1986. 11 fig, 16 ref.

Descriptors: *Path of pollutants, *Pumpage, *Recharge, *Groundwater movement, Mathematical analysis, Galerkin technique, Mathematical models, Water pollution sources, Water pollution effects.

The transient movement of contaminants under pumpage and recharge conditions in steady groundwater flows in a vertical cross section of a confined aquifer, is simulated using a finite-element numerical model based on the Galerkin technique. Various factors like time step, space increment, and boundary conditions, which affect the accuracy of the numerical solution, are considered in validating results of the numerical model with results of an analytical solution. In general, as the dispersivity value increases, contaminants move further through the flow system. However, with time, due to pumpage, concentration at the well and downstream, reaches a relatively low steady-state value instead of approaching the input concentration as in the case of uniform flow. If the waste input is discontinued, with pumpage on the downstream side, the previously contaminated region is restored to a pure state faster as the well acts as a sink for mass flux. Without pumpage, the contaminating plume transports with the flow further downstream and disperses with increased time. The effect of pumpage is quite significant insofar as restricting the movement of contaminant further downstream is concerned. For certain practical situations, this is an effective means of controlling the movement of contaminated groundwater. The inference drawn from this study provides a general idea on the effectiveness of a hydraulic barrier for the retardation of contaminant movement which can assist in planning a suitable groundwater quality management policy. (Lantz-PTT)
W86-04278

ANALYTICAL AND APPROXIMATE SOLUTIONS TO RADIAL DISPERSION FROM AN INJECTION WELL TO A GEOLOGICAL UNIT WITH SIMULTANEOUS DIFFUSION INTO ADJACENT STRATA,

Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
C.-S. Chen.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1069-1076, August 1985. p 1069-1076, 4 fig, 31 ref.

Descriptors: *Injection wells, *Mathematical models, *Aquifers, *Aquitards, *Fate of pollutants, Path of pollutants, Groundwater pollution, Groundwater movement, Model studies, Models, Hydrological models, Mathematical equations.

Analytical and approximate solutions are developed for radial dispersion in aquifers with simultaneous diffusion into adjacent strata. Contaminants from the injection well are transported within the main aquifer by advection and mechanical dispersion, assuming a steady state and radially diverging groundwater flow field. The leakage of contaminants from the main aquifer to the aquitards is accounted for by molecular diffusion. A mathematical model consisting of two coupled differential equations is proposed to investigate concentration distributions in the main aquifer as well as in the adjacent aquitards. By making use of Laplace transforms, analytical solutions valid for small time periods are obtained without difficulty. To complement these analytical solutions concentration distributions for intermediate and large time intervals are determined approximately by numerically inverting the appropriate transformed solution in the Laplace domain with the Stehfest algorithm. Excellent agreement exists between analytical solutions and approximate solutions for small time intervals, supporting the validity of approximate solutions for intermediate and large time periods. It is shown that the diffusive leakage may significantly delay contaminant movement within the main aquifer at relatively large time periods. The solutions can be applied to study radial dispersion in granular aquifers bounded by relatively low permeability aquitards, or in planar fractures contained in porous formations. (Author's abstract)
W86-04304

GROUNDWATER MASS TRANSPORT AND EQUILIBRIUM CHEMISTRY MODEL FOR MULTICOMPONENT SYSTEMS,

Stanford Univ., CA. Dept. of Civil Engineering.
G. A. Cederberg, R. L. Street, and J. O. Leckie.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1095-1104, August 1985. p 1095-1104, 5 fig, 8 tab, 29 ref. EPA Contract No. CR-808857.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Groundwater movement, *Path of pollutants, *Mathematical models, Numerical analysis, Mathematical studies, Ion transport, Ion exchange, Cadmium, Chlorides, Bromides, Mass transfer, Hydrologic models, Models, Solute transport.

A mass transport model, TRANQL, for a multicomponent solution in equilibrium with a groundwater system was developed for modeling the transport of contaminants through groundwater flow systems. The equilibrium interaction chemistry is posed independently of the mass transport equations which leads to a set of algebraic equations for the chemistry coupled to a set of differential equation for the mass transport. Significant equilibrium chemical reactions such as complexation, ion exchange, competitive adsorption, and dissociation of water may be modeled by TRANQL. A finite element solution is presented first for cadmium, chloride, and bromide transport in a one-dimensional column where complexation and sorption are considered. Second, binary and ternary ion exchange are modeled and compared to the results of other investigators. Results showed that TRANQL exhibited versatility, and could potentially be extended to a wide range of equilibrium reactions. (Geiger-PTT)
W86-04307

TRANSIENT MOVEMENT AND TRANSFORMATION OF CARBON SPECIES IN SOIL DURING WASTEWATER APPLICATION,

California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5E.
W86-04311

FIELD EXAMPLE OF MEASURING HYDRODYNAMIC DISPERSION IN A SINGLE FRACTURE,

Atomic Energy of Canada Ltd., Ottawa (Ontario).
K. S. Novakowski, G. V. Evans, D. A. Lever, and K. G. Raven.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1154-1174, August 1985. 8 fig, 1 tab, 34 ref.

Descriptors: *Tracers, *Geologic fractures, *Solute transport, *Groundwater movement, Boreholes, Observation wells, Pump wells, Hydrologic models, Injection wells, Model studies, Flow velocity.

A field example of measuring the dispersive properties of a single fracture in fractured plutonic rock is presented. The experimental technique involves injecting a slug of conservative tracer into a 'steady' groundwater flow field established between a pumping and recharging borehole and monitoring the tracer breakthrough by sampling the withdrawal water directly. The breakthrough curves from two experiments were analyzed with a model which describes the flow field geometry either analytically or numerically and solves for hydrodynamic dispersion analytically. A longitudinal dispersivity of 1.40 m was estimated by fitting the model to each set of field data. The magnitude of the dispersion was determined to be independent of dispersive effects created by flow through the borehole instrumentation and thought to be purely hydrodynamic in nature. (Author's abstract)
W86-04314

FREQUENCY DOMAIN APPROACH TO WATER QUALITY MODELING IN GROUNDWATER: THEORY,

Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
C. J. Duffy, and L. W. Gelhar.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1175-1184, August 1985. 9 fig, 27 ref, NSF Grant No. CEE-8307962.

Descriptors: *Groundwater, *Path of pollutants, *Water quality, *Tracers, *Stochastic process, *Models, Solute transport, Frequency analysis, Mathematical models, Mathematical studies, Stochastic hydrology, Filters, Convection, Time series analysis.

A method for the analysis of complex temporal variations of environmental tracers or pollution time series in groundwater is examined using spectral analysis and linear filter theory for stationary stochastic processes. The interpretation of solute fluctuations subject to a time varying sources is accomplished via frequency domain solutions to stochastic differential equations for three widely applied transport models: a lumped parameter or linear reservoir model; convective (advective) transport in a curvilinear flow field; and convective-dispersive transport in a uniform flow field. Frequency domain solutions are presented in terms of the theoretical transfer function and phase spectra which describe the amplitude attenuation and phase lag between frequencies in the input and output. A comparison of the frequency response of the three models indicates that the unique filtering characteristics of each may provide a diagnostic tool for matching the appropriate theory to a sampled water quality 'signal'. A procedure is suggested for parameter estimation which involves comparison of hte theoretical and field estimated transfer function and phase spectra. (Author's abstract)
W86-04315

CLOSTRIDIUM PERFRINGENS, A RELIABLE INDICATOR OF STREAM WATER QUALITY,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W86-04328

OPTIMAL DISCHARGE PROFILES FOR SUDDEN CONTAMINANT RELEASES IN STEADY UNIFORM OPEN-CHANNEL FLOW,

For primary bibliographic entry see Field 5E.
W86-04344

CHEMISTRY AND TRANSPORT OF SOLUBLE HUMIC SUBSTANCES IN FORESTED WATERSHEDS OF THE ADIRONDACK PARK, NEW YORK,

Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
C. S. Cronan, and G. R. Aiken.
Geochimica et Cosmochimica Acta, Vol. 49, No. 8, p 1697-1705, August 1985. 6 fig, 3 tab, 26 ref. EPRI Contract RP1109.

Descriptors: *Path of pollutants, *Humic acids, *Adirondack Park, *New York, *Forest watersheds, Integrated Lake-Watershed Acidification Study, Interstitial water, Dissolved organic carbon, Leaching, Soil chemistry, Mixed forests, Natural water.

Studies were conducted in conjunction with the Integrated Lake-Watershed Acidification Study (ILWAS) to examine the chemistry and leaching patterns of soluble humic substances in forested watersheds of the Adirondack region. During the summer growing season, mean dissolved organic carbon (DOC) concentrations in the ILWAS watersheds ranged from 21-32 mg C/l in O/A horizon leachates, from 5-7 mg C/l in B horizon leachates, from 2-4 mg C/l in groundwater solutions, from 6-8 mg C/l in first order streams, from 3-8 mg C/l in lake inlets, and from 2-7 mg C/l in lake outlets. During the winter, mean DOC concentrations dropped significantly in the upper soil profile. Soil solutions from mixed and coniferous stands contained as much as twice the DOC concentration of lysimeter samples from hardwood stands. Results of DOC fractionation analysis showed that hydrophobic and hydrophilic acids dominate the organic solute composition of natural waters in these watersheds. Charge balance and titration results indicated that the general acid-base characteristics of the dissolved humic mixture in these natural waters can be accounted for by a model organic acid having an average pK sub a of 3.85, and average charge density of 4-5 microequivalents/mg C at ambient pH, and a total of 6-7 meq COOH per gram carbon. (Author's abstract)
W86-04347

TRACE METAL DEPOSITION AND MOBILITY IN THE SEDIMENTS OF TWO LAKES NEAR SUDBURY, ONTARIO,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan, and J. O. Nriagu.
Geochimica et Cosmochimica Acta GCACAK, Vol. 49, No. 8, p 1753-1764, August 1985. 3 fig, 4 tab, 31 ref.

Descriptors: *Trace metals, *Deposition, *Path of pollutants, *Lakes, *Sudbury, *Ontario, Diffusion, Clearwater Lake, McFarlane Lake, Iron, Manganese, Aluminum, Copper, Nickel, Lead, Hydrogen ion concentration, Water pollution sources.

The accumulation and mobility of Fe, Mn, Al, Cu, Ni and Pb in the sediments of two lakes (Clearwater, pH 4.5; and McFarlane, pH 7.5) near Sudbury, Ontario have been investigated. The Al, Cu and Ni concentrations are expectedly relatively high in the overlying waters of Clearwater Lake and much lower for Al and Cu in McFarlane Lake. The low trace metal concentrations found in the anoxic porewaters of Clearwater Lake could be explained by a sharp increase in porewater pH concomitant with SO4(2-) reduction and H2S production within the first 1-2 cm of the sediments, which has conceivably led to the precipitation of mineral phases such as AL(OH)3, NiS, and CuS. In both lakes, Fe concentrations in anoxic porewaters appear to be controlled by FeS and/or FeCO3 formation. It is suggested that upwardly decreasing total Mn profiles resulting from the removal of Mn from the top sediment layers under acidic conditions may constitute a reliable symptom of recent lake acidification. The downward diffusion of Al, Cu and Ni from the overlying water to the sediments has been estimated from their concentration gradients at the interface and compared to their total accumulation rates in the sediments. In both lakes the diffusion of Al is negligible compared to its accumulation rate. However, diffusion accounts for 24-52% of the accumulation of Cu in the sediments of Clearwater Lake, but appears negligible in McFarlane Lake.

The downward diffusive flux of Ni is important and may explain appears negligible in McFarlane Lake. The downward diffusive flux of Ni is important and may explain 76-161% of the estimated Ni accumulation rate in Clearwater Lake, and 39% in McFarlane Lake. The porewater Cu and Ni profiles suggest that the subsurface sedimentary trace metal peaks observed in Clearwater Lake (as in other acid lakes) may not be caused by sediment leaching or by a recent reduction in sedimentation but may have a diagenetic origin instead. (Author's abstract)
W86-04349

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. I. FJALLSJOKULL (SOUTH-EAST ICELAND): BULK MELT WATERS WITH CLOSED-SYSTEM CHARACTERISTICS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04351

MODEL FOR POLLUTANT CONCENTRATIONS DURING SNOW-MELT,

Nottingham Univ. (England). Dept. of Theoretical Mechanics.
S. Hibberd.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 58-65, 1984. 7 fig, 17 ref.

Descriptors: *Model studies, *Path of pollutants, *Melt water, *Pollution load, Rivers, Lakes, Unsaturated flow, Snow pack, Percolation, Hydrodynamics, Saturated flow.

In recent years extensive measurements of pollutant concentrations within the environment have been made over western Europe following reports of unusually high pollution levels within rivers and lakes, especially after the start of the spring melting period. A simple model is presented to describe, theoretically, the pollutant efflux within the first fractions of melt water released from a snowpack at the start of the melting season. The dominant features included are the appearance of a wave-front as heading the unsaturated flow of melt water and the pollutant dispersion arising from the interaction of the flow with the porous structure of the snow-pack and molecular diffusion. Results of the snow-melt model appear to be in agreement with the available experimental studies, however two aspects require further comment. First the percolation of melt water is not a homogeneous process; melt water often follows preferred channels through the snow-pack rather than percolating downwards as a uniform front of water. Such inhomogeneities will cause pollutant and melt water to penetrate the snow-pack more quickly within the preferred channels, resulting in an earlier and less abrupt start to the melt-water run-off. The second aspect concerns the value for the coefficient of hydrodynamic dispersion. Theories for hydrodynamic dispersion are well proven for the saturated flow of liquids through porous media, but many results for unsaturated flow must be obtained by direct inference from the corresponding results for the saturated flow. Correspondingly the prediction for the dispersion coefficient may need modification when used for the highly unsaturated flow conditions typical within a melting snow-pack. (Lantz-PTT)
W86-04354

FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS, II,

Henkel K.G.a.A., Duesseldorf (Germany, F.R.). Dept. of Ecology.
P. Wierich.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 290-294, December 1985. 1 ref, append.

Descriptors: *Activated sludge process, *Mathematical models, *Adsorbents, Dry matter, Sludge, Mathematical analysis, Solubility.

An inhomogeneous first-order differential equation allows description of the time-dependent concentration change of an adsorbing compound in an activated sludge plant. Besides those parameters formerly considered (i.e., adsorption constant and surplus sludge wastage rate) the difference in dry matter content of the wasted sludge and that remaining in the activated sludge stage are now taken into account as well. This facilitates a more exact calculation of the elimination. The essential advantage of the new model lies in its simpler and faster applicability. The equations are steady, and can be integrated facilitating activities such as the calculation of the mean retention time of the adsorbed material in the activated sludge stage. Other mechanisms such as biodegradation, precipitation, flocculation, and stripping are, as in the older model, not taken into account. (Author's abstract)
W86-04356

CMA: AN ALTERNATIVE TO ROAD SALT,

Defense Environmental Leadership Project, Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04359

CHLOROFORM IN TAP WATER AND HUMAN BLOOD,

Turku Univ. (Finland). Dept. of Public Health.
For primary bibliographic entry see Field 5F.
W86-04361

ACCUMULATION OF SEDIMENT-BOUND PCBS BY FIDDLER CRABS,

Environmental Research Lab., Gulf Breeze, FL.
J. R. Clark, J. M. Patrick, Jr, J. C. Moore, and J. Forester.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 571-578, April 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Polychlorinated biphenyls, *Bioaccumulation, *Fiddler crabs, *Sediments, *Uptake, *Depuration, New York harbor, Pilot study, Toxicity, Food webs.

Rates of polychlorinated biphenyl (PCB) uptake and depuration were determined in a simulated spoil bank habitat that contained PCBs in weathered sediment (New York Harbor sediments). In a pilot study, the rates were compared in Uca pugilator, an inhabitant of relatively dry and sandy areas and U. minax, which inhabits wetter and muddier substrates. Mortality for U. minax ranged from 2-14% over the contaminated substrate treatment and 6-10% over the controls; for U. pugilator mortality ranged from 2-8% on contaminated substrates and 1-4% for controls. Mortality was attributed to cannibalism upon molting rather than toxic effects. Because of the variability of PCB concentrations within crab populations, little significance can be attributed to higher bioaccumulation factor (BAF) values calculated for U. minax compared to U. pugilator, especially in light of test results showing that the BAFs for the two species were similar in two series of experiments. Fiddler carabs have the potential to accumulate PCBs rapidly from contaminated sediments and to develop body burdens similar to concentrations in sediment. Contaminated sediments must be taken into account when evaluating environmental exposures to PCBs because other animals feed on fiddler crabs, possibly resulting in bioaccumulation of PCBs in food webs. (Rochester-PTT)
W86-04365

HEAVY METALS IN OYSTER TISSUE AROUND THREE COASTAL MARINAS,

South Carolina State Dept. of Health and Environmental Control, Columbia.
J. M. Marcus, and A. M. Thompson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 587-594, April 1986. 1 fig, 5 tab, 11 ref.

Descriptors: *Oysters, *South Carolina, *Coastal pollution, *Monitoring, *Bioindicators, *Marinas, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Heavy metals, Condition index, Correlation coefficient.

The content of heavy metals was determined in tissue of the American oyster, Crassostrea virginica, collected at three marinas in coastal South Carolina. Mercury was not detected at any time at any station; Cd, Cu and Zn were measured in tissue from every station, whereas Pb and Ni were found at all but a few stations. Chromium was rarely detected. Total mean metal contents of tissue increased between spring and summer sampling periods. In most cases, there was a negative correlation between metal concentration and condition index (CI), indicating that the increases in metals concentrations between sampling periods were related to a loss of oyster body weight. Metals were preferentially partitioned to the gills and mantle. Strong positive correlations were between Cu and Cd at two of the three marinas and between Zn and Cd and Zn and Cu at all three marinas activities were limited essentially to shellstock from very near the marinas. (Rochester-PTT)
W86-04367

FENITROTHION AND AMINOCARB RESIDUES IN WATER AND BALSAM FIR FOLIAGE FOLLOWING SPRUCE BUDWORM SPRAYING PROGRAMS IN QUEBEC, 1979 TO 1982,

Quebec Ministere de l'Energie et des Ressources.
R. Morin, G. Gaboury, and G. Mamarbachi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 622-628, April 1986. 1 tab, 23 ref.

Descriptors: *Fenitrothion, *Aminocarb, *Balsam Fir, *Spruce trees, *Insecticides, Spraying, Monitoring, Sumithion, Matacil, Aircraft, Quebec, Canada, Insect control, Forests.

Insecticide concentrations in the environment were determined in an area receiving annual spraying of Sumithion (fenitrothion) at 210 g active ingredient/hectare and Matcil 180D (aminocarb) at 52 g active ingredient/hectare in diesel oil diluent. Concentrations of fenitrothion and aminocarb in water and foliage showed very high variations among samples, with low concentrations in most and very high residue concentrations in some. Over the 4 yr studied, median residue levels were 3.81 micron g/g (dry weight) of fenitrothion and 0.94 micron g/g of aminocarb in balsam fir foliage, with maximum concentrations of 111 and 37.3 micron g/g, respectively. In lentic water, median residue levels were 5.82 micron g/l of fenitrothin and 0.74 micron g/l of aminocarb, with maximum levels of 1,114 and 331 micron g/l, respectively. In lotic water, median concentrations were 2.84 micron g/l of fenitrothion and 0.86 micro g/l of aminocarb, with maximum levels of 127 and 18.4 micro g/l, respectively. These reported insecticide levels were obtained 1-4 hr after spraying at a time when concentrations would be expected to peak. Data on residual concentrations of these insecticides suggests that the contamination of water by forest spraying presents few risks to fish and aquatic invertebrate populations. (Rochester-PTT)
W86-04368

OIL POLLUTION OF A GROUNDWATER SOURCE,

Eastbourne Waterworks Co. (England).
A. J. L. Clark.
Institute of Water Engineers and Scientists Journals JIWSDI, Vol. 40, No. 1, p 17-28, February 1986. 5 fig, 7 ref, 2 append.

Descriptors: *Oil pollution, *Groundwater, *Wells, Divers, Fluorimetry, Monitoring, England, Complaints, Costs.

The general characteristics of the Eastbourne Waterworks Company, East Sussex, England, are described and two incidents of oil pollution of groundwater sources are recounted, with information on investigations, remedial measures taken, costs of the incident, and seeking compensation for expenses. Incidents consisted of two occasions of consumer complaints about oily taste in the water. Immediately after each incident, the level of oil present in the water was estimated to be about 0.02

mg/l. Remedial and securing activities consisted of (1) a survey of the adit system by divers, (2) sealing of trial bores made along the line after the first incident, including pumping and sealing of these bores, and (3) sealing the adit system feeding from the suspected contamination source. These measures successfully stopped the oil contamination in the water system. A fluorimeter was obtained and installed in a continuously operating mode with an alarm to detect any future leakage of oil into the system from this source. (Rochester-PTT)
W86-04377

STUDY OF THE TRACE ORGANICS PROFILES OF RAW AND POTABLE WATER SYSTEMS,

Anglian Water Authority, Cambridge (England).
For primary bibliographic entry see Field 5F.
W86-04382

VOLATILE ORGANIC COMPOUNDS AT HAZARDOUS WASTE SITES AND A SANITARY LANDFILL IN NEW JERSEY,

New Jersey Inst. of Tech., Newark.
J. LaRegina, J. W. Bozzelli, R. Harkov, and S. Gianti.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 18-27, February 1986. 9 fig, 7 tab, 14 ref.

Descriptors: *Volatile organic compounds, *Hazardous waste sites, *Adsorbent, *Landfill, *Air pollution, Urban environment, Rural environment, Gas chromatography, Mass spectroscopy, New Jersey, Leachates, Vents.

Data were collected on ambient levels of volatile organic compounds (VOC: primarily chlorinated and aromatic) in and around six sites in New Jersey. Five sites were hazardous waste sites currently on the National Priorities List and were located in rural areas; one site was a landfill presently receiving non-hazardous municipal waste and situated in a more urban location. It is clear that VOC levels at hazardous sites and landfills vary greatly from site to site and at locations within each site. However, the overall levels were higher than typically found in urban environments for some VOCs, and it seems likely that the high levels are due ot the sites themselves. At one site, for example, average levels of toluene were on the order of 10 times that normally found at urban locations. The effects of the site characteristics and meteorological events on the level of VOCs at in the ambient air at these sites were not very clear. Although some samples did show higher levels of some VOCs near leachate pools or vents, no real trends were evident. Finally, problems were found with quality assurance with Tenax GC adsorbent used in the present study; these must be controlled with rigorous cleaning and maintenance procedures and perhaps more studies into the pore effects involved. (Rochester-PTT)
W86-04384

DISSOLVED AND SUSPENDED MATTER TRANSPORTED BY THE GIROU RIVER (FRANCE): MECHANICAL AND CHEMICAL EROSION RATES IN A CALCAREOUS MOLASSE BASIN,

Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 2J.
W86-04387

ANALYSE THE HYDROCARBONS IN LIQUID REFINERY WASTES,

Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W86-04388

HEALTH RISK COMPARISON BETWEEN GROUNDWATER TRANSPORT MODELS AND FIELD DATA,

Environmental Protection Agency, Washington, DC. Office of Research and Development.
S. T. Hwang.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 66-70, February 1986. 2 fig, 2 tab, 19 ref.

Descriptors: *Risks, *Mathematical models, *Monitoring, *Waste disposal, *Groundwater movement, Carcinogens, Noncarcinogens, Model validation, Dispersion, Simulation.

Techniques of performing assessments of health risks from intake of groundwater impacted by waste disposal facilities are presented. The assessment consists of using monitored plume data, fate and transport modeling, or a combination of both approaches, and of using health effect data for carcinogens and noncarcinogens for health risk assessment. Examples of employment of the mathematical modeling approach at three sites and of the monitoring approach at five sites are presented, and the limitations of assessment methods are discussed. Despite uncertain parameters, particularly values for dispersivities, the fate and transport models are an important toll in supporting the health risk assessment that is based on monitoring data or conducted in the absence of such data. Though there are many analytical and numerical simulation techniques available at present, the reliability of such models cannot be adequately tested because of the inability to define the dispersion parameter for model validation. (Rochester-PTT)
W86-04397

EPIDEMIC CAMPYLOBACTERIOSIS ASSOCIATED WITH A COMMUNITY WATER SUPPLY,

Georgia Dept. of Human Resources, Atlanta.
For primary bibliographic entry see Field 5C.
W86-04403

METAL MOVEMENT IN SLUDGE-TREATED SOILS AFTER SIX YEARS OF SLUDGE ADDITION: 2. NICKEL, COBALT, IRON, MANGANESE, CHROMIUM, AND MERCURY,

California Univ., Berkeley. Dept. of Plant and Soil Biology.
D. E. Williams, J. Vlamis, A. H. Pukite, and J. E. Corey.
Soil Science SOSCAK, Vol. 140, No. 2, p 120-125, August 1985. 4 fig, 2 tab, 10 ref.

Descriptors: *Heavy metals, *Land disposal, *Soil chemistry, *Sludge disposal, Sludge-treated soils, Path of pollutants, Nickel, Cobalt, Iron, Manganese, Chromium, Mercury, Loam, Oakland, California.

A study was conducted of the movement of the metals Ni, Co, Fe, Mn, Cr, and Hg in Dublin loam soil, after 6 years of sludge addition. Sludges from two sources were added annually at rates ranging from 0 to 225 metric tons/hectare (t/ha) in increments of 45 t. Increasing rates of sludge addition resulted in almost no change in the concentration of metals in the surface soil, with the exception of Cr and Hg, where the metal concentrations in the added sludge were markedly greater than those found in the untreated soil. In these cases, metal increased linearly with rate of sludge addition. Surface concentrations of HNO3-extracted Mn were less than those obtained at lower depths. The low values appeared to be due to the failure of HNO3 to extract all the Mn from sludge-treated soils. Only Fe, of all elements, increased significantly in the profile with time. No element moved more than 5 cm below the zone of sludge incorporation in either the highly acid (pH 4.5) Oakland or the near-neutral (pH 7.3) Pacheco sludge-treated soils. Relative metal availability followed the same order for both sludges, i.e., Mn > Co = Ni > Fe > Cr. Percentage of available metal in Oakland sludge-treated plots was nearly double that in Pacheco sludge-treated plots. Percentage availability of Fe and Cr was extremely low. (Lantz-PTT)
W86-04408

VARIATION IN THE QUALITY OF TENSION LYSIMETER SOIL WATER SAMPLES FROM A FINNISH FOREST SOIL,

Finnish Forest Research Inst., Helsinki.
For primary bibliographic entry see Field 2G.
W86-04410

FATE OF DI-2-(ETHYLHEXYL)PHTHALATE IN THREE SLUDGE-AMENDED NEW MEXICO SOILS,

B. C. Fairbanks, G. A. O'Connor, and S. E. Smith.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 479-483, October-December 1985. 3 fig, 2 tab, 19 ref. Contract No. DE-AC04-83AL21776.

Descriptors: *Fate of pollutants, *Path of pollutants, *Sludge, *Phthalates, *Soil Amendments, Organic compounds, Adsorption, Degradation.

The degradation, volatilization, and adsorption of Di-3-(ethylhexyl) phthalate (DEHP) were monitored in three calcareous soils from New Mexico amended or unamended with sewage sludge. Evolution of 14CO2 was the only mechanism of loss of DEPH from these soils. No volatilization of parent compound or organic metabolites was detected. The effects of sewage sludge on DEPH degradation varied with soil, DEPH concentration, and sludge incubation time. As a result, 50% disappearance time varied from 8 to 72 d, depending on treatment interactions. After 146 d, 76 to 93% of the DEHP-14C was evolved as CO2. DEHP persistence was reduced by previous exposure of the soil to sludge, but was increased or unaffected by fresh additions of sludge. Increasing DEHP concentration from 2 to 20 mg/kg soil increased DEHP persistence. Degradation of DEHP was greater in two sandy loams (Typic Haplargids and Petrocalcic Paleustolls) than in a clay soil (Typic torrifluvents). Preliminary data suggest extensive adsorption of DEPH by all soils with no effect of sewage sludge additions. (Author's abstract)
W86-04413

RESIDUAL CADMIUM FORMS IN ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,

Pennsylvania State Univ., University Park. Dept. of Agronomy.
R. E. Feltz, and T. J. Logan.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 483-488, October-December 1985. 3 fig, 4 tab, 19 ref.

Descriptors: *Cadmium, *Anaerobic digestion, *Sludge, Speciation, Inorganic compounds, Metals, Extraction, Phosphates, Trace metals.

The effects of phosphorus and lime additions after acid extraction on residual Cd solubility and chemical forms in an anaerobically digested sewage sludge were investigated. High Cd content (11 mmol Cd/kg) anaerobically digested sewage sludge was aerated and then acidified to pH 2 to solubilize Cd. After 18 hr of acidification, the sludge was dewatered and the supernatant and solids separated. Seventy or more percent of the Cd was removed from the solids. Similar amounts of Ni, Mn and Zn were also removed, but Cu removal was only 26% and that of Pb was <5%. The acid extracted sludge was neutralized to pH 5.9 with Ca(OH)2. Before liming, the sludge was amended with rock phosphate (RP) or monocalcium phosphate (MCP). Solution Cd in the limed MCP sludge was 12% of that in the limed RP sludge or in the limed sludge without P addition. Chemical fractionation indicated that 50% of the Cd in the aerated unextracted sludge existed as inorganic precipitates with another 40% Na4P2O7 extractable (organically bound). Acidification solubilized 98% of the inorganic Cd and 86% of the organically bound Cd. Seventy-nine percent of the Cd remaining in the dewatered acidified sludge was in the KNO3 extractable (exchangeable) fraction. Liming redistributed the Cd with 13 to 19% as inorganic precipitates, 70 to 85% organically bound and <3% in the exchangeable fraction. Phosphate addition had no significant effect on Cd fractionation. (Author's abstract)
W86-04414

PLANT UPTAKE OF CADMIUM FROM ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,

Pennsylvania State Univ., University Park. Dept. of Agronomy.

Group 5B—Sources Of Pollution

T. J. Logan, and R. E. Feltz.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 495-500, October-December 1985. 6 fig, 17 ref.

Descriptors: *Cadmium, *Sludge, *Path of pollutants, *Plants, Soil analysis, Nitrogen, Trace metals, Absorption, Phosphorus, Vegetable crops, Extraction.

Approximately 80% of the Cd in an anaerobically digested sewage sludge (initially containing 11.6 mmol Cd/kg) was removed by acid extraction and dewatering. The acid extracted sludge was treated by (i) neutralization to pH 5.9 with Ca(OH)2, (ii) addition of monocalcium phosphate (MCP) followed by Ca(OH)2, neutralization to pH 5.9, and (iii) addition of rock phosphate (RP) followed by Ca(OH)2 neutralization to pH 5.9. The three treated sludges and the non acid-extracted sludge (aerated prior to application to soil) were applied to Spinks loamy sand at rates equivalent to 18.7 and 37.4 micromol Cd/kg. Swiss chard (Beta vulgaris) was grown in the greenhouse for 56 d. Cadmium concentration in saturation extracts of the soil with MCP sludge decreased below the detection limit of 1.8 x 10 to the minus 10th power mol/L by day 4 at the 37.4 micromol Cd/kg application rate, while Cd concentrations in saturation extracts of the other sludge treatments were much higher throughout the study. Chard yields were higher in the control than in any of the sludge treatments, and the difference was attributed to greater N availability in the control. Cadmium concentration in Swiss chard tissue at harvest was significantly lower from the MCP sludge than from the other sludges. Cadmium concentration in chard tissue was also higher from the aerated sludge (11.9 mmol Cd/kg) than from the three acid-extracted sludges (2.58-3.29 mmol Cd/kg). No significant difference in the Cd concentration of chard was obtained for the 18.7 and 37.4 micromol Cd/kg rates of the MCP sludge, while Cd concentrations in chard increased linearly with Cd applied by the other sludges. (Author's abstract)
W86-04415

DISTRIBUTION OF PLUTONIUM AND AMERICIUM BENEATH A 33-YR-OLD LIQUID WASTE DISPOSAL SITE,

Los Alamos National Lab., NM.
J. W. Nyhan, B. J. Drennon, W. V. Abeele, M. L. Wheeler, and W. D. Purtymun.
Journal of Environmental Quality, Vol. 14, No. 4, p 501-509, October-December 1985. 4 fig, 4 tab, 16 ref. Contract No. W-7405-Eng. 36.

Descriptors: *Toxic wastes, *Path of pollutants, *Landfills, *Waste dumps, *Plutonium, *Americium, *Radioactive waste disposal, Heavy metals, Water pollution sources, Radioactive wastes.

The distribution of Pu, 241Am, and water in Bandelier Tuff beneath a former liquid waste disposal site at Los Alamos was investigated. The waste use history of the site is described, as well as the previous field and laboratory studies of radionuclide migration performed at this site. One of the absorption beds studied had 20.5 m of water added to it in 1961 in an agressive attempt to change the distribution of radionuclides in the tuff beneath the bed. Plutonium and 241Am were detected to sampling depths of 30 m in this bed, but only found to depths of 6.5 to 13.41 m in an adjacent absorption bed (bed 2) not receiving additional water in 1961. After 17 yr of migration of the slug of water added to bed 1, 0.3 to 5.1% of the Pu inventory and 3.0 to 49.6% of the 241Am inventory was mobilized within the 30-m sampling depth, as less than one column volume of water moved through the tuff profile under the bed. The results of similar lab and field studies performed since 1953 were compared with our 1978 data and site hydrologic data was used as a time marker to estimate how fast radionuclide migration occurred in the tuff beneath absorption bed 1. Most of the radionuclide migration appeared to have occurred within 1 yr of the 20.5-m water leaching in 1961. The implications of our research results to nuclear waste management were also discussed. (Author's abstract)
W86-04416

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: I. A CASE STUDY,

Guelph Univ. (Ontario). Dept. of Soil Science.
M. H. Miller, J. B. Robinson, and R. W. Gillham.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 533-538, October-December 1985. 5 fig, 4 tab, 14 ref.

Descriptors: *Manure, *Ponds, *Surface sealing, *Infiltration, Feedlot wastes, Groundwater, Wastewater collection, Chlorides, Nitrates, Denitrification, Path of pollutants, Water pollution sources.

A monitoring system was established on an unlined, earthen storage pond near Kitchener, prior to the addition of liquid manure from a 4500-head beef (Bos taurus) feeding operation. The bottom of the pond, which had a surface area when full of 2 ha, was a coarse textured sand. This material, with some gravel layers, extended below the water table, which was initially at 13.7 m below the ground surface. A platform, at which soil moisture measurement and groundwater sampling tubes were installed, was constructed within the pond. Additional groundwater sampling tubes were installed at several points surrounding the pond. Moisture content of the soil immediately below the pond reached saturation when liquid manure was first added but began to decrease within 2 weeks and reached a steady state at a water potential of about -0.03 MPa within 90 days. The infiltration rate at this time was estimated to be <10 to the minus 8th power m/s, a value considered to indicate that the bottom was effectively sealed. There was a rapid increase in Cl content of the groundwater within 2 weeks of manure addition but the concentration declined to initial values within 12 weeks. The NO3-N content of groundwater below the pond decreased to non-detectable values very shortly after addition of manure but returned to background values within 12 weeks except in the upper portions of the groundwater. It is concluded that the NO3-N depression was due primarily to denitrification in the groundwater as it passed below the pond. It is concluded that, with some limitations, unlined earthen manure ponds are environmentally acceptable, even in sandy material. (Author's abstract)
W86-04417

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: II. RATE AND MECHANISM OF SEALING,

New Liskeard Coll. of Agricultural Technology (Ontario).
J. G. Rowsell, M. H. Miller, and P. H. Groenevelt.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 539-543, October-December 1985. 3 fig, 4 tab, 19 ref.

Descriptors: *Manure, *Ponds, *Surface sealing, *Infiltration, Feedlot wastes, Animal wastes, Soil porosity, Wastewater collection, Wastewater disposal, Path of pollutants, Water pollution sources.

A laboratory study was conducted to determine the degree and rate of sealing of the soil surface where liquid beef (Bos taurus) manure with solids content of 50 g/kg was infiltrated into cores of a sandy loam, a loam, and a clay soil under hydraulic heads of 1 and 5 m. The infiltration rate was expressed in the logarithmic form of the Kostiakov equation: log q = A + b log t where q = infiltration rate (m/s) and t = time (s). In this relation A represents the log of the initial infiltration rate (at 1.0 s) and b is the rate of change in rate with time and reached a value of 10 to the minus 8th power m/s or less within 30 days on all soils at 1-m hydraulic head. This rate indicates an essentially impermeable system. At a 5-m head the infiltration rate reached 10 to the minus 8th power m/s within 10 days on the clay soil but required periods > 30 days on the other two soils. A physical blocking of pores was the major mechanism of sealing. The rate of reduction of infiltration into the loam soil was similar for sterilized manure indicating that biological activity was not a factor. Infiltration of a salt solution having similar cationic constituents as the manure remained constant over time indicating that dispersion of soil particles was not a factor. These results indicate that a liquid manure storage pond will effectively self-seal even with sandy materials. (Author's abstract)
W86-04418

GROUNDWATER QUALITY CHANGES RESULTING FROM A SURFACE BROMIDE APPLICATION TO A PASTURE,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, R. W. van Keuren, and W. M. Edwards.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 543-548, October-December 1985. 5 fig, 2 tab, 17 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Leaching, Infiltration, Bromides, Subsurface drainage, Solute transport, Pastures, Lysimeters, Groundwater movement.

Potassium bromide was applied at a rate of 168 kg Br(-)/ha to two 1.1-ha pasture watersheds in east-central Ohio to study the impacts on groundwater quality of a one-time application of a soluble constituent. The watersheds had well-drained residual silt loam soils and average slopes of 20%. A nearly impermeable clay layer under the watersheds created a perched aquifer from which groundwater samples could be taken at developed springs. Three monolith, grassed lysimeters having soil profiles similar to the watersheds also received the Br(-) treatment. The lysimeters, which were 8 m2 in surface area and had a depth of 2.4 m, had shorter leaching pathways than the watersheds and showed peak Br(-) concentrations in percolation (24.0 mg/L maximum peak) occurring 52-78 weeks following the Br(-) application. The Br(-) concentration in the groundwater from the watersheds had lower peaks (9.2 mg/L maximum peak) but occurred 84 to 104 weeks after the Br(-) application. Because of variable leaching pathway lengths, including pathways much longer than those in the lysimeters, the watershed groundwater Br(-) applications had shown no meaningful decrease by 2 yrs after the Br(-) application. It is concluded that a one-time application of a soluble, nondegradable chemical constituent can have a multi-year influence on groundwater quality. (Author's abstract)
W86-04419

EFFECT OF NITRILOTRIACETIC ACID ON THE SOLUBILITIES OF METALS IN SOIL-SLUDGE MIXTURES,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-04420

PICLORAM MOVEMENT IN AN APPALACHIAN HARDWOOD FOREST WATERSHED,

Florida Univ., Gainesville. Dept. of Soil Science.
D. G. Neary, P. B. Bush, J. E. Douglass, and R. L. Todd.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 585-592, October-December 1985. 4 fig, 3 tab, 40 ref.

Descriptors: *Herbicides, *Path of pollutants, *Soil solution, Springs, Pesticides, Stream pollution, Forest watershed, Appalachian Mountains.

Picloram (4-amino-3,5,6-trichloropicolinic acid) was applied at a rate of 5.0 kg/ha acid equivalent to 4 ha of the 28-ha Watershed 19, Coweeta Hydrologic Laboratory in western North Carolina. The herbicide was broadcast manually as a pellet formulation (10% acid equivalent) in May 1978, to eliminate a poor-quality mixed oak overstory and rhododendron (Rhododendron maximum L.)-laurel (Kalmia latifolia L.) understory prior to planting white pine (Pinus strobus L.). Soil solution contained the highest picloram levels at 0.6 m (peak of 330 mg/cu m). Picloram residues were detected in soil solution 1.2 m into the soil, but concentrations were <25 mg/cu m, and persisted for only 60 weeks. Intensive sampling of two springs detected trace levels for a period of 18 days. Only sporadic, low level picloram residues

were detected in streamflow from nested 10-ha and 28-ha watersheds during a 70-week period. Use of the herbicide picloram did not affect the quality of streamflow from Watershed 19 for domestic or agricultural purposes within the two years of the study. (Peters - PTT)
W86-04421

TRACE ORGANIC COMPOUNDS IN RAIN. 4. IDENTITIES, CONCENTRATIONS, AND SCAVENGING MECHANISMS FOR PHENOLS IN URBAN AIR AND RAIN,

Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
C. Leuenberger, M. P. Ligocki, and J. F. Pankow.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1053-1058, November 1985. 5 tab, 39 ref. EPA Grant No. R8113380.

Descriptors: *Air pollution, *Fate of pollutants, *Rain, *Chemistry of precipitation, *Phenols, Hydrocarbons, Precipitation, Organic compounds, Trace levels, Urban areas, Pollutant identification, Industrial wastes, Portland, Oregon, Henry's law.

The gaseous and filterable air concentrations of a variety of phenols were determined for seven rain events in Portland, Oregon. The dissolved and filterable rain concentrations were also determined concurrently. The phenols in the air were found to exist virtually exclusively in the gaseous state as expected on the basis of their large vapor pressures. The fact that virtually all of the phenols found in the rain were present in the dissolved state is in agreement with the air data. The rain (dissolved) concentrations were quite high, in the microgram per liter range. Of all the constituents present in the rain samples, the most concentrated ones were phenols. The results indicate that gas scavenging is much more important than particle scavenging for phenols. Considering the rather low values of their Henry's law constants, gas scavenging is an efficient atmospheric removal process for these compounds. (Author's abstract))
W86-04422

TIME SCALES OF CATCHMENT ACIDIFICATION,

Virginia Univ., Charlottesville.
B. J. Cosby, G. M. Hornberger, J. N. Galloway, and R. F. Wright.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1144-1149, December 1985. 2 fig, 16 ref. NSF Grant No. CEE-8215914.

Descriptors: *Acid rain, *Sulfates, *Path of pollutants, *Acidification, *Water pollution effects, Atmospheric deposition, Water pollution sources, Soil chemistry.

A quantitative model that is used to estimate patterns and absolute time scales of surface water acidification is presented that is based on mathematical representations of those processes that are thought to be the primary catchment controls on acidification. The model which is based on the assumption that surface water chemistry is determined by reactions that occur in the soils and rocks within a catchment is called MAGIC (model of acidification of groundwater in catchments). In the present study in estimating time scales, a hypothetical catchment was used along with a simplified temporal sequence of atmospheric sulfur deposition to elicit the widest range of responses possible from the soil processes included in MAGIC. The MAGIC model expands the simple, two-component (Ca-Al) system of Reuss and Johnson to include other important ions in catchment soil and surface waters. The hypothetical catchment used in the study was designed to be sensitive, with low alkalinity prior to onset of acid deposition, yet relatively slow responding, with moderate sulfate adsorption capacity. Results of the model are divided into the stages of acidification. The present model is considered an effective tool for examining the implications of certain assumptions about the long-term processes that control the acidification and recovery of upland catchments. (Geiger - PTT)
W86-04423

DIFFUSION AND PARTITIONING OF HEXACHLOROBIPHENYL IN SEDIMENTS,

Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
D. M. DiToro, J. S. Jeris, and D. Ciarcia.
Environmental Science and Technology ESTHAG, Vol. 12, p 1169-1176, December 1985. 5 fig, 6 tab, 30 ref. EPA Grant No. R805229.

Descriptors: *Fate of pollutants, *Hexachlorobiphenyls, *Diffusion coefficient, *Polychlorinated biphenyls, *Sediment-water interfaces, *Mathematical models, Organic compounds, Marine sediments, Path of pollutants, Sediments, Interstitial water, Sorption, Adsorption, Mathematical studies, Hydrophobic compounds, Saginaw Bay.

The fate of persistent hydrophobic chemicals in natural bodies of water is greatly affected by the transport mechanisms between sediments and the overlying water: particle transport and interstitial water diffusion. An experimental study was made of the interstitial water diffusion of hexachlorbiphenyl (HCBP) in undisturbed sediments taken from Saginaw Bay. The diffusion coefficient and partition coefficient of HCBP were determined by using a dual radio-tag experiment that extended over 2 yr. In general, constant coefficients were observed. An independent measurement of the diffusion coefficient for a nonsorbing chemical (tritiated water) allows an estimate to be made of the interstitial water-sediment partition coefficient. The results were in close agreement with those predicted from hydrophobic sorption correlations based upon sediment organic carbon and HCBP octanol-water partition coefficients. The results also correspond to the low particle concentration limit of the partition coefficients found when batch equilibrations of dilute suspensions of the same sediment were used. (Geiger - PTT)
W86-04424

LEAD CYCLING IN AN ACIDIC ADIRONDACK LAKE,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2K.
W86-04425

RAPID CONSUMPTION OF BROMINE OXIDANTS IN RIVER AND ESTUARINE WATERS,

Maryland Univ., College Park. Dept. of Chemistry.
D. A. Jaworske, and G. R. Helz.
Environmental Science and Technology, Vol. 19, No. 12, p 1188-1191, December 1985. 6 fig, 2 tab, 27 ref.

Descriptors: *Bromine, *Seawater, *Fate of pollutants, *Electrochemistry, *Oxidation-reduction potential, *Estuaries, *Rivers, Chlorine, Ozone, Chemical reactions, Oxidation process, Oxidation, Organic matter, Humic acid, Decomposition, Halogens, Patuxent River, Maryland, Photolysis.

Fluvial and estuarine waters possess a substantial reductive capacity that rapidly destroys strong oxidants introduced from natural or anthropogenic sources. The rapid reduction of bromine oxidants, which in marine waters are intermediates in the decomposition of both chlorine and ozone, has been studied electrochemically in the field and the laboratory with a rotating ring disk electrode. Patuxent extuary water was found to contain about .00001 M of substances that reacted extremely rapidly with bromine. Estimated second-order rate constants were on the order of 10 to the 7th power /M/sec or higher. Bromine consumption did not correlate with salinity, nor was it altered by addition of .0001 M ethylenediaminetetraacetic acid or by ultrafiltration. However, destruction of organic matter by UV photolysis eliminated bromine consumption on the .02/sec time scale of the experiments. Likewise, the bromine-consuming components could be titrated away with HOBr, indicating that they are not catalysts. Commercially available humic acid behaved qualitatively in a similar fashion to the natural reductants. (Author's abstract)
W86-04426

INTERFERENCE IN THE BACTERICIDAL PROPERTIES OF INORGANIC CHLORAMINES BY ORGANIC NITROGEN COMPOUNDS,

California Univ., Irvine. Program in Social Ecology.
R. L. Wolfe, N. R. Ward, and B. H. Olson.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1192-1195, December 1985. 1 fig, 4 tab, 18 ref. Grant No. MUD 1373.

Descriptors: *Fate of pollutants, *Chloramines, *Disinfectants, *Organic compounds, *Nitrogen compounds, *Bactericides, Disinfection, Reservoirs, Water treatment, Bacteria, Ammonia, Water quality, Water quality control, Water quality, Management, Amino acids, Glycine, Chloramines.

The interference of nitrogenous organic compounds on the bactericidal activity of chloramines was examined. The amino acid glycine (0.1-0.5 milligrams/liter as nitrogen) was supplemented into water samples obtained from a finished water reservoir to artificially increase the levels of organic nitrogen. Inactivation rates of total count bacteria were markedly slower with chloramines (1.6 milligrams/liter; Cl2-N, 3:1 w/w; pH 8) when preammoniation and concurrent application methods were compared to preformed chloramines. Levels of glycine as low as 0.1 milligrams (as nitrogen)/liter reduced the bactericidal activity with the preammoniation procedure. No decrease in the bactericidal properties was observed when preformed chloramines were assayed in the presence of glycine. Significantly, the inorganic chloramine residuals (ammonia derived) and organic chloramine residuals (glycine derived) could not be distinguished by amperometric or ferrous ammonium sulfate-diethyl-p-phenylenediamine titration techniques. Hence, residual measurement by conventional analytical techniques may not indicate the true level of disinfection potential of chloramines. (Author's abstract)
W86-04427

DECOMPOSITION OF OZONE IN WATER IN THE PRESENCE OF ORGANIC SOLUTES ACTING AS PROMOTERS AND INHIBITORS OF RADICAL CHAIN REACTIONS,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Staehelin, and J. Hoigne.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1206-1213, December 1985. 9 fig, 2 tab, 40 ref.

Descriptors: *Ozone, *Decomposition, *Fate of pollutants, *Chemical reactions, *Organic compounds, Disinfectants, Water treatment, Drinking water, Humic acid, Sugars, Acids, Alcohols, Solutes.

The decomposition of aqueous ozone is generally due to a chain reaction involving OH radicals. Many organic solutes (impurities) can react with OH to yield O(2-) upon addition of 02. O(2-) transfers its electron to a further ozone molecule in a rather selective reaction. The ozonide anion O(3-) formed immediately decomposes into a further OH radical. Compounds that convert OH radicals into ozone-selective O(2-), therefore, act as promoters of the chain reaction. The efficiences of different OH to O(2-) converters (e.g., formic acid, primary and secondary alcohols (including sugars), glyoxylic acid, and humic acids) are tested in the presence of other OH radical scavengers that do not primarily produce O(2-) (carbonate, aliphatic alkyl compounds, and tert-butyl alcohol). The derived reaction kinetics allows one to qualitatively interpret the variation of the lifetime of O(3-) found in model solutions and even in natural waters and during drinking water treatment. (Author's abstract)
W86-04428

SURFACE CHARGE AND ADSORPTION PROPERTIES OF CHRYSOTILE ASBESTOS IN NATURAL WATERS,

California Inst. of Tech., Pasadena. Dept. of Envi-

ronmental Engineering Science.
R. C. Bales, and J. J. Morgan.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1213-1219, December 1985. 11 fig, 27 ref.

Descriptors: *Asbestos, *Decomposition, *Natural waters, *Adsorption, *Model studies, Absorption, Ions, Organic matter, Fate of pollutants, Asbestos cement, Pipelines, Pipes, Models, Minerals, Weathering, Silica, Magnesium.

Changes in surface-charge adsorption properties of chrysotile asbestos aging in water were studied in a series of constant-pH laboratory experiments. Chrysotile freshly suspended in an inorganic electrolyte has a positive surface charge below pH 8.9. Charge reversal occurs within about 2 weeks due to more rapid dissolution of chrysotile's outer magnesium hydroxide surface relative to the underlying silica component of the mineral. The inorganic anions NO3(-), Cl(-), HCO3(-), and SO4(2-) did not absorb. A constant-capacitance model can be used to relate surface charge to adsorption of protons over the pH range 7-9. At natural organic matter (NOM) concentrations at or below those encountered in natural waters, the particles can absorb sufficient organic matter within 1 day to acquire a negative charge. Adsorption of NOM reached a maximum of .000030 milligrams of C/sq cm after 21 hr; catechol continued to adsorb over 5 days. (Author's abstract)
W86-04429

IMPLICATIONS OF A GRADIENT IN ACID AND ION DEPOSITION ACROSS THE NORTHERN GREAT LAKES STATES,

Environmental Research Lab.-Duluth, MN.
G. E. Glass, and O. L. Loucks.
Environmental Science and Technology ESTHAG, Vol. 20, No. 1, p 35-43, January 1986. 3 fig, 6 tab, 39 ref. Agreement Nos. CR809412 and CR809484.

Descriptors: *Acid rain, *Spatial distribution, *Deposition, *Fate of pollutants, *Chemistry of precipitation, Acidic water, Ions, Cations, Anions, Sulfates, Sulfur, Ammonia, Hydrogen ion concentration, Nitrates, Oxides, Minnesota, Wisconsin, Michigan.

Average precipitation pH, 1979-1982, declines from west to east from 5.3 to 4.3 along a cross section of sites in Minnesota, Wisconsin, and Michigan. This answers questions about the seasonal and geographic pattern of anthropogenic acid precursor emissions and reaction products (SO4(2-), NO3 (-), H(+), NH4(+)) that increase from west to east. Except for higher concentrations of Ca(2+) and Mg(2+) observed at one site in the cultivated area of southwestern Minnesota, the contribution of soil-related metal cations to the total ions in solution is small (17%) and relatively uniform across the region. Significant seasonal and geographic patterns patterns in precipitation chemistry and deposition values are observed. Close correspondence of the sums of strong acid anions with the sums of hydrogen and ammonium ions in precipitation is observed, indicating anthropogenic sources of sulfur and nitrogen oxides. Present atmospheric inputs show close chemical correspondence when precipitation chemistry values are compared to the resulting ionic composition of weakly buffered lakes in north central Wisconsin and northern Michigan. The wet deposition of total acidity in the middle and eastern part of the region is comparable to that of impacted sites in the Adirondacks and in regions of Scandinavia. (Author's abstract)
W86-04431

AROMATIC HYDROCARBONS IN NEW YORK BIGHT POLYCHAETES: ULTRAVIOLET FLUORESCENCE ANALYSES AND GAS CHROMATOGRAPHY/GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSES,

Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
J. W. Farrington, S. G. Wakeham, J. B. Livramento, B. W. Tripp, and J. M. Teal.
Environmental Science and Technology ESTHAG, Vol. 20, No. 1, p 69-72, January 1986. 4 fig, 2 tab, 20 ref. Contract No. DE-AC02-77EV04256. A007.

Descriptors: *Polychaetes, *Aromatic compounds, *Fate of pollutants, *Fluorometry, *Pollutant identification, Bioaccumulation, Gas chromatography, Mass spectrometry, Biological samples, Hydrocarbons, Petroleum products, Organic compounds, New York, Path of pollutants.

Polychaetes collected from New York Bight sediments near sewage sludge and harbor dredge spoil dumpsites contained a series of diaromatic tetracyclid hydrocarbons of apparent triterpenoid origin. Microbial processes in sewage sludge are a likely source of these compounds. These octahydrochrysenes were much more abundant in the polychaetes than were the fossil fuel and combustion-derived polycyclic aromatic hydrocarbons which were found in the sediments, presumably because they are more available for biological uptake. If the polychaetes had been analyzed only by the spectrofluorometric techniques often used for screening samples for petroleum contamination, then grossly inaccurate results for aromatic hydrocarbon content would have been obtained. Therefore, UV fluorescence must be used in a hierarchical approach, with more sophisticated procedures available to verify the petrogenic nature of the hydrocarbons. (Author's abstract).
W86-04432

PRODUCTS AND QUANTUM YIELDS FOR PHOTOLYSIS OF CHLOROAROMATICS IN WATER,

SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
D. Dulin, H. Drossman, and T. Mill.
Environmental Science and Technology ESTHAG, Vol. 20, No. 1, p 72-77, January 1986. 8 tab, 40 ref.

Descriptors: *Aromatic compounds, *Photolysis, *Fate of pollutants, *Decomposition, *Degradation products, Organic compounds, Oxidation, Degradation, Polychlorinated biphenyls, Hydrocarbons.

Photolysis of chlorobenzene, 2- and 4-chlorobiphenyl, and 2- and 4-chlorobiphenyl ethers in water with 250-300-nm light produce corresponding phenols or, in the case of 2-chlorobiphenyl ether, dibenzofuran exclusively. Quantum yields in most cases are very similar to those reported in hexane for the reduction process. 1,2,4-Trichlorobenzene and 2,3,7,8-tetrachlorodibenzodioxin (TCDD) photolyze much less efficiently in water than in hexane. A common pathway for photolysis of mono-chloroaromatics involving aryl cations accounts well for the experimental observations. C-O rather than C-Cl cleavage in TCDD may be a major pathway for its loss. Half-lives for photolysis of these chloroaromatics in sunlight in water range from 460 yr to 5 days; TCDD photolyzes in water with a half-life of about 4-5 days in summer at 4 deg latitude. (Author's abstract)
W86-04433

PCBS HAVE DECLINED MORE THAN DDT-GROUP RESIDUES IN ARCTIC RINGED SEALS (PHOCA HISPIDA) BETWEEN 1972 AND 1981,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
R. F. Addison, M. E. Zinck, and T. G. Smith.
Environmental Science and Technology, Vol. 20, No. 3, p 253-256, March 1986. 2 tab, 26 ref.

Descriptors: *Polychlorinated biphenyls, *DDT, *Arctic ringed seals, Path of pollutants, Water pollution effects, Tissue analysis, Air pollution, Metabolism, Arctic.

Mean DDT-group concentrations in the blubber of western Arctic ringed seals (Phoca hispida) sampled in 1981 were less than 1 microgram/g wet weight blubber, and mean PCB concentrations were less than 2 microgram/g wet weight. Male seals had higher concentrations than did females. In males, residue concentrations in blubber tend to increase with age, and a similar trend is seen in other marine mammals. This probably occurs because the males have no route other than slow metabolic degradation by which to excrete these compounds. In female seals, residue concentrations appear not to increase with age or at least not as sharply as in males. PCB concentrations were about half of those in a sample of the same population taken in 1972, when allowance was made for the variation of residue concentrations with age, sex and condition. This decline probably results from the ban on PCB manufacture and use imposed in the early 1970s. Concentrations of DDT-group residues did not show any clear decline over the same interval, and the relative proportions of p, p prime-DDT and p, p prime-DDE suggested that there is a continuing supply of DDT to the western Arctic. The most probable source of this is by atmospheric or water transport from the Far East, where DDT was used until at least the late 1970s. (Lantz-PTT)
W86-04440

FATE OF HAZARDOUS WASTE DERIVED ORGANIC COMPOUNDS IN LAKE ONTARIO,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Jaffe, and R. A. Hites.
Environmental Science and Technology, Vol. 20, No. 3, p 267-274, March 1986. 9 fig, 4 tab, 24 ref. EPA Grant R-808961.

Descriptors: *Fate of pollutants, *Hazardous wastes, *Organic compounds, *Lake Ontario, Path of pollutants, Water pollution, Distribution patterns, Gas chromatography, Mass spectrometry, Aromatic compounds, Niagara Falls, Fish.

Dated sediments cores from Lake Ontario's four sedimentation basins and sedentary fish from tributaries and embayments were analyzed by gas chromatographic, methane-enhanced, negative ion mass spectrometry for a group of fluorinated aromatic compounds. The historical record of these chemicals in Lake Ontario sediments agrees well with the use of the Hyde Park dump in the city of Niagara Falls, NY. These compounds first appeared in sediments in 1958 and rapidly increased until 1970. These dates coincide with the onset of dumping at Hyde Park and remedial action undertaken when this dump was closed, respectively. Chemicals leaking from this site are transported across the entire lake and accumulate in the three major sedimentation basins and in fish from the southern and eastern shores of the lake. Suspended sediment with its load of organic compounds enters the lake from the Niagara River and is swept along the southern nearshore zone by water currents. Sediment deposits temporarily all along this zone in a rather uniform distribution and, because water flow in this zone is rapid, this distribution takes place within a few months. From this point, mixing takes place in two ways. First, the sediment from the nearshore zone is mixed into the deep zones of the lake, probably by seasonal, thermal inversions of the water column. Second, the sediments in the deep zones are spread from basin to basin by mixing the layer of suspended sediment at the lake bottom. This transport mechanism distributes the pollutants in a relatively rapid and uniform way throughout the lake. The depositional record of a selected group of pollutants reflects the history of the Hyde Park dump's operation. (Lantz-PTT)
W86-04441

SNOW CHEMISTRY OF THE CASCADE-SIERRA NEVADA MOUNTAINS,

Geological Survey, Tacoma, WA. Water Resources Div.
L. B. Laird, H. E. Taylor, and V. C. Kennedy.
Environmental Science and Technology, Vol. 20, No. 3, p 275-290, March 1986. 11 fig, 7 tab, 47 ref.

Descriptors: *Atmospheric deposition, Acid rain, *Snow sampling, *Chemical manalysis, *Cascade Mountains, *Sierra Nevada Mountains, Hydrogen ion concentration, Sulfates, Nitrates, Water pollution effects, Path of pollutants, Washington, Oregon, California, Statistical analysis.

The assessment of geographic variations in atmospheric deposition in Washington, Oregon, and California using snow cores from the Cascade-Sierra Nevada Mountains, collected from late February to mid-March 1983, is presented. A statistical analysis of the analytical and sampling precision was made. The snowpack in the higher Cascades and Sierra Nevada is not strongly influenced by anthropogenic activities at present. The pH of snow samples ranges from 5.11 to 5.88. Sulfate and nitrate correlate with H(+) in some segments of the sample traverse. The SO4 data show apparent influence from major source areas in Washington and California; nitrate does not. An apparent decrease in NH4 in snow in Washington and California suggests atmospheric interactions resulting in the removal of NH4. The NH4 reduction raises questions about nutrient supply to the mountain vegetation. Heavy-metal correlations included Cd, Cu, and Fe with Pb, and Mn with K and DOC, among others. No correlation was found between constituents and snow-water content. (Lantz-PTT)
W86-04442

SOLUTION OF HYDROCARBONS IN A HYDROCARBON-WATER SYSTEM WITH CHANGING PHASE COMPOSITION DUE TO EVAPORATION,

Virginia Inst. of Marine Science, Gloucester Point.
D. R. Burris, and W. G. MacIntyre.
Environmental Science and Technology, Vol. 20, No. 3, p 296-299, March 1986. 4 fig, 1 tab, 12 ref.
USAF Grant No. AFOSR-83-0036.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Evaporation, *Oily water, *Phase composition, Oil-water interfaces, Path of pollutants, Oil spills, Methylcyclohexane, Ethylbenzene, Tetralin, 1-Methylnapthalene.

Several oil spill weathering studies have investigated the fate of spills in the aquatic environment. Weathering is a complex process that includes evaporation, dissolution, dispersion, advection, photochemical oxidation, and microbial degradation. Examination of the overall weathering process is further complicated by the complex composition of petroleum and difficulties in environmental sampling, but can be conducted in laboratories using water solubility vessels designed for use with both the single-component and four-component hydrocarbon mixtures of constant composition. Pure water was brought into contact with a four-component liquid hydrocarbon phase comprised of methylcyclohexane, ethylbenzene, tetralin, and 1-methylnaphthalene. The headspace above the hydrocarbon phase was continually purged with N2 to provide a controlled evaporative loss. Hydrocarbon concentrations in the water and hydrocarbon phases changed due to dissolution and evaporation and were measured as a function of time. A surface renewal mass transfer model is congruent with the observed hydrocarbon concentrations in the aqueous phase. Hydrocarbon-phase composition and component interactions are important in determining the time dependence of the aqueous-phase composition. The results have implications concerning the fate of components of petroleum products discharged in the aquatic environment. (Lantz-PTT)
W86-04443

DIAGENETIC TRACE-METAL PROFILES IN ARCTIC LAKE SEDIMENTS,

Alaska Univ., Fairbanks. Inst. of Marine Science.
J. C. Cornwell.
Environmental Science and Technology, Vol. 20, No. 3, p 299-302, March 1986. 1 fig, 36 ref.

Descriptors: *Trace metals, *Lake sediments, *Arctic, Manganese, Iron, Barium, Cobalt, Copper, Nickel, Zinc, Path of pollutants, Toolik Lake, Alaska.

The surfaces of hydrous Mn and Fe oxides are important sites for the removal of trace metals from natural waters. Selective extraction techniques show that trace metals on suspended particulates and in sediments are often associated with metal oxide phases. In Toolik Lake, AK, postdepositional migration of Mn and Fe within sediment results in Mn- and Fe-rich horizons. These arise from the reduction of Mn and Fe oxides, upward diffusion of Mn(2+) and Fe(2+), and precipitation of oxides closer to the sediment-water interface. The purpose of this study is to examine the effect of Mn and Fe migration on the distribution of trace metals (Ba, Co, Cu, Ni, and Zn) commonly found associated with lacustrine ferromanganese deposits. Heterogeneous trace-metal profiles have been found in the slowly accumulating sediments of Toolik Lake. Elevated Ba, Co, Cu, Mo, and Ni concentrations near the sediment-water interface are inconsistent with inputs from recent watershed disturbances. The apparent cause of trace-metal enrichment is comigration with Mn and Fe in pore water resulting in narrow bands of trace-metal enrichment associated with high (>15%) concentrations of Mn and Fe. The misinterpretation of diagenetic enrichments as anthropogenic features is a potential problem in mildly reducing, Mn- and Fe-rich lake sediments. (Lantz-PTT)
W86-04444

CHEMILUMINESCENCE VS. KJELDAHL DETERMINATION OF NITROGEN IN OIL SHALE RETORT WATERS AND ORGANONITROGEN COMPOUNDS,

California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W86-04445

COMPARISON OF ULTRAVIOLET AND REDUCTIVE AMPEROMETRIC DETECTION FOR DETERMINATION OF ETHYL AND METHYL PARATHION IN GREEN VEGETABLES AND SURFACE WATER USING HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,

Middle Tennessee State Univ., Murfreesboro. Dept. of Chemistry and Physics.
For primary bibliographic entry see Field 5A.
W86-04446

INTERLABORATORY STUDY ON DETERMINATION OF POLYCHLORINATED BIPHENYLS IN ENVIRONMENTALLY CONTAMINATED SEDIMENTS,

Environmental Monitoring and Support Lab.-Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W86-04449

CHARACTERIZATION OF DYES IN ENVIRONMENTAL SAMPLES BY THERMOSPRAY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY,

Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
For primary bibliographic entry see Field 5A.
W86-04452

DEGRADATION OF THE TRI-N-BUTYLTIN SPECIES IN WATER AND SEDIMENT FROM TORONTO HARBOR,

Canada Centre for Inland Waters, Burlington (Ontario).
R. J. Maguire, and R. J. Tkacz.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 5, p 947-953, September/October 1985. 3 fig, 6 tab, 32 ref.

Descriptors: *Degradation, *Tri-n-butyltin, *Path of pollutants, *Toronto Harbor, Water pollution, Sediments, Tin, Environmental effects, Water pollution effects, Toxicity, Light intensity, Thermal effects, Ontario.

The article discusses the adsorption of tri-n-butyltin species (Bu sub 3Sn(+)) to sediments and the degradation of Bu sub 3Sn(+) in water and sediment from Toronto Harbor, which is contaminated with butyltin species and inorganic tin. Contamination of water and sediment with Bu sub 3Sn(+) often produces its less toxic degradation products, the di-n-butyltin species (Bu sub2SN(2+)), n-butyltin species (BuSn(3+)), and inorganic tin. At some locations the concentration of Bu sub 3SN(+) in water is high enough to warrant concern with regard to chronic toxicity to sensitive organisms. The Bu sub 3Sn(+) species: (1) is bound fairly strongly to sterile Toronto Harbor sediment and the half-life of desorption is at least 10 months at 20 C, (2) can be taken up from sediment and degraded by oligochaetes, and (3) is degraded by a sequential debutylation pathway at 20 C in Toronto Harbor water and water-sediment mixtures with half-lives of 5 and 4 months, respectively. On the basis of this and earlier work, it is concluded that the main factors limiting the persistence of the tri-n-butyltin species in aquatic ecosystems are photolysis in water and biological degradation in water and sediment, and with the temperatures and sunlight intensities prevalent in Canada, the half-life is likely to be at least a few to several months. (Lantz-PTT)
W86-04454

DETERMINATION OF SELENIUM SPECIATION IN BIOGENIC PARTICLES AND SEDIMENTS,

Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W86-04458

GEOPHYSICAL MONITORING OF GROUND WATER CONTAMINATION AROUND WASTE DISPOSAL SITES,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. P. Greenhouse, and M. Monier-Williams.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 63-69, Fall 1985. 7 6 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Geophysics, Waste disposal sites, Seismic properties, Electrical studies, Electromagnetic studies, Conductivity, Landfills.

Geophysical techniques are widely used in evaluating potential sites for the disposal of waste. Seismic and electrical surveys are routinely undertaken to determine the nature and variability of geological and geotechnical parameters that influence the choice of a site. In the last decade, however, geophysics has assumed a further role. Electrical and electromagnetic methods are increasingly being used in the burgeoning activity of groundwater quality control around waste-disposal sites. These geophysical applications fall into two broad categories, here termed monitoring and mapping, both of which identify contaminated groundwater because of the enhanced electrical conductivity associated with abnormally high concentrations of dissolved solids. The potential and the problems for geophysical monitoring programs at waste disposal sites are discussed. No data are presented, but the expectations, design criteria and implementation of a geophysical monitor are examined for a hypothetical landfill. The authors conclude that any geophysical monitor must be designed to allow for future changes in the physical setting, geophysical technology and the personnel who will record, process and interpret the data. This suggests that permanent installations be kept to a minimum, and that a high priority be given to simplicity and reliability. It is also important that the detection limits of the monitor be clearly established, that the noise levels in readings unrelated to changes in contamination levels are well defined and that the monitor is integrated into an overall hydrogeological monitoring program. (Lantz-PTT)
W86-04473

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-04474

BIOLOGICAL ACCUMULATION AND MONITORING OF CHEMICAL WASTES IN ARCTIC WATERS,

Solway Marine Investigations, Maryport (England).
E. J. Perkins.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 1-11, 1986.

Descriptors: *Biological monitoring, *Chemical wastes, *Arctic zones, Solway Firth, England, Toxicity, Fertility, Gastropods, Crustaceans, Polychaetes, *Bioaccumulation, Trace elements.

The biological accumulation and monitoring of chemical wastes are considered with particular reference to the Solway Firth, U.K. Monitoring of the influence of chemical wastes may be concerned with somatic or reproductive responses and is more usually the former. It is shown that size and abundance are not an indication of a species fertility which is crucial to its conservation. Diet has an important influence upon the magnitude of the trace element burden of gastropod molluscs and it is shown that the fertility of Patella vulgata and Littorina littorea is unaffected by marked increases in the trace element burden. In this study, some of the species examined such as, the polychaete worms Phyllodoce maculata and Scoloplos armiger, the decapod crustacean Pagurus bernhardus and the gastropod molluscs, Littorina littorea and Thais lapillus, have a distribution which extends into arctic waters. Clearly such animals offer the opportunity for comparative studies to test the more general application of the work reported. Such comparative work would also facilitate efforts to apply data from the boreal region to problems in the Arctic. (Author's abstract)
W86-04475

BEHAVIOUR AND FATE OF ARCTIC OIL SPILLS,

Environmental Protection Service, Ottawa (Ontario). Environmental Emergencies Technology Div.
A. M. Bobra, and M. F. Fingas.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 13-23, 1986. 2 fig, 4 tab, 8 ref.

Descriptors: *Path of pollutants, *Oil spills, *Arctic, *Cleanup operations, *Oil pollution, Fate of pollutants, Evaporation, Dispersants, Emulsifiers, Ice, Physicochemical properties, Distribution patterns, Beaufort Sea.

A brief overview is provided, based on several recent reports, of the dominant factors and processes which influence the behavior and physical fate of spilled crude oil in the remote harsh Arctic offshore regions. These factors and processes include physical-chemical properties, evaporation, dispersion, dissolution, emulsification, physical movement and interaction with ice. Rates of the individual dominant processes for a typical Beaufort oil in the Beaufort Sea under different physical environments are approximated and applied to various spill scenarios. Research needs in this field are summarized. (Author's abstract)
W86-04476

RANDOM TRANSPORT OF OIL BY SEA ICE,

Washington Univ., Seattle. Polar Science Center.
R. Colony.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 25-39, 1986. 9 fig, 13 ref. NOAA Contract No. 83-ABC-00358.

Descriptors: *Path of pollutants, *Random transport, *Oil spills, *Sea ice, Arctic, Mathematical models, Model studies, Markov Process, Prudhoe Bay, Peard Bay, Statistical analysis, Distribution patterns.

The transport of oil spilled upon the wintertime Arctic Ocean is modelled. As the motion of this oil is almost wholly due to its advection by sea ice, it is sufficient to study the motion of individual ice floes. The observational basis for our understanding of sea ice motion comes from the trajectories emanating from a potential site of spilled oil. This ensemble is modelled by a Markov process and is formulated in terms of the observed motion. Statistics of the modelled ensemble address the probability that an oil spill will be transported to an arbitrary region, perhaps an environmentally sensitive one. Results are shown for potential spills at Prudhoe Bay and Peard Bay. (Author's abstract)
W86-04477

OIL IN ICE COMPUTER SIMULATION MODEL,

Dome Petroleum Ltd., Calgary (Alberta).
P. D. Wotherspoon, and J. J. Swiss.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 41-46, 1986. 1 fig.

Descriptors: *Path of pollutants, *Fate of pollutants, *Oil spills, *Sea ice, *Simulation analysis, *Model studies, Mathematical models, Physicochemical properties, Distribution patterns, Beaufort Sea.

A computer simulation program which depicts the behavior and distribution of oil spilled in or under sea ice has been developed. The program combines mathematical models developed in previous studies to describe the motion of oil in/under landfast, first-year and multi-year ice. By inputting or estimating such key parameters as oil type, spill type, spill duration, flow rate, ice type, relative under ice current speed and direction, under ice roughness and distinct ice features, a time series of 'maps' is generated showing the distribution of the spilled oil. At present, the simulation does not include the movement of oil contaminated ice but future development plans include incorporation of the program into a Beaufort Sea ice motion model. The program is a tool which can be used to assist on-scene commanders during spill response and to plan counter-measures for oil spills in/under sea ice. (Author's abstract)
W86-04478

ACCUMULATION OF AIRBORNE TRACE POLLUTANTS BY ARCTIC PLANTS AND SOIL,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
W. Thomas.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 47-57, 1986. 3 fig, 6 tab, 21 ref.

Descriptors: *Air pollution, *Arctic, *Trace levels, *Vegetation, *Soils, Polyaromatic hydrocarbons, Heavy metals, Chlorinated pesticides, Benzohexachloride, Path of pollutants, Accumulation.

Plant and soil samples from 4 locations in Spitsbergen (Norway) were analyzed for major ions, heavy metals, polyaromatic hydrocarbons (PAH) and chlorinated pesticides. The results indicate that trace amounts of these substance groups result from a number of different sources, namely from subsoil material, local emissions and long range atmospheric transport. A comparison of inorganic and organic micropollutant concentrations allows a distinct between trace substance uptake from soil or air. (Author's abstract)
W86-04479

FATE OF PETROLEUM POLLUTANTS IN ARCTIC ECOSYSTEMS,

Louisville Univ., KY. Dept. of Biology.
R. M. Atlas.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 59-67, 1986. 2 fig, 1 tab, 77 ref.

Descriptors: *Fate of pollutants, *Oil pollution, *Arctic ecosystems, *Microbial degradation, Aquatic ecosystems, Biodegradation, Microorganisms, Nitrogen, Oxygen, Phosphorus, Oil spills.

Both experimental oil release field studies, in Arctic tundra, freshwater, and marine ecosystems, and follow-up studies after Arctic and subarctic oil spillage indicate long persistence times for hydrocarbon contaminants and slow rates of microbial biodegradation. The slow rates of petroleum biodegradation in Arctic ecosystems are not due to a lack of indigenous hydrocarbon-degrading microorganisms since virtually all Arctic ecosystems contain numbers of naturally occurring populations of hydrocarbon-degrading microorganisms, and generally numbers of hydrocarbons degraders increase following addition of oil. Low temperatures alone also can not explain the limited rates of hydrocarbon biodegradation. Rather the limitation to microbial degradation of petroleum hydrocarbons in Arctic ecosystems appears to be due to the combination of several factors, including the availability of nitrogen, phosphorus, and oxygen. Although the potential for hydrocarbon degradation exists, the actual rates of hydrocarbon biodegradation in Arctic ecosystems are slow; microbial hydrocarbon degradation can decontaminate Arctic ecosystems but the time frame after a major spillage will be decades rather than years. (Author's abstract)
W86-04480

ACID NEUTRALIZING CAPACITY OF GLACIAL SEDIMENTS IN WESTERN UNGAVA,

Montreal Univ. (Quebec). Dept. of Geology.
H. Wilson, M. A. Bouchard, and C. E. Delisle.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 69-85, 1986. 9 fig, 5 tab, 33 ref. NSERC Grant A8424.

Descriptors: *Acid neutralization, *Glacial sediments, *Acid rain, *Ungava, Ontario, Hydrogen ion concentration, Ecological effects, Carbonates, Silt, Clays.

The present research evaluates the sensitivity of the terrestrial and aquatic ecosystems to acid precipitation in western Ungava, Quebec. pH values of the acid-sediment mixtures were used to classify the sediments according to their capacity to neutralize acid. The carbonate and the silt and clay content of the sediments are considered as the main controlling factors of their neutralization properties. Average acid neutralizing capacity (ANC) values were calculated for 14 sites. pH values, determined from the neutralization characteristics at each site, were used to classify the sites on a pH scale, presumably a sensitivity scale. On this scale, the least sensitive site, with pH remaining above 7, is from the coast of Hudson Strait where the sediment is a clayey fossiliferous glaciomarine diamicton. Of higher but still relatively low sensitivity, with pH remaining above 4.5, are two sites below the Tyrrell Sea marine limit, where the sediments are predominantly shell-bearing raised littoral deposits. Of high sensitivity, with pH below 4.5, are the remaining sites either below or above marine limit. By comparison to pH values determined for samples collected further south, namely in the Chibougamau-Lac Mistassini region, in the Thetford Mines region, and in northeastern Ontario, the group of samples with pH remaining above 7 may be qualified as showing low sensitivity, those with pH between 7 and 4.5, of intermediate sensitivity, and finally those with pH below 4.5 of high sensitivity. It is concluded that ANC determinations can provide an adequate means of quantitative comparisons between widely separated regions and could possibly be used as one index of terrain sensitivity. Full assessment of terrestrial sensitivity to acid precipitation must also consider the hydrogeological characteristics at different localities. (Author's abstract)
W86-04481

COASTAL ECOLOGY AND THE ARCTIC OIL INDUSTRY: SOME ELEMENTS FOR FUTURE OIL-SPILL CONTINGENCY PLANNING,

Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5G.
W86-04482

ATMOSPHERIC ENVIRONMENT SERVICE LONG RANGE TRANSPORT OF AIR POLLUTANT ACTIVITIES IN THE TERRITORIES,

Atmospheric Environment Service, Edmonton (Alberta).
For primary bibliographic entry see Field 5A.
W86-04483

BACKGROUND LEVELS OF PETROLEUM RESIDUES IN THE CANADIAN ARCTIC MARINE ENVIRONMENT,

Bedford Inst. of Oceanography, Dartmouth (Nova

Scotia).
E. M. Levy.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 161-169, 1986. 1 fig, 3 tab, 21 ref.

Descriptors: *Baseline studies, *Canada, *Arctic, *Marine environment, Hydrocarbons, Petroleum residues, Surface microlayer, Bottom sediments.

The background levels of petroleum-related substances present as solid particulate material floating on the sea surface, as dissolved/dispersed residues in the sea surface microlayer and in the water column, and as substances in surficial bottom sediments have been measured throughout much of the Canadian arctic marine environment. The region is presently devoid of floating particulate petroleum residues, and the background levels of dissolved/dispersed petroleum residues are generally less than 30 micrograms/l in the surface microlayer and less than 0.5 micrograms/l in the water column. Concentrations of extractable residues are generally less than 5 micrograms/l in the sediments. In all cases, the existing background levels are well below those which have detrimental effects on living marine resources. (Author's abstract)
W86-04488

VARIABILITY OF PESTICIDE LOADS TO SURFACE WATERS,

New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Haith.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1062-1067, November 1985. 4 fig, 5 tab, 20 refs.

Descriptors: *Path of pollutants, *Water pollution sources, *Farm runoff, *Monte Carlo simulation, *Hydrologic models, *Weather, *Atrazine, *Carbofuran, Surface runoff, Frequency distribution, Insecticides, Herbicides, Atlanta, Georgia, Des Moines, Iowa.

The variability inherent in pesticide loads to surface water is considered and an efficient procedure for estimating mean and critical loads is presented. Pesticide loads to surface waters are essentially uncertain, but can be quantified in terms of probabilities by Monte Carlo simulation. The simulation process involves three model components: (1) a weather generator, which drives the second component with precipitation, temperature, and rainfall erosivity results, (2) a hydrology model, which yields runoff and sediment flow results, and (3) a soil chemical model, which produces estimates of pesticide runoff. To demonstrate the simulation procedure, pesticide runoff loads were estimated for hypothetical corn fields with 3% slopes and 91 m slope lengths near Atlanta, Georgia, and Des Moines, Iowa. Two commonly used pesticides were considered: carbofuran, an insecticide used for control of corn rootworm, and atrazine, an herbicide. Both pesticides were applied at 3,000 g/ha to the soil surface, on planting day each year, in the simulationmodel runs. Mean monthly and annual runoff loads are given by the model as percentages of the original 3,000 g/ha application rate. Monte Carlo simulation of pesticide runoff loads is not trivial. It requires mathematical models of weather, hydrology, and soil chemistry. Such models now are readily available, however, and their data needs can be met from available published sources. The models are easily programmed for small computers, making the simulation process a practical tool for water quality planners and engineers. (Rochester-PTT)
W86-04491

AIRBORNE MERCURY IN PRECIPITATION IN THE LAKE SUPERIOR REGION,

Environmental Research Lab.-Duluth, MN.
G. E. Glass, E. N. Leonard, W. H. Chan, and D. B. Orr.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 37-51, 1986. 3 fig, 6 tab, 3 ref. Grant No. CR809412.

Descriptors: *Air pollution, *Precipitation, *Chemistry of precipitation, *Mercury, *Lake Superior, Duluth, Minnesota, Ontario, Rain, Snow, Wisconsin, Michigan, Heavy metals, Acid rain.

Mercury was measured in accumulated snow (March 1982) sampled from around Lake Superior and in rainfall from Duluth, Minnesota, (June-September 1982 and March-November 1983). Forbes Township, and Dorset in northwestern and central Ontario, respectively (May-September 1983). Methods of melting snow and collecting rain samples were investigated to avoid loss of mercury during the melting process and sample shipment and storage. Low concentrations in snow and rain required greater analytical sensitivity. A detection limit of 0.008 + or - 0.004 micrograms/L of mercury (N = 26) was attained using the cold vapor technique; and by utilizing a gold gauze amalgam accessory for preconcentration, a detection limit of 0.005 + or - 0.003 migrogram/L (N = 13) was attained. Regional comparisons of mercury accumulation in the snow pack across the northern parts of Minnesota, Wisconsin, Michigan, and Ontario show highest values, 0.10 + or - 0.17 microgram/L Hg, in the Grand Rapids, Minnesota, area and lowest values in remote areas of Minnesota and Ontario. Rainfall concentrations of total mercury were substantially higher than snow accumulation and were mainly of inorganic forms (73%). The highest amounts of mercury were measured in rainfall at Duluth, Minnesota (3.4 micrograms/L) during June 1982 and at Forbes township, Ontario, (1.2 micrograms/L) during July 1983. Substantially lower concentrations were observed in the other months of 1982 and 1983. There is no unique association of the observed mercury concentration with the air parcel history. However, the single highest mercury concentration in rainfall observed at Duluth, Minnesota, occurred when the 850-mb air parcel back trajectory indicated upwind corridors to the N-NW and the highest concentration at Forbes Township, Ontario, was associated with an 850-mb trajectory from W-NW. Significant positive correlation coefficients (0.05) were obtained with other measured components in rain at Duluth, Minnesota, including S, B, Ca, Mg, Na, Fe, Mn, and Zn in 1983. Mercury concentrations in precipitation and in lake water for precipitation-dominated lakes are similar and indicate that atmospheric deposition can be the major source of mercury for some lakes in the Lake Superior region. (Author's abstract)
W86-04525

SEASONAL AND SPATIAL DISTRIBUTION OF BACTERIA, CHLOROPHYLL, AND NUTRIENTS IN NEARSHORE LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W86-04526

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN NON-MIGRATORY FISH FROM THE NIAGARA RIVER AREA AND TRIBUTARIES TO LAKE ONTARIO,

Indiana Univ. at Bloomington. Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-04527

MEASURED AND CREAMS-PREDICTED NITROGEN LOSSES FROM TOMATO AND CORN MANAGEMENT SYSTEMS,

Southeast Kansas Branch Experiment Station, Parsons.
D. W. Sweeney, A. B. Bottcher, K. L. Campbell, and D. A. Graetz.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 867-873, October 1985. 4 fig, 1 tab, 12 ref.

Descriptors: *Agricultural runoff, *Trickle irrigation, *Denitrification, *Sprinkler irrigation, *Soil types, *Sand, *Leaching, Seasonal variation, Mathematical Models, Simulation, Soil porosity, Permeability Coefficient, Cultivated lands.

Nitrogen runoff and leaching losses from two tomato and four corn field plots were compared to model predictions by CREAMS, a field-scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The tomato treatments included trickle irrigation and overhead sprinkler irrigation and different N treatments, and the corn treatments included multiple N applications, minimum tillage and 'conventional' tillage. Model predictions of N losses from tomato and corn treatments located on sandy soils often disagreed with measured values. Treatment influences and seasonal trends for N losses from corn treatments located on a higher clay content soil were more satisfactorily predicted by CREAMS. The simulation ability of CREAMS for predicting N leaching on deep sands probably needs to be improved. Sensitivity analyses indicated that annual nitrate-N leaching loss predictions were either minimally or not affected by changes in saturated hydraulic conductivity. Input estimations of the fraction of soil pore space filled at field capacity and soil organic matter were inversely related to annual nitrate-N leaching losses, whereas potential mineralizable N was directly related to annual N leaching losses. (Rochester-PTT)
W86-04538

GEOCHEMISTRY OF SUSPENDED PARTICULATE MATTER IN TWO NATURAL SEDIMENTATION BASINS OF THE RIVER RHINE,

Technische Hogeschool Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
D. Van de Meent, J. W. De Leeuw, P. A. Schenck, and W. Salomons.
Water Research WATRAG, Vol. 19, No. 11, p 1333-1340, 1985. 7 fig, 1 tab, 26 ref.

Descriptors: *Geochemistry, *Organic Matter, *Trace Metals, *Multivariate analysis, *Rhine River, *Downstream gradient, Polysaccharides, Proteins, Principal components analysis, Canonical correlation analysis, Meuse River, suspended solids, Sedimentation, Particulate matter.

Multivariate analysis procedures were employed to trace possible correlations between changes in the composition of particulate organics and changes in the ratios of trace metal contents of suspended matter present in two major sedimentation basins of the River Rhine. In both basins, seaward gradients were observed in the organic characteristics as well as the trace metal 'patterns.' These two phenomena are well correlated. It can be concluded that the correlations observed in both basins for the changes in organic characteristics and the changes in trace metal pattern result from the processes that cause both these changes, namely, sedimentation of river particles and autochthonous production of organic matter in a seaward direction for the Ketelmeer/Ijsselmeer basin and admixture of particulate matter of the rivers Meuse and Rhine and the resuspension of particulate matter for the Hollands Diep/Haringvliet basins. (Rochester-PTT)
W86-04547

SOURCES OF WATER TO THE SEAWATER WELL WHICH SUPPLIES THE FISH PONDS IN EILAT: IMPLICATIONS FOR FISHPOND MANAGEMENT,

National Mariculture Centre, Eilat (Israel).
M. D. Krom.
Water Research WATRAG, Vol. 20, No. 4, p 463-469, April 1986. 1 fig, 5 tab, 24 ref. BARD Research Grant No. I-626-83 and NCRD Grant No. AQ/13-157.

Descriptors: *Seawater wells, *Fish ponds, *Eilat, *Israel, *Water reuse, Water supply, Fish management, Aquaculture, Fisheries, Wastewater, Nutrients, Water management, Saline water.

The sources of water to the well supplying the fishponds in Eilat were determined using a simple mass balance approach, in which the concentration of various components in the source waters were measured and a series of simultaneous equations solved to determine the hydrological budget. It was calculated that 80% of the water supplied to the well was recycled pond water, 10% was seawater and 10% was sewage effluent. On the basis of major ion determinations, it was shown that there could be no significant contribution from natural groundwater. This method of water supply

has both disadvantages and benefits. The fishpond system was operated to produce gilthead seabream and gray mullet in the pond and oysters on the pond effluent. The major disadvantage was that the excess nutrients supplied in the inflow may have limited the total biomass of fish which could be grown in the ponds by making them more susceptible to mass mortalities due to both high oxygen or high ammonia/low oxygen concentrations. The benefits include the high productivity of diatoms due to the nutrients supplied which enabled there. to be a successful oyster culture. In addition, 95-97% of the nitrogen supplied in the sources was as ammonium which is toxic to fish. After passage through the aerobic groundwater, 97% of the dissolved nitrogen was in the form of nitrate. At the same time, the coliform counts were reduced to undetectable levels. The major ion composition of the pond was enriched 25% relative to seawater because the evaporated seawater was replaced by sewage effluent. Despite this unusual ionic composition, fish, oysters and prawns were grown successfully in these ponds. (Author's abstract)
W86-04576

BIODEGRADATION PATHWAY OF O-CRESOL BY HETEROGENEOUS CULTURE: PHENOL ACCLIMATED ACTIVATED SLUDGE,

National Research Inst. for Pollution and Resources, Yatabe (Japan).
For primary bibliographic entry see Field 5D.
W86-04578

BIOLOGICAL HALF-LIVES OF EIGHT POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN RAINBOW TROUT (SALMO GAIRDNERI),

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W86-04582

INTEGRATED ANALYSIS OF ACIDIFICATION IN EUROPE,

National Board of Waters, Helsinki (Finland). Water Research Inst.
J. Alcamo, L. Hordijk, J. Kamari, P. Kauppi, and M. Posch.
Journal of Environmental Management JEVMA, Vol. 21, No. 1, p 47-61, July 1985. 12 fig, 1 tab, 8 ref.

Descriptors: *Acid rain, *Models, *Decision making, *Environmental impact statement, *Fate of pollutants, *Water pollution sources, Acidic water, Lakes, Sulfur, Water pollution prevention, *Water pollution control, Air pollution, Environmental effects, Acidity, Hydrogen ion concentration, Water pollution effects, Regional Acidification Information and Simulation, RAINS.

The interim status of the RAINS (Regional Acidification Information and Simulation) model designed to aid in decision making on acid rain control strategies in Europe is reviewed. RAINS consists of three linked compartments: pollutant generation, atmospheric processes, and environmental impact. Each of these compartments can be filled by four different submodels: sulfur emissions, EMEP sulfur transport, forest soil acidity, and lake acidity. The lake acidity submodel, which computes lake acidity levels as a function of catchment characteristics and local acid deposition contains four modules. The hydrological module routes precipitation into quickflow, baseflow and flow between soil layers. The soil chemistry module estimates the concentration of hydrogen ions in soil layers. The meteorological module transforms monthly sulfur deposition into acid stress to various sectors of the catchment. The lake response module calculates the concentration of hydrogen ions of the lake based on the ion loads. Model input of an energy pathway, a pollution control strategy, and an environmental impact indicator yields a scenario which is a consistent set of energy pathway, sulfur emissions, forest soil acidity and lake acidity. The RAINS model allows a user to quickly evaluate the consequences of many different alternatives to control acidification in Europe. (Geiger-PTT)
W86-04589

STREAM ACIDITY IN SOME AREAS OF WALES IN RELATION TO HISTORICAL TRENDS IN AFFORESTATION AND THE USAGE OF AGRICULTURAL LIMESTONE,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, and R.W. Edwards.
Journal of Environmental Management JEVMA, Vol. 20, No. 2, p 189-197, March 1985. 6 fig, 2 tab, 28 ref.

Descriptors: *Acidity, *Lime, *Acidic streams, *Reforestation, *Acid rain, *Wales, Hydrogen ion concentration, Acidic water, Agricultural runoff, Water pollution sources, Mineralization, Alkalinity, Limestone, Wye River.

Reported are recent patterns of pH and alkalinity in upland streams draining afforested and unafforested sub-catchments of the River Wye. Historical trends in afforestation, and in the use of agricultural limestone in Wales and elsewhere in the United Kingdom are also reviewed in relation to the possible influences these factors may have on surface water acidity caused by acid rain. Winter values of pH and alkalinity were significantly lower in 1983-1985 at four sites on soft water streams draining afforested catchments of the River Wye than at two sites on neighboring streams draining moorland. There was a decline in mean measured pH at all the sites between 1964-1970 and 1983-1985 which was more pronounced in afforested than in moorland streams. These findings are discussed in relation to historical patterns in afforestation and the use of agricultural limestone. Afforestation peaked in Wales, and on the study catchments, between 1950 and 1970. Lime usage in the United Kingdom had decreased by 46% by 1982; in Wales, a 55% decrease has occurred by 1970. Calculations indicate that agricultural liming could have a substantial effect on the mineral concentrations of soft water streams, although further experimentation is needed to substantiate these predictions. (Geiger-PTT)
W86-04600

MANAGEMENT OF OIL POLLUTION OF NATURAL RESOURSES IN NIGERIA,

Ibadan Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 5G.
W86-04601

COMMUNITY RESPONSES TO NON-POINT POLLUTION FROM AGRICULTURE,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. E. Rickson, and P. J. Stabler.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 281-293, April 1985. 4 tab, 42 ref.

Descriptors: *Nonpoint pollution sources, *Soil erosion, *Agricultural runoff, *Water pollution sources, *Social aspects, Public opinion, Attitudes, Erosion control, Environmental policy, Public policy, Education, Municipal water, Lakes.

Soil runoff from farms is a primary nonpoint source of urban water pollution and cooperation between farm and city residents is needed for the successful development and implementation of pollution control efforts. A critical point of analysis is whether rural and city people, when there is nonpoint pollution from farm erosion, respond on the basis of their self-interest or knowledge of the causes and consequences of pollution. Interviews of farmers and urban residents in an American midwestern state showed that farmers tended to blame city residents for lake pollution, although studies in the community revealed that lake pollution is mostly caused by farm soil loss. Levels of technically accurate knowledge had no direct association with either concern or allocation of blame. Education, as one indicator of knowledge, was associated with level of technical knowledge and concern, but not with how residents attributed blame. These data illustrate the dilemmas of regulating nonpoint water pollution from farm erosion. It was suggested that residential self-interest by farmers is related more to the constraints they face in controlling soil erosion, than to any inherently negative response to environmental quality and management. (Geiger-PTT)
W86-04605

VARIATIONS IN NITRATE CONCENTRATIONS AT AN IDAHO SITE DUE TO SEASONAL INFLUENCES,

South Central District Health Dept., Burley, ID.
J. Tolman.
Journal of Environmental Health JEVHAH, Vol. 48, No. 1, p 22-25, July/August 1985. 2 fig, 1 tab, 11 ref.

Descriptors: *Nitrates, *Drinking water, *Idaho, *Water pollution sources, *Groundwater pollution, *Seasonal variation, Aquifers, Wells, Irrigation water, Water supply, Sampling.

In fulfilling the requirements for sampling public water supplies in the state of Idaho, samples from one system were found to have high nitrate concentrations in both initial and check samples. A random sample by the purveyor seven months after the initial samples indicated lowered nitrate levels. To determine the yearly nitrate content of the supply and investigate the source or sources of the elevated levels, an investigation was initiated. Samples were collected between October 19, 1981 and September 27, 1982 from the subject well and twelve other wells in the general area. All samples were analyzed at certified laboratories. Results indicated considerable seasonal fluctuation in nitrates at the principal study location. Location of a drainfield in close proximity to the well and seasonal groundwater variations due primarily to irrigation and, to a lesser degree, to precipitation were probably responsible for the wide fluctuation of nitrate concentrations in the well water at the study site. (Author's abstract)
W86-04607

GROUNDWATER CONTAMINATION: A NATIONAL PROBLEM WITH IMPLICATIONS FOR STATE AND LOCAL ENVIRONMENTAL HEALTH PERSONNEL,

Winnebago County Dept. of Public Health, Rockford, IL.
J. M. Bacon, and W. A. Oleckno.
Journal of Environmental Health JEVHAH, Vol. 48, No. 3, p 116-121, November/December 1985. 1 fig, 1 tab, 27 ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Groundwater management, *Public health, *Water pollution sources, Water pollution prevention, Water quality control, Water quality management, Drinking water, Landfills, Leachates, Organic solvents, Legislation.

Groundwater contamination by synthetic organic chemicals (SOCs) is a significant environmental health problem that has only recently gained national recognition. Lack of adequate testing requirements for organic contaminants in drinking water, the unique hydrogeological characteristics of groundwater, the quantity and variety of waste disposal and non-waste disposal sources of contamination, and the practical absence of drinking water standards for toxic organic compounds have contributed to the complexity of the problem. A recent EPA survey found that 80% of the nationwide cases of groundwater contamination by SOCs involved trichlorethylene. Sources for contamination were linked to leaking underground storage tanks, improper waste disposal methods for solvents, the use of septic tank cleaning solutions containing organic compounds, and leachates from landfills, surface impoundments, and dumps. Increasingly sensitive analytical and risk assessment capabilities have continued to link lower levels of organic compounds to chronic health conditions. Solutions to the problem of groundwater pollution have been hampered by lack of comprehensive and relevant legislation and coordinated efforts at the federal, state, and local levels. State and local agencies can respond to the problem by prompt

investigation of identified problems, developing adequate facilities for the screening of SOCs and other non-traditional pollutants in groundwater, regularly collecting groundwater quality data, increasing public education, and adopting better land use planning methods. (Geiger-PTT)
W86-04609

SUMMARY OF WATERBORNE ILLNESS TRANSMITTED THROUGH CONTAMINATED GROUNDWATER,

Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W86-04610

ORGANIC CONTAMINANTS IN GROUNDWATER,

Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5G.
W86-04617

RELATIONSHIP BETWEEN ACID PRECIPITATION AND THREE-DIMENSIONAL TRANSPORT ASSOCIATED WITH SYNOPTIC-SCALE CYCLONES,

National Center for Atmospheric Research, Boulder, CO.
P. L. Haagenson, A. L. Lazrus, Y. H. Kuo, and G. A. Caldwell.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 9, p 967-976, September 1985. 17 fig, 1 tab, 19 ref. EPA Grant EPA-AD-49F-0-028-0.

Descriptors: *Acid rain, *Model studies, *Hydrologic models, *Cyclones, *Sulfur compounds, *Synoptic-Scale cyclones, Precipitation, Acidity, Hydrogen ion concentrations, Storms, Air pollution, Path of pollutants, Fate of pollutants, Acidic water.

Field data collected during the Acid Precipitation Experiment (APEX) were used in conjunction with an isentropic trajectory model to analyze the relationship between acid precipitation and three-dimensional transport associated with cyclonic storms. Results indicate that high acidity in precipitation is often associated with slow transport speed and elevated SO2 concentrations in the dry air feeding into the precipitating regions. Conversely, low acidity is usually related to rapid transit, descending motion, and transport above the atmospheric boundary layer. Also, precipitation in the cold sector of a cyclone (in advance of the surface warm front) is often more acidic than that in other sectors of the storm. Four case studies demonstrate some of these meteorological effects. Cases studied were warm-sector samples obtained in the boundary layer, cold sector samples in cold air following the cold front, warm-sector sector samples obtained above the boundary layer, and cold sector samples in the cold sector in advance of the surface warm front. (Geiger-PTT)
W86-04629

MODEL FOR SEDIMENT OXYGEN DEMAND IN LAKES,

Beak Consultants Ltd., Mississauga (Ontario).
R. R. Walker, and W. J. Snodgrass.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 25-43, February 1986. 5 fig, 2 tab, 42 ref, 1 append.

Descriptors: *Lake sediments, *Sediment oxygen demand, *Models, *Biological oxygen demand, *Chemical oxygen demand, Mathematical models, Kinetics, Biodegradation, Oxygen transfer, Wastewater pollution, Eutrophication.

A model for sediment oxygen demand (SOD) in lakes was developed for aerobic (BSOD) and chemical (CSOD) components. The CSOD uses first order kinetics while BSOD uses Monod kinetics with respect to oxygen concentration. The model is calibrated using laboratory data for sediments from four lakes - one heavily impacted by eutrophication and wastewater discharges, while the other three lay on the forested Precambrian shield. Model values showed excellent agreement with laboratory data for all water bodies for temperatures between 4 and 22 degrees. The model implies that CSOD is diffusion controlled at one temperature, but strongly dependent on anaerobic biological processes over a range of temperatures. To complete model development, future research should aim to incorporate overlying water velocity and sediment biodecomposability into kinetic expressions. (Geiger-PTT)
W86-04639

ASSESSING PHOSPHORUS CONTROL IN THE JAMES RIVER BASIN,

Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04640

EFFECT OF THREE DRILLING FLUIDS ON GROUND WATER SAMPLE CHEMISTRY,

Geological Survey, San Antonio, TX. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-04655

INTERPRETATION OF VLF RESISTIVITY DATA FOR GROUND WATER CONTAMINATION SURVEYS,

University of South Florida, Tampa. Dept. of Geology.
M. Stewart, and R. Bretnall.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 71-75, Winter 1986. 8 fig, 7 ref.

Descriptors: *Groundwater pollution, *Geophysical surveys, *Radio waves, *Very low frequency communications, *Resistivity, Geophysics, Magnetic studies, Vertical flow, Groundwater movement.

Shallow geophysical surveys to locate groundwater contamination and vertical geologic contacts, can be facilitated with the use of very low frequency (VLF) military communications systems. Useful properties that can be easily obtained from the interaction of the earth and the primary field are the magnitude of the vertical secondary magnetic field, the surface impedence, and the phase angle between the electrical and magnetic horizontal components. The variations in the secondary magnetic field can be related to vertical geologic contacts, such as the edges of landfill trenches. The surface impedence yields an apparent terrain conductivity, which can be used to locate low-resistivity anomalies often associated with contaminated groundwater. The phase angle gives information on vertical variations in resistivity, phase angles less than 45 degrees, indicating increasing resistivity with depth. The depth of penetration of the VLF field is about one skin depth. For a frequency of 20 kHz, with skin depth in meters is approximately equal to 3.6 x square root of p, where p is terrain resistivity in ohmmeters. (Lantz-PTT)
W86-04656

COMPUTER DATA BASE FOR OVERVIEW OF GROUND WATER POLLUTION INVESTIGATIONS,

New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 7C.
W86-04657

METHOD FOR SIMULTANEOUS IN SITU MEASUREMENT IN THE VADOSE ZONE OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY AND THE CONDUCTIVITY-PRESSURE HEAD RELATIONSHIP,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, and D. E. Elrick.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 84-95, Winter 1986. 4 fig, 3 tab, 31 ref.

Descriptors: *Vadose water, *In situ tests, *Geulph permeameter, *Hydraulic conductivity, *Hydraulic sorptivity, Pressure head, Steady flow, Experimental design.

The Guelph Permeameter (GP) method for simultaneous, in situ measurement in the vadose zone of field-saturated hydraulic conductivity (K sub fs), sorptivity (S) and the conductivity-pressure head relationship (K(theta)) is described and discussed. The method involves measuring the steady-state liquid recharge, Q, necessary to maintain a constant depth of water, H, in an uncased, cylindrical well of radius, a, finished above the water table. An 'in-hole' Mariotte bottle device is used to maintain H and to measure Q. Step-by-step procedures with example calculations are given for obtaining K sub fs, S and K(theta). Techniques for assessing the results are also given. The GP method will (theoretically) yield simultaneous, in situ measurements of K sub fs and K(theta) for infiltration of any wet liquid, and yields a 'point' measurement requiring replication. The GP apparatus is inexpensive, simple and easily operated by one person. The method can be used to obtain vertical profiles of K sub fs, S and alpha, requiring less time per measurement than most other methods. (Lantz-PTT)
W86-04659

GAS METABOLISM EVIDENCE IN SUPPORT OF THE JUXTAPOSITION OF HYDROGEN-PRODUCING AND METHANOGENIC BACTERIA IN SEWAGE SLUDGE AND LAKE SEDIMENTS,

Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-04665

MODELING THE RESPONSE OF GREENHOUSE-GROWN RADISH PLANTS TO ACIDIC RAIN,

Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 5C.
W86-04668

RESPONSES OF THREE WHEAT CULTIVARS TO SIMULATED ACID RAIN,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-04669

ENTEROVIRUSES IN SLUDGE: MULTIYEAR EXPERIENCE WITH FOUR WASTEWATER TREATMENT PLANTS,

Ohio State Univ., Columbus. Dept. of Medical Microbiology.
For primary bibliographic entry see Field 5D.
W86-04671

INCIDENCE OF VIBRIO CHOLERAE AND RELATED VIBRIOS IN A COASTAL LAGOON AND SEAWATER INFLUENCED BY LAKE DISCHARGES ALONG AN ANNUAL CYCLE,

Valencia Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W86-04674

SURVIVAL AND ENUMERATION OF THE FECAL INDICATORS BIFIDOBACTERIUM ADOLESCENTIS AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,

Puerto Rico Univ., Rio Piedras. Dept. of Biology.
M. Carrillo, E. Estrada, and T. C. Hazen.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 468-476, August 1985. 4 fig, 3 tab, 34 ref. PHS Grant 8102, Sea Grant UPR SG 04F15844030, Project EN/P-45.

Descriptors: *Forest watersheds, *Biological indicators, *Tropical regions, Bifidobacterium adolescentis, Escherichia coli, Coliforms, Survival, Bacteria, Ecological effects, Puerto Rico, Bacterial analysis.

The density of Bifidobacterium spp., fecal coliforms, Escherichia coli, and total anaerobic bacteria, acridine orange direct counts, percentages of total bacterial community activity and respiration, and 12 physical and chemical parameters were measured simultaneously at six sites for 12 months in the Mameyes River rain forest watershed, Puerto Rico. The densities of all bacteria were higher than those reported for uncontaminated temperate rivers, even though other water quality parameters would indicate that all uncontaminated sites were oligotrophic. The highest elevation site in the watershed had the highest densities. Correlations between bacterial densities, nitrates, temperature, phosphates, and total phosphorus indicated that all viable counts were related to nutrient levels, regardless of the site sampled. In situ diffusion chamber studies at two different sites indicated that E. coli could survive, remain physiologically active, and regrow at rates that were dependent on nutrient levels of the ambient waters. Bifidobacterium adolescentis did not survive at either site but did show different rates of decline and physiological activity at two sites. Bifidobacteria show promise as a better indicator of recent fecal contamination in tropical freshwaters than E. coli or fecal coliforms; however, the YN-6 medium did not prove to be effective for enumeration of bifidobacteria. The coliform maximum contaminent levels for assessing water usability for drinking and recreation appear to be unworkable in tropical freshwaters. (Author's abstract)
W86-04675

SULFATE-REDUCING BACTERIA: PRINCIPAL METHYLATORS OF MERCURY IN ANOXIC ESTUARINE SEDIMENT,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
G. C. Compeau, and R. Bartha.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 498-502, August 1985. 3 fig, 2 tab, 21 ref.

Descriptors: *Sulfur bacteria, *Methylation, *Mercury, *Estuarine sediments, Salt marshes, Desulfovibrio desulfuricans, Cultures, Pollutant identification, Bioindicators, Anoxic water.

Substrate-electron acceptor combinations and specific metabolic inhibitors were applied to anoxic saltmarsh sediment spiked with mercuric ions (Hg(2+)) in an effort to identify, by a direct approach, the microorganisms responsible for the synthesis of hazardous monomethylmercury. 2-Bromoethane sulfonate (30 mM), a specific inhibitor of methanogens, increased monomethylmercury synthesis, whereas sodium molybdate (20mM), a specific inhibitor of sulfate reducers, decreased Hg(2+) methylation by more than 95%. Anaerobic enrichment and isolation procedures yielded a Desulfovibrio desulfuricans culture that vigorously methylated Hg(2+) in culture solution and also in samples of presterilized sediment. The Hg(2+) methylation activity of sulfate reducers is fully expressed only when sulfate is limiting and fermentable organic substrates are available. To date, sulfate reducers have not been suspected to Hg(2+) methylation. Identification of these bacteria as the principal methylators of Hg(2+) in anoxic sediments raises questions about the environmental relevance of previous pure culture-based methylation work. (Author's abstract)
W86-04676

5C. Effects Of Pollution

PREY SELECTION AND FEEDING PATTERNS OF FISH IN A SOUTHERN UNITED STATES HYDROPOWER TAILWATER,
Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
D. H. Barwick, P. L. Hudson, and J. M. Nestler.
Miscellaneous Paper E-85-1, October 1985. Final Report. 21 p, 4 tab, 22 ref.

Descriptors: *Power plants, *Hydroelectric plants, *Fish, *Fish food, Aquatic life, Water quality, Tailwater, Reservoirs, Moxostoma anisurum, Lepomis auritus, Lepomis cyaellus, Lepomis machrochirus.

The downstream effects of peaking hydropower generation at Lake Hartwell Georgia-South Carolina, on the diel prey selection and feeding of four species of fish -- silver redhorse (Moxostoma anisurum), redbreast sunfish (Lepomis auritus), green sunfish (L. cyanellus), and bluegill (L. machrochirus) -- were determined. Aquatic insects (primarily dipterans, ephemeropterans, and trichopterans), crayfish, and terrestrial organisms (primarily insects) composed most of the food eaten. These fish fed primarily during daylight, before daily hydropower generation began, and little or no feeding occurred during generation. Consequently, few organisms entrained from the reservoir or displaced from the tailwater during hydropower generation were eaten by these fish. (Author's abstract)
W86-03902

DISPERSION AND SELF-PURIFICATION OF POLLUTANTS IN SURFACE WATER SYSTEMS,
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 5B.
W86-03906

ACID DEPOSITION: EFFECTS ON TERRESTRIAL ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W86-03908

RESULTS OF 4-M3 LNG SPILLS ONTO WATER,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W86-03909

EFFECTIVENESS, BEHAVIOR, AND TOXICITY OF DISPERSANTS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay, and P. G. Wells.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p. 65-71, 3 fig, 2 tab, 11 ref.

Descriptors: *Dispersants, *Toxicity, *Environmental effects, *Oil slicks, *Diffusion, *Effectiveness, *Benthos, Surfactants, Oil, Bottom sediments, Suspended sediments, Water column, Mackay-Nadeau-Steelman System.

Three key issues must be addressed when deciding on the desirability of using chemical dispersants for mitigating the adverse effects of oil spills: (1) how effective a given dosage of dispersant will be on a given oil slick; (2) how the dispersed oil and dispersant diffuse into the water column, dissolve, volatilize, degrade, and interact with suspended and bottom sediments; and (3) what effects the dissolved and particulate oil and dispersant will have on water column and benthic biota. It is essential that the first two areas (physical and chemical studies) relate closely to the third (biological aspects) in order that bioassay exposure (in terms of concentration of dispersant, classes of and individual hydrocarbons, and duration) addressing the toxicity issue be realistic. Here, we review the current status of a research program which addresses these issues. Under the program, attempts are being made to quantify dispersant effectiveness (including consideration of effectiveness testing using the Mackay-Nadeau-Steelman system for oils which have evaporated and/or formed water-in-oil emulsions to various extents), water column diffusion, and partitioning of specific hydrocarbons among water, oil, and suspended sediment as well as into the atmosphere. A procedure is described which has been used to quantify the acute toxicity of dispersants to copepods and which is being extended to apply also to the toxic contributions of dissolved and particulate oil. Hopefully, by assembling quantitative expressions for effectiveness, behavior, and toxicity, those situations in which dispersion is desirable can be better identified. (Author's abstract)
W86-04010

ECOLOGICAL MAPPING AND CLEANUP OF OIL SPILLS ONSHORE,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W86-04018

OIL SPILL ON NORTHERN SHORELINES: AN EVALUATION OF SOME OPTIONS DEALING WITH THIS PROBLEM,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5G.
W86-04022

OIL DEGRADATION AND ENVIRONMENTAL IMPACT OF VARIOUS CO-DISPOSAL METHODS,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5E.
W86-04024

TESTING OF CRUDE OILS AND PETROLEUM PRODUCTS FOR ENVIRONMENTAL PURPOSES,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, W. Stiver, and P. A. Tebeau.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 331-337, 4 fig, 1 tab, 27 ref.

Descriptors: *Oil, *Environmental effects, *Ecological effects, *Petroleum products, Chemical analysis, Chemical properties, Oil pollution.

When crude oil or a petroleum product is to be produced or transported in the marine environment, there is always a risk of spills. To assess the nature of the risk and the likely behavior of the spilled oil, it is desirable to test the oil for those properties which will determine its environmental behavior and effects. Further, the properties should be expressed in the form of parameters in equations which are suitable for direct incorporation into oil spill models. Suitable tests for properties such as chemical composition, density, viscosity or rheology, volatility, aqueous solubility, and interfacial properties are suggested and equations suggested for these properties as a function of temperature and extent of weathering. Tests which can be used to predict the rates of environmental processes such as evaporation, water-in-oil emulsion formation, natural and chemically induced dispersion and spreading are also reviewed and test inadequacies identified. A reasonably complete test protocol can be established now but some problems remain, especially with regard to characterization of an oil's natural dispersability. (Author's abstract)
W86-04027

FATE OF TWO LARGE OIL SPILLS IN THE ARABIAN GULF,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
For primary bibliographic entry see Field 5B.
W86-04030

HASBAH 6 (SAUDI ARABIA) BLOWOUT: THE EFFECTS OF AN INTERNATIONAL OIL SPILL AS EXPERIENCED IN QATAR,
Shell International Petroleum Mij., The Hague (Netherlands).
J. A. Van Oudenhoven.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3,

1983, San Antonio, Texas. p 381-388, 5 fig, 2 tab, 3 ref.

Descriptors: *Oil spills, *Environmental effects, *Path of pollutants, *Distribution patterns, Environmental effects, Planning, Oil, Hasbah 6, Saudi Arabia, Case studies.

An oil well blowout in the Arabian Gulf lasted only eight days, however, the resultant oil spill threatened neighboring coasts for as long as two months. On windy days, nearly neutrally buoyant oil slicks approaching the Qatar coasts seemed to disappear, but they soon surfaced again whenever the weather improved. Qatar, suddenly faced with a very unusual spill, did not have an oil spill response plan. Throughout the emergency, therefore, valuable time was lost discussing the appropriate measures and setting protection priorities. Often, any understanding of the nature of the problems involved was lacking. Although most beaches became covered with the tar-like substance, a small task force from the state oil company, supported by a few foreign advisers, was able to protect all the important water intakes. Examples are given of how general principles were adapted to the specific local circumstances; for instance, lagoons were used to trap and handle the oil, and discarded SBM hoses served as breakwaters. To ensure an environmentally responsible cleaning operation, the few personnel available were provided with lists of do's and don'ts.The effectiveness of various approaches to dispose of collected oil is discussed. A framework for an oil spill contingency plan for Qatar has been developed and a government environmental committee set up. The oil companies' mutual aid organization, put to the test, revealed weak areas, such as transboundary and communication problems, forcing the partners to review the organization. To enhance in-house response, the state oil company purchased spill-response equipment and is considering hands-on training of emergency crews. The valuable experience gained during this emergency should be used to improve future spill preparedness. (Author's abstract)
W86-04031

BIOLOGICAL MONITORING OF THE FORTIES OILFIELD (NORTH SEA),

Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
For primary bibliographic entry see Field 5A.
W86-04033

BIOS PROJECT: AN UPDATE,

Environmental Protection Service, Edmonton (Alberta).
For primary bibliographic entry see Field 5B.
W86-04035

EFFECT OF SPILLS OF DISPERSED AND NON-DISPERSED OIL ON INTERTIDAL INFAUNAL COMMUNITY STRUCTURE,

Bowdoin Coll., Brunswick, ME.
E. S. Gilfillan, S. A. Hanson, D. Vallas, R. Gerber, and D. S. Page.
In: Proceedings of the 1983 Oil Spill conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 457-463, 6 fig, 4 tab, 18 ref.

Descriptors: *Oil spills, *Intertidal areas, *Dispersion, Infaunal communities, Environmental effects, Oil pollution, Oil, Sensitivity analysis.

The effect of two nearshore discharges of Murban crude oil on community structure in intertidal benthic communities was studied. One discharge consisted of 250 gallons of Murban crude only. Following the discharge, no measurable amount of Murban crude could be found in sediments exposed to the cloud of dispersed oil. Significant amounts were found in the test plot exposed to untreated oil. In the area exposed to untreated oil, more oil was found in the upper intertidal zone than lower down. Effects on infaunal communities mirrored the analytical results. There was no evidence of adverse effects on infaunal community structure from exposure to dispersed oil. There is clear evidence that exposure to untreated oil did adversely affect community structure. Some indigenous species were reduced in number or eliminated; there were blooms of opportunistic polychaetes. The changes in community structure brought about by the untreated oil are consistent with results observed at real-world oil spill sites. (Author's abstract)
W86-04036

LONG-TERM FATE OF DISPERSED AND UNDISPERSED CRUDE OIL IN TWO NEARSHORE TEST SPILLS,

Bowdoin Coll., Brunswick, ME.
D. S. Page, J. C. Foster, J. R. Hotham, E. Pendergast, and S. Hebert.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 465-471, 11 fig, 3 tab, 13 ref.

Descriptors: *Oil spills, *Water pollution effects, *Cleanup operations, *Dispersants, *Fate of pollutants, Testing procedures, Environmental effects, Distribution patterns, Oil, Oil pollution.

The fate and effects of two nearshore discharges of Murban crude oil at Long Cove, Searsport, Maine in August 1981 were studied following a one-year, pre-spill baseline study of the test areas. an upper and a lower intertidal sampling area within a 60 x 100 meter test plot were exposed to dispersed oil in water resulting from the discharge of 250 gallons of oil pre-mixed with 25 gallons of Corexit 9527 dispersant. Release of treated oil was around high-water slack tide on the surface of the water, with added mixing energy provided by mixing gates deployed by small boats. The maximum water depth over the test areas was 3.5 meters. Untreated crude oil (250 gallons) was released on an ebbing tide within a separate, boomed-off 60 x 100 meter test plot. A third test plot served as an oil-free reference plot. Water samples taken near the bottom during and after discharge showed that chemically dispersed oil loses lower boiling hydrocarbons in both the aliphatic and aromatic fractions below n-C17 as the droplets diffuse downward. Data are given for sediment samples taken from the test plots 11 months pre-spill and 10 months post-spill. Hydrocarbon analyses of the sediment samples show little incorporation of dispersed oil into the sediments of the treated oil plot relative to the sediments exposed to undispersed oil. (Author's abstract)
W86-04037

POTENTIAL DAMAGE OF OIL WASTES IN COASTAL ESTUARY SEDIMENTS,

J. S. Lytle, and T. F. Lytle.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 491-500, 6 figs, 3 tabs, 33 ref.

Descriptors: *Sediments, *Estuaries, *Water pollution effects, *Ecological effects, *Oil wastes, Oil pollution, Chemical analysis, Minnows, Shrimp, Amphipods, Oil.

Bayou Casotte, Mississippi, an estuarine waterway near the eastern end of Mississippi Sound, has been altered to accommodate an extensive industrial complex including a large oil refinery. Several small oil spill accidents recently occurred in the bayou; the most serious, on June 13, 1981, involved 600 barrels of asphaltic crude. the ecological effects of continued exposure to low level oily wastes were estimated by examining pollution levels in sediments both in 10-foot cores and surface samples. Petroleum hydrocarbons (PHC) and other hydrocarbons occur at levels as high as 12,300 micrograms per gram (mu g/g or ppm to total hydrocarbons, dry weight) in surficial sediments and 1,000 mu g/g at 120 centimeter sediment depths. Dredging operations have removed most polluted sediments very near the refinery site in the bayou, but dispersal of petroleum wastes has caused PHCs to be dominant pollutants in other regions where no dredging has occurred and where care is required if any dredging is permitted. Toxicological examination of sheepshead minnows, mysid shrimp and amphipods reveals significant mortalities to mysids from bioassay exposures to surficial sediments. Settling rate determinations, leachability, community structure vulnerability, and sediment disturbance probability are factors assimilated into an 'environmental stress index' that indicates this to be a potentially harmful site to bottom feeders and, if sediments are disturbed, to free swimming organisms in sensitive life stages. (Author's abstract)
W86-04038

GEOMORPHOLOGICAL IMPACT OF CLEANUP OF AN OILED SALT MARSH (ILE GRANDE, FRANCE),

Institut National de la Recherche Scientifique, Rimouski (Quebec).
B. F. Long, and J. H. Vandermeuler.
In: Proceedings of the 1983 Oil Spill conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 501-505, 12 fig, 3 ref.

Descriptors: *Geomorphology, *Water pollution effects, *Salt marshes, *Oil pollution, *Drainage systems, Channel morphology, Artificial water courses, Sediment erosion, Erosion, Ile Grande, France.

As a result of removal of surface sediment following heavy oiling from the Amoco Cadiz spill (March 1978), the Ile Grande marsh has undergone rapid erosion, instead of continuing in the normal depositional phase of formation. This resulted directly from the sediment removal, which led to increased water flow velocities through the marsh. Four years after the cleanup, the old marsh drainage system, based on the equilibrium between channel cross section, channel slope, tidal current velocity and marsh sediments (grain size, stabilization through vegetation), has been replaced by a new artificial drainage system. The principal factor in the new system is the formation of a new meander channel system with increased cross sections of primary and secondary draining channels (tidal prism), slumping of channel banks and widening of the meanders. Primary and secondary channels, in both the mudflat and the upper vegetative zones, now exhibit meander channel valleys of 5.4 to 15 meters wide, and 1 m deep (the original width was 0.5 to 1 m). The beds of some of these channels, formerly of silt, now are the sites of sandbar formation. Thus the marsh is a continuing erosional phase. The process is accelerated by the erosion of the interior vegetative zone through the washout and enlargement of the marsh pools on the upper part of the marsh. Normally not part of the marsh drainage system, these were connected to the marsh channels by hand-dug ditches at the time of cleanup, thereby allowing tidal flow into the upper, low-energy marsh. (Author's abstract)
W86-04039

NATURAL RESOURCES DAMAGE ASSESSMENT STUDY: THE IXTOC I BLOWOUT,

Energy Resources Co., Inc., Cambridge, MA.
P. D. Boehm, D. L. Fiest, I. Kaplan, and P. Mankiewicz.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 507-515, 9 fig, 16 ref.

Descriptors: *Oil spills, *Natural resources, *Water pollution effects, *Resources assessment, *Benthic environment, Damage, Environmental effects, Ecological effects, Chemical analysis, Oil.

Following the Ixtoc I blowout and Burmah Agate spill in 1979, a program was initiated to investigate the extent of damage to the offshore benthic environment. A program of chemical and biological measurements was conducted based on samples taken during and after the spills and compared with results obtained in a baseline program conducted before the spills. A new chemical method combining molecular (gas chromatography/mass

spectrometry) and atomic (stable isotope) measurements was used to identify the source of weathered oil residues. The program concluded that the important biological changes observed cannot be attributed to a chemical impact from either spill and hence must be attributed to other causes. (Author's abstract)
W86-04040

SPILL OF LIGHT FUEL OIL IN THE BALTIC SEA,

Swedish Environmental Research Inst., Karlskrona.
O. Linden, J. Mattson, and M. Notini.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 517-520, 2 fig, 4 tab, 16 ref.

Descriptors: *Oil spills, *Ecological effects, *Water pollution effects, *Biochemical analysis, *Littoral environment, Dispersion, Dispersants, Fauna, Biomass, Oil pollution, Oil, Baltic Sea.

The impact of a spill of about 375 tons of light fuel oil in the southern Baltic Sea has been studied for one year. The spill originated from the tanker Sefir which sank to a 50 meter depth about six nautical miles east of the island of Oland. The study showed that the oil formed droplets which were taken up by zooplankton. Up to 50 percent of the zooplankton died during the acute phase of the spill. The oil droplets were well dispersed and sedimented over large areas. In six weeks during the acute phase of the spill, about 20,500 kilograms of oil corresponds to about 5.5 percent of the total amount of lost oil. Bivalves showed some uptake of oil. The littoral fauna was reduced drastically over a 10 km stretch of the coast. Only 2 percent of the fauna survived. The biomass and number of species also dropped considerably. One year after the spill, a slight recovery could be observed. The severe impact in the littoral zone was caused by a combination of the high toxicity of the oil and the low water exchange in the shallow water. In addition, the low water temperature preserved the toxic properties of the oil. (Author's abstract)
W86-04041

COMBINED USE OF GENOTOXICITY AND WHOLE EMBRYO TERATOGENICITY SCREENING ASSAYS IN PREDICTING TERATOGENIC RISKS,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
J. A. Bantle, and C. L. Courchesne.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 175-176, 4 fig, 7 ref. Contract No. 15-30.

Descriptors: *Amphibians, *Toxicity, *Water pollution effects, *Bioindicators, *Bioassay, Teratogenicity, Genotoxicity, Embryos, Xenopus laevis, Biosynthesis, Ribonucleic acid, Deoxyribonucleic acid, RNA, DNA.

Whole amphibian embryo teratogenicity assays are useful for predicting risk to aquatic species. However, extrapolation of data to other systems is difficult because of differing metabolisms and other factors. One way to make whole embryo teratogenicity assays more predictive is to understand which molecular mechanisms are inhibited. If such mechanisms are common to many species, then results of both assays complement one another. Whole embryo teratogenicity assays use embryos of the frog Xenopus laevis. Endpoints measured were 96 h lethality, malformation, growth, and the teratogenicity index (LC50/ EC50 malformation). Our genotoxicity bioassay measures the ability of a substance to alter RNA of protein biosynthesis. This assay involves treatment of the plasmid pHSV-106 containing the herpes thymidine kinase (TK) gene with the test substance. The plasmid is then microinjected into Xenopus oocytes and the amount of TK made is assayed. The second genotoxicity assay involves injecting TK gene, exposing the oocyte, and then measuring TK production. This assay measures the agent's ability to interfere with the metabolic machinery that makes protein. We have validated both assays using known inhibitors of DNA, RNA and protein synthesis. (Author's abstract)
W86-04088

USE OF THE ELECTRICAL POTENTIAL OF CELL MEMBRANES TO RAPIDLY ASSESS POTENTIAL TOXICANTS,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W86-04091

INDICES IDENTIFYING SUBSURFACE MICROBIAL COMMUNITIES THAT ARE ADAPTED TO ORGANIC POLLUTION,

Florida State Univ., Tallahassee. Center for Biomedical and Toxicological Research.
For primary bibliographic entry see Field 5B.
W86-04099

EFFECT OF NAPHTHALENE ON SOIL AND FRESH-WATER ALGAE,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
V. G. Struble, and H. J. Harmon.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 214-216, 4 tab, 14 refs.

Descriptors: *Groundwater, *Soils, *Algae, *Surface water, *Naphthalene, Microenvironment, Aromatic hydrocarbons, Organic compounds, Chlamydomonas moewusii, Chlorella pyrenoidosa, Photosynthesis, Respiration.

Organisms present in microcommunities may alter the presence or nature of contaminants in soils, ground water, and surface waters. The survival and viability of these microorganisms after exposure to contaminants either from surface spills or seepage can be important in the fate and transport of the contaminants. Representative organisms from the microcommunities may be used to predict or indicate the responses of other organisms of the microcommunity. In this study, the effects of the ubiquitous pollutant naphthalene, a polycyclic aromatic hydrocarbon, on respiration and photosynthetic oxygen evolution of two algae species was determined polarographically. Chlamydomonas moewusii is a representative eucaryotic soil alga. Exposure of the log phase organism to 15 to 30 ppm naphthalene inhibited both oxygen consumption and evolution. A two hour exposure resulted in an increase in inhibition of both rates. Chlorella pyrenoidosa is a representative eucaryotic fresh water alga. Oxygen evolution rates were affected by naphthalene in a similar manner as with Chlamydomonas. However, with stationary phase cells, exposure to all concentrations inhibited respiration by at least 30%, with rates approaching those of controls for all but cultures exposed to 30 ppm after 2 hours. Respiration by log phase cells was stimulated by exposure to 30 ppm while lower concentrations were inhibitory; rates approached those of controls after 2 hours. Exposure to the higher concentrations of naphthalene induced morphological variations in both types of algae after 24 and 48 hours. (Author's abstract)
W86-04100

ABUNDANCE, HETEROTROPHIC ACTIVITY AND TAXONOMY OF BACTERIA IN A STREAM SUBJECT TO POLLUTION BY CHLOROPHENOLS, NITROPHENOLS AND PHENOXYALKANOIC ACIDS,

Hull Univ. (England). Dept. of Plant Biology.
C. R. Milner, and R. Goulder.
Water Research WATRAG, Vol. 20, No. 1, p 85-90, January 1986. 6 tab, 43 ref.

Descriptors: *Heterotrophic bacteria, *Taxonomy, *Streams, *Chlorophenols, *Nitrophenols, *Phenoxyalkanoic acids, Water pollution, High performance liquid chromatography, Yorkshire, England, Pseudomonas, Statistical analysis.

Analysis by HPLC identified 14 individual chlorophenols, nitrophenols and phenoxyalkanoic acids in a small stream in West Yorkshire; concentrations fluctuated markedly over 12 months. Abundance of bacteria (as direct counts and colony-forming units) and heterotrophic activity (as fraction of glucose substrate mineralized) were measured in water and artificial gravel substratum at two sites in this stream. Mean bacterial abundance, and at one site activity, were at least similar to those found in an adjacent unpolluted stream. Sometimes, however, colony-forming units and activity were depressed. Multiple-regression analysis demonstrated relationships between bacteria and pollution-related variables; low pH and nitrophenols (particularly picric acid), were identified as possible causes of bacterial inhibition. Taxonomic investigation of isolates from sediment demonstrated that bacteria in the polluted stream were dominated by Pseudomonas, whereas a wide range of mainly Gram-negative bacteria was present in the unpolluted stream. (Author's abstract)
W86-04113

COMPARISON OF ALGAL ASSAY SYSTEMS FOR DETECTING WATERBORNE HERBICIDES AND METALS,

Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W86-04114

STATIC SHAKE-FLASK BIOTRANSFORMATION OF ENDOTHALL,

North Texas State Univ., Denton. Dept. of Biological Sciences.
K. H. Reinert, J. H. Rodgers, T. J. Leslie, and M. L. Hinman.
Water Research WATRAG, Vol. 20, No. 2, p 255-258, February 1986. 2 fig, 4 tab, 21 ref.

Descriptors: *Aquatic herbicides, *In vitro tests, *Aquatic plants, *Biotransformation, Kinetics, Reservoirs, Biodegradation, Herbicides, Endothall.

Laboratory biotransformation and biodegradation rate coefficient were determined for the aquatic herbicide, endothall. Concentrations of 0.5, 2.0 and 4.0 mg/l endothall were employed in a static shake-flask test containing reservoir water. A pseudo-first-order biotransformation rate coefficient of 0.083/day and an aqueous half-life of 8.45 days were calculated for endothall from this study. Test results support endothall as an environmentally labile aquatic herbicide with respect to biotransformation, which suggests that an adequate margin of safety exists for endothall application in aquatic environments. (Lentz-PTT))
W86-04132

SEASONAL VARIATION IN WEATHERING AND TOXICITY OF CRUDE OIL ON SEAWATER UNDER ARCTIC CONDITIONS,

Tromsoe Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04134

BIOCONCENTRATION FACTORS OF SOME HALOGENATED ORGANICS FOR RAINBOW TROUT: LIMITATIONS IN THEIR USE FOR PREDICTION OF ENVIRONMENTAL RESIDUES,

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and A. J. Niimi.
Environmental Science and Technology ESTHAG, Vol. 19, No. 9, p 842-849, September 1985. 1 fig, 7 tab, 49 ref.

Descriptors: *Biological concentration, *Organic compounds, *Trout, *Bioaccumulation, *Halogenated pesticides, Fish, Pesticides, Pesticide residues, Pesticide kinetics, Water pollution effects, Pollutant identification, Water analysis, Hydrocarbons, Absorption, Chlorine, Bromine, Lake Ontario.

The bioconcentration factors, BCF's for 34 chlorinated and brominated chemicals in rainbow trout have been determined by the steady-state approach by using chemical water concentrations in the nanogram per liter range. In addition, for 13 chemicals with a known half-life in trout, BCF's were also estimated by using the kinetic approach. The two methods gave comparable results for compounds with short half-lives in the fish but significantly different results for longer half-life chemicals. The BCF's have been shown to correlate well with octanol/water partition coefficients for many of the study compounds. But the BCF's of high molecular weight compounds and compounds metabolized by the fish did not correlate with octanol/water partition coefficients. The laboratory-derived BCF's were compared to field-derived BCF's for Lake Ontario rainbow trout. This comparison showed that predictions based on laboratory BCF's were useful for chemicals with short half-lives in fish but were much too low for long half-life chemicals, where contaminated food is the major chemical source. (Author's abstract)
W86-04142

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, W. L. Reichert, J. E. Stein, D. W. Brown, and H. R. Sanborn.
Environmental Science and Technology ESTHAG, Vol. 19, No. 9, p 836-841, September 1985. 2 fig, 4 tab, 24 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Marine sediments, *Bioaccumulation, *Marine animals, *Biotransformation, *Estuaries, Water pollution effects, Shrimp, Benthos, Clams, Mollusks, Fish, Metabolism, Amphipods, Gas chromatography, Mass spectrometry, High pressure liquid chromatography, Fluorescence spectrometry.

Phylogenetically diverse benthic organisms (amphipods - Rhepoxynius abronius and Eohaustorius washingtonianus; clams - Macoma nasuta; shrimp - Pandalus platyceros; fish - Parophrys vetulus) were exposed to an urban estuarine sediment (16 ppm of two to six benzenoid ring aromatic hydrocarbons - AHs) to which trace amounts of H3-benzo(a)pyrene (BaP) were added. The techniques used to assess uptake and metabolism of AHs were gas chromatography/mass spectrometry (GC/MS) for AHs; high-pressure liquid chromatography/fluorescence spectrometry for AH metabolites in fish bile, and radiometric analyses for biotransformation of H3-BaP. Generally, the extent of metabolism of H3-BaP (M. nasuta < E. washingtonianus < R. abronius < or = P. platyceros = or equivalent to P. vetulus) was negatively correlated to tissue concentrations of AHs (three to six ring), except that amphipod species accumulated higher concentrations of AHs than did clams, indicating that other factors (e.g., feeding strategy and rate of excretion) also influenced accumulation of AHs. Radiometric and GC analyses for BaP in both sediment and tissues suggested that not all of the BaP (and presumably other AHs) extracted chemically from sediment was bioavailable. (Geiger - PTT)
W86-04143

VARIABILITY OF ALUMINUM CONCENTRATIONS IN ORGANS AND WHOLE BODIES OF SMALLMOUTH BASS (MICROPTERUS DOLOMIEUI),

Columbia National Fisheries Research Lab., MO.
W. G. Brumbaugh, and D. A. Kane.
Environmental Science and Technology ESTHAG, Vol. 19, No. 9, p 828-831, September 1985. 6 tab, 20 ref.

Descriptors: *Bass, *Water pollution effects, *Absorption, *Aluminum, *Bioaccumulation, *Spectrophotometry, Fish, Metals, Fish populations, Pollutant identification, Acidic water, Ecological effects, Hydrogen ion concentration, Biological samples, Error analysis, Atomic absorption spectrophotometry.

High soluble concentrations of metals in lakes and streams are often associated with low pH levels as a result of the mobilization or dissolution from sediments or terrestrial soils. Bioaccumulation of contaminants is often used as an indicator of the health of fish populations and is usually measured in whole-body fish. The primary objective in the present study was to ascertain potential field and analytical sources of variability and error when whole-body fish samples are analyzed for Al. Variability of Al concentrations in smallmouth bass was evaluated by analysis with graphite furnace atomic absorption spectrophotometry. Fish analyzed as whole bodies were compared to fish which had selected organs analyzed individually and separately from the carcass. Gastrointestinal tract contents contained highly variable amounts of Al and caused bias and increased variability when included in whole-body samples. Since Al concentrations in tissues of stomach and intestine were similar to those in the whole-body (less gastrointestinal tract contents), the entire gastrointestinal tract and contents could be removed to reduce bias and variability without measurably altering the true whole-body Al concentrations. Of the organs analyzed, gill filaments had the highest and most variable Al concentrations and may have contributed to within-fish whole-body variability because of incomplete homogenization. (Geiger - PTT)
W86-04144

EFFECT OF ELECTROPLATING FACTORY EFFLUENT ON THE GERMINATION AND GROWTH OF HYACINTH BEAN AND MUSTARD,

Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, and A. U. Khan.
Environmental Research ENVRAL, Vol. 38, No. 2, p 248-255, December 1985. 2 fig, 3 tab, 31 ref.

Descriptors: *Metal-finishing wastes, *Electroplating, *Water pollution effects, *Germination, *Heavy metals, Plant growth, Beans, Industrial wastes, Effluents, Ecological effects, Minerals, Calcium, Magnesium, Sodium, Potassium, Copper, Zinc, Iron, Electrolytes, Chromium, Nickel, Cobalt, Manganese, Lead, Absorption, Metals.

The effect of electroplating factory effluent in different concentrations (viz., 0.1, 0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, and 4.0%) on the germination and growth of hyacinth beans (Dolichos lablab) and mustard seeds (Brassica compestris) was studied. The germination of seeds was delayed with the increase of effluent concentration and the germination of mustard seeds was totally inhibited at 1.5% effluent concentration while hyacinth bean seeds tolerated the effluent up to 2.4% concentration. The metal content in the hyacinth bean plants increased with increasing effluent concentration but after 1.0% effluent concentration, the concentration of all the metals (Ca, Mg, Na, K, Cu, Zn, Fe) decreased in the plants except Cr, which increased throughout. Percentage germination, fresh weight, dry weight, root length, and shoot length of the plants were also analyzed. Cd, Ni, Co, Mn, and Pb were not detectable in the hyacinth bean plants. (Author's abstract)
W86-04145

SUCCESSFUL ABATEMENT OF LEAD EXPOSURE FROM WATER SUPPLIES IN THE WEST OF SCOTLAND,

Glasgow Univ. (Scotland). Dept. of Medicine.
M. R. Moore, W. N. Richards, and J. G. Sherlock.
Environmental Research ENVRAL, Vol. 38, No. 1, p 67-76, October 1985. 2 fig, 3 tab, 36 ref.

Descriptors: *Water pollution effects, *Public health, *Lead, *Water distribution, *Water pollution control, Water pollution prevention, Water pollution treatment, Drinking water, Pipelines, Water mains, Acidic water, Hydrogen ion concentration, Blood, Scotland, Glascow, Ayr.

A major problem has existed in the West of Scotland for at least the past century associated with lead uptake by water from lead in water distribution systems. Initial studies in Glasgow from 1969 to 1976 and in Ayr in 1980/1981 showed that not only were water supplies soft, acid and in consequence highly plumbosolvent, and that water lead levels were, on average, unacceptably high but that blood lead concentrations were also in excess of acceptable limits. A decision was therefore made by Strathclyde Water Department to carry out remedial water treatment to adjust the water pH. The success of this venture was proven by the parallel rapid falls in blood lead and water lead concentrations in the city of Glasgow. This encouraged the Water Department to institute a similar scheme in the town of Ayr. Work on this commenced in 1981, and in a study of the participants in a previous blood lead survey, a highly significant fall in blood lead concentrations was observed. The equation linking these two parameters was found to follow a curvilinear relationship were blood lead varied as the cube root of the water lead with a highly significant coefficient of correlation. This relationship has been shown to hold across a wide range of water lead concentrations down to 1 microgram/liter. This detailed information allows accurate calculation of acceptable limits of lead exposure from specific sources based upon acceptable blood lead concentrations. (Author's abstract)
W86-04146

CHEMICAL CONTAMINATION OF WATER SUPPLIES,

North Carolina Univ. at Chapel Hill. School of Public Health.
C. M. Shy.
Environmental Health Perspectives EVHPAZ, Vol. 62, p 399-406, October 1985. 6 tab, 31 ref.

Descriptors: *Organic compounds, *Drinking water, *Water pollution effects, *Carcinogens, *Epidemiology, Public health, Water quality, Halogenated pesticides, Hydrocarbons, Ecological effects, Human pathology, Potable water.

Man-made organic chemicals have been found in drinking water for many years. Their numbers and varieties increase as our analytical capabilities improve. The identified chemicals comprise 10 to 20% of the total organic matter present. These are volatile or low molecular weight compounds which are easily identified. Many of them are carcinogenic or mutagenic. Chlorinated compounds have been found in untreated well water at levels up to 21,300 micrograms/liter and are generally present at higher levels in chlorine-treated water than in untreated water. Aggregate risk studies for cancer are summarized. The most common sites are: bladder, stomach, colon, and rectum. Such studies cannot be linked to individual cases. However, they are useful for identifying exposed populations for epidemiologic studies. Five case-control studies were reviewed, and significant associations with water quality were found for: bladder cancer in two studies, colon cancer in three and rectal cancer in four. A large study by the National Cancer Institute found that there had been a change in the source of raw water for 50% of the persons in one area between the years 1955 and 1975. Such flaws in the data may preclude finding a causal relation between cancer and contaminants in drinking water. Large case-control and cohort studies are needed because of the low frequency of the marker diseases, bladder and rectal cancer. Cohort studies may be precluded by variations in the kinds of water contaminants. Definitive questions about these issues are posed for cooperative effort and resolution by water chemists, engineers, and epidemiologists. (Author's abstract)
W86-04147

FROM PHYTOPLANKTON TO DETRITUS AND BACTERIA: EFFECTS OF SHORT-TERM NUTRIENT AND FISH PERTURBATIONS IN A EUTROPHIC LAKE,

Oslo Univ. (Norway). Biologisk Inst.
D. O. Hessen, and J. P. Nilssen.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 273-284, January 1986. 5 fig, 3 tab, 29 ref.

Descriptors: *Eutrophic lakes, *Phytoplankton, *Bacteria, *Detritus, Fish, Population dynamics, Roach, Algal biomass, Eutrophication, Rotifers, Zooplankton, Food chains.

Enclosure experiments in the eutrophic Lake Gjersjoen, Norway, showed that the presence of pre-adult planktivorous roach (Rutilus rutilus) more or less eliminated the crustacean zooplankton, especially daphniids, bosminids and advanced stages of copepods, whereas the density of rotifers increased. Analyses of gut content from roach captured in the lake showed the same predation pattern. The combination of roaches and excess nutrients, gave rise to a strong increase in phytoplankton and bacterial biomass. In bags with Daphnia and no fish present, the algal biomass was checked due to grazing, even when nutrients were available. The maintenance of high nutrient levels in such bags could also be due to increased recycling through herbivorous zooplankton. The detritus component increased where fish were present. A large pelagic population of fish in eutrophic lakes, eliminates large sized zooplankton, resulting in more energy being diverted through the detritus food-chain, instead of the more efficient grazer food-chain. (Lantz-PTT)
W86-04180

ALGAL ECOLOGY OF DEEPWATER RICE-FIELDS IN THAILAND,

Durham Univ. (England). Dept. of Botany.
B. A. Whitton, and H. D. Catling.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 289-297, January 1986. 2 fig, 1 tab, 9 ref.

Descriptors: *Rice fields, *Ecology, *Algae, *Thailand, Water chemistry, Diatoms, Seasonal distribution, Flood irrigation, Nitrogen fixing bacteria, Cyanophyta, Chlorophyta.

An account is given of changes in water chemistry and algal vegetation in one Thailand deepwater rice field (Huntra) through the 1983-1984 flood season, together with comparative observations with two other sites in September 1982. The Huntra field had standing water for almost six months (July-January), reaching a maximum depth of 175 cm in late October. The attached algal vegetation was dominated by heterocystous species of blue-green algae throughout the period, suggesting the importance of nitrogen fixation. The most abundant genera were Nostoc, Gloeotrichia, Aulosira and Anabaena (in decreasing order). Green algae were the next most important phylum, with Bulbochaete and Oedogonium predominant. Diatoms showed an obvious increase in abundance in October, but even then formed a small part of the algal biomass in comparison with blue-green and green algae. The algal vegetation at two other sites, including one on acid sulphate soil, had a quite similar algal vegetation, in spite of obvious differences in water chemistry. Azolla pinnata reached a density of 223 individuals/sq m at one site, but was absent at the other two sites. (Lantz-PTT)
W86-04181

REGULATING FACTORS OF THE CONCENTRATION OF DISSOLVED CARBOHYDRATES IN A CENTRAL WATER COLUMN OF LAKE SUWA, JAPAN,

Yamagata Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-04182

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 1. DYNAMICS OF PRODUCTION AND POPULATION OF THE PHYTOPLANKTON IN DEPENDENCE ON NUTRIENTS (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 1. PRODUCTIONS- UND POPULATIONSDYNAMIK DES PHYTOPLANKTONS IN ABHANGIGKEIT VOM NAHRSTOFFANGEBOT),

Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
V. N. Schilling, M. Schowalter, A. Peuker, M. Senser, and P. Wolf.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 329-343, January 1986. 7 fig, 1 tab, 26 ref.

Descriptors: *Limnology, *Lake Kochel, *Nutrients, *Phytoplankton, *Population dynamics, Lake morphology, Eutrophic lakes, Loisach River, Biomass, Algae, Silicon, West Germany.

The annual productivity of the phytoplankton (186 g C/sq m) in Lake Kochel, is lower than normally found in eutrophic lakes. However, it must be taken into consideration, that the water temperatures in Lake Kochel remain very low over the whole year and the high concentration of suspended particles evoked by peak water discharges of the Loisach river reduces the Euphotic zone and shades the organisms. The vertical profiles of high productivity, however, exhibit clinograde curves, which are typical of eutrophic lakes. The phytoplankton population is eutrophic with respect to both composition and succession. The Bacillariophyceae (23 species) are dominant in biomass production. The second most important group of algae is the Cryptophyceae (4 species), which are always present in the lake, but markedly reduced during the spring and autumn blooms of Bacillariophyceae. 23 species of Chlorophyceae have been detected, but only one species of Chlamydomonas appeared in significant numbers in summer. Although 7 species of Cyanophyceae could be observed, these organisms were found in very low numbers. Nutrient experiments show, that their phytoplankton composition (and succession) in Lake Kochel is primarily regulated by the amount of silicon dissolved in the water. (see also W86-04184) (Lantz-PTT)
W86-04183

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 2. SEASONAL, VERTICAL AND HORIZONTAL DISTRIBUTION OF BACTERIA (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 2. SAISONALE, VERTIKALE UND HORIZONTALE VERTEILUNG DER BAKTERIEN),

Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
V. N. Schilling, H. Kropp, and R. Hilpert.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 345-353, January 1986. 4 fig, 2 tab, 19 ref.

Descriptors: *Limnology, *Lake Kochel, *Bacteria, *Seasonal distribution, *Lake morphology, Thermal stratification, Bacterial growth, Enteric bacteria, West Germany, Population dynamics, Loisach River.

The autochthonous growth of bacteria in Lake Kochel is superceded by the allochthonous input of bacteria from the Loisach River. The highest proportions of the number of colonies to that of total bacteria (0.11-0.20) were also always determined for this depth region. This quotient is considerably smaller (0.02-0.06) in the hypolimnion, which thus appears to constitute an essentially isolated body of water. Enterobacteriaceae and Enterococcae, which are indicative of fecal pollution, also evidence a pronounced clinograde distribution. Fecal bacteria can however only be detected in low concentration at the lake outlet (Coliform = 300 organisms x 100/ml; Enterococcae = 124 organisms x 100/ml). (see also W86-04183) (Lantz-PTT)
W86-04184

STUDIES ON THE POPULATION DYNAMICS OF GAMMARUS TIGRINUS SEXTON (CRUSTACEA: AMPHIPODA) IN THE RIVER WESER NEAR BREMEN(UNTERSUCHUNGEN ZUR POPULATIONSDYNAMIK VON GAMMARUS TIGRINUS SEXTON (CRUSTACEA: AMPHIPODA) IN DER WESER BEI BREMEN),

Bremen Univ. (Germany, F.R.).
V. E. Hackstein, M. Schirmer, and H. Liebsch.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 443-458, February 1986. 7 fig, 7 tab, 21 ref.

Descriptors: *Population dynamics, *Crustaceans, *Weser River, *Temperature effects, *Cadmium, Water pollution effects, Growth stages, Growth, Thermal pollution.

The population dynamics of Gammarus tigrinus SEXTON in the river Weser were studied over a period of 12 months. Lifespan of generations, length, weight, praecopulae, number of eggs per female and cadmium burden were measured and their dependence on temperature was tested. In 1981/1982 four generations of G. tigrinus were born in the river Weser. Temperature appears to influence growth rate, time to reach maturity and lifespan. If temperatures are elevated, G. tigrinus reaches maturity with less length and weight. The number of eggs per female depends on length. Cadmium burden depends on temperature and length of Gammarids: high temperatures are correlated with a small cadmium burden and juveniles carry a higher cadmium burden than adults, perhaps as a consequence of different food. (Lantz-PTT)
W86-04186

DIMENSIONAL DIFFERENTIATION BETWEEN FIVE PLANKTONIC ORGANISMS LIVING IN TWO AREAS CHARACTERIZED BY DIFFERENT SALINITY CONDITIONS,

Athens Univ. (Greece). Zoological Lab. and Museum.
M. Moraitou-Apostolopoulou, G. Verriopoulos, and N. Tsipoura.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 459-469, February 1986. 2 fig, 4 tab, 22 ref.

Descriptors: *Dimensional analysis, *Plankton, *Saline water, *Water pollution effects, Marine animals, Gastropods, Copepods, Cladocera, Saronicos Gulf, Amvrakicos Gulf, Greece.

Dimensional variations whether they occur seasonally or geographically have been observed in many species of marine invertebrates. These variations have been largely attributed to the differing conditions of various environmental factors, primarily temperature, food, or pollution conditions. Salinity has also been referred to as an environmental factor which can influence body size. Thus in the gastropod Neritina, dwarfs have been observed in the lowest and highest salinities encountered over the distributional range of this animal. In laboratory experiments body size has also been shown to be a function of salinity. Comparative measurements of three dimensional characters were realized in five planktonic organisms from two marine areas characterized by different salinity conditions. The five studied organisms were Acartia clausi, Centropages kroyeri (Copepoda) and Penilia avirostris, Evadne spinifera and Evadne tergestina (Cladocera). The two collection areas were: a) Saronicos Gulf, and b) Amvrakicos Gulf, a semi closed bay where the discharge of two rivers significantly lowers the salinity. All measured dimensional characters of the five organisms were lower in Amvrakicos Gulf. The multilinear regression analysis proved that salinity and temperature are important factors for the formation of body length while phytoplankton quantity is of minor importance. Due to the strong salinity differences of the two Gulfs, it was concluded that the decreased body dimensions of the organisms living in Amvrakicos Gulf is mainly related to salinity. (Lantz-PTT)
W86-04187

INVESTIGATIONS ABOUT THE FATE OF HEAVY METALS IN LAKES: 1. THE ROLE OF FERROUS OXIDIZING BACTERIA TO CO-PRECIPITATION OF HEAVY METALS (UNTERSUCHUNGEN ZUM VERHALTEN VON SCHWERMETALLEN IN GEWASSERN: 1. DIE BEDEUTUNG EISENOXIDIERENDER BAKTERIEN DUR DIE KOPRAZIPATION VON SCHWERMETALLEN),

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
For primary bibliographic entry see Field 5B.
W86-04188

ENERGY FLOW IN THE POPULATIONS OF EUDIAPTOMUS GRACILOIDES AND DAPHNIA GALEATA IN LAKE ESROM,

Copenhagen Univ., Hillerod (Denmark). Dept. Ferskvands-Biologiske Lab.
K. Hamburger.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 517-530, February 1986. 4 fig, 1 tab, 23 ref.

Descriptors: *Energy transfer, *Population dynamics, *Eudiaptomus graciloides, *Daphnia galeata, Lake Esrom, Denmark, Biomass, Respiration, Seasonal variation, Phytoplankton, Foods.

The energy flow in two populations of planktonic crustaceans in eutrophic Lake Esrom, Denmark, was investigated. Two species, the calanoid copepod, Eudiaptomus graciloides and the daphnid, Daphnia galeata, account for 90% of the crustacean biomass and about 80% of the total zooplankton biomass. The energy flow was calculated as the sum of the energy in biomass respiration and the energy of the production, based on previous investigations of population dynamics and production in conjunction with respiration measurements on animals reared in the laboratory. In both populations the energy flow reached a maximum at the time when the phytoplankton spring bloom was over and the phytoplankton production had reached a minimum. These changes in ambient food concentration were reflected on the net production efficiency (K sub 2). K sub 2 varied greatly with the season, with maximum in May and minimum in July. The respiratory expenditures are discussed in relation to the ambient food concentration. It is concluded that the annual assimilation in the population of E. graciloides was between 258 and 320 kcal/sq m of which the production amounted to 65 kcal/sq m. For the population of D. galeata the corresponding values were 277 to 350 kcal/sq m and 120 kcal/sq m. Altogether the planktonic crustaceans in Lake Esrom assimilated between 27 and 33% of the gross phytoplankton production out of which 9% went on to higher trophic levels. (Lantz-PTT)
W86-04189

WASTE TREATMENT/DISPOSAL SITE EVALUATION PROCESS FOR AREAS UNDERLAIN BY CARBONATE AQUIFERS,

Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5G.
W86-04219

EFFECTS OF EXPOSURE TO SALTY DRINKING WATER IN AN ARIZONA COMMUNITY: CARDIOVASCULAR MORTALITY, HYPERTENSION PREVALENCE, AND RELATIONSHIPS BETWEEN BLOOD PRESSURE AND SODIUM INTAKE,

Centers for Disease Control, Atlanta, GA. Div. of Chronic Disease Control.
T. k. Welty, L. Freni-Titulaer, M. M. Zack, P. Weber, and J. Sippel.
Journal of the American Medical Association, Vol. 255, No. 8, p 622-626, February 7, 1986. 1 fig, 5 tab, 24 ref.

Descriptors: *Saline water, *Water pollution effects, *Drinking water, *Blood pressure, *Sodium, Gila Bend, Arizona, Papago Indians, Potable water, Physiology.

A high level of sodium (440 mg/L) in the water supply of Gila Bend, Arizona, caused concern because of apparently elevated rates of hypertension in Gila Bend Papago Indians. Surveyed were 342 Gila Bend Papago Indians and 375 non-Indians from July to September 1983. Participants 25 years of age and older were interviewed for health risk factors, water consumption, and dietary sodium and calcium intake and had height, weight, blood pressure, and urinary sodium and potassium levels measured. Although this study did not provide any evidence of a positive association between blood pressure and water sodium intake, it was not designed to evaluate the effect of the high drinking-water sodium level on hypertensive patients, cardiac patients, or persons who are genetically sensitive to sodium intake. Drinking water high in sodium has been reported as an unsuspected cause of cardiac decompensation. Mean blood pressures for the Gila Bend whites were lower in most age groups than in comparison US white populations. The prevalence rates of hypertension in Gila Bend were not significantly higher than the national rates. (Lantz-PTT)
W86-04223

KINETICS OF ALUMINUM FLUORIDE COMPLEXATION IN ACIDIC WATERS,

Maine Univ. at Orono. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04226

REACTIONS OF FISH TO MICROORGANISMS IN WASTEWATER,

Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
N. Buras, L. Duek, and S. Niv.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 989-995, October 1985. 13 tab, 18 ref.

Descriptors: *Fish Ponds, *Wastewater Reuse, *Microbiological Studies, Fish Physiology, Bacterial Analysis, Bacteriophage, Polio Virus, Carp, Tilapia.

Carp and tilapia were inoculated with various microorganisms (bacteria, bacteriophage, and polio virus) present in wastewater. A threshold concentration was determined over which these microorganisms were recovered from the muscles. The threshold concentrations were different for bacteria, bacteriophages, and polio 1 LSc virus. The threshold values were lower when fish were inoculated than when they were immersed in water containing these organisms. Depuration experiments were efficient when the fish did not contain high concentrations of bacteria in their muscles. As the threshold concentrations are an expression of the capability of the immune system of the fish, these values can be useful for the design and management of fishponds in which treated wastewater is used. (Author's abstract)
W86-04236

EFFECT OF COMMERICAL FORMULATION OF FOUR ORGANOPHOSPHORUS INSECTICIDES ON THE OVARIES OF A FRESHWATER TELEOST, MYSTUS VITTATUS (BLOCH) - A HISTOLOGICAL AND HISTOCHEMICAL STUDY,

Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. Haider, and N. Upadhyaya.
Journal of Environmental Science and Health JPFCD2, Vol. B20, No. 3, p 321-340, June 1985. 14 fig, 1 tab, 33 ref.

Descriptors: *Organophosphorus insecticides, *Insecticides, *Fish, *Pesticide Toxicity, Fish Physiology, Toxicity, Organic Pesticides, Phosphorus Compounds.

The chronic effect of an exposure to a sublethal concentration of commercial formulation of 4 organophosphorus insecticides, (OPI), birlane (chlorfenvinphos), gardona (tetrachlorvinphos), phosdrin (mevinphos) and malathion, on midvitellogenic ovaries of 50 Mystus vittatus was investigated using histological and histochemical techniques. The loss of stage II and III oocytes accompanied by a significant decline in gonadosomatic index was recorded. The occurrence of only stage I oocytes in OPI-treated M. vittatus indicates that there was no vitellogenesis. The RNA content of remaining stage I oocytes of exposed fishes resembled that of the stage I oocytes of the control fishes. The absence of delta 5-3 beta-hydroxysteroid dehydrogenase suggests the lack of steroidogenesis. Reduced glucose-6-phosphate dehydrogenase (G-6-PD) activity was also observed. The occurrence of G-6-PD in follicular cells of OPI-treated fish oocytes may suggest the presence of an active mixed function oxidase system requiring nicotine-amide adenine dinucleotide phosphate. However, the role of follicular cells in biotransformation of OPI needs further study. (Peters-PTT)
W86-04238

INFLUENCE OF DEEP OCEAN SEWAGE OUTFALLS ON THE MICROBIAL ACTIVITY OF THE SURROUNDING SEDIMENT,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 5E.
W86-04257

INHIBITION OF BRAIN ACHE IN BROOK TROUT BY AMINOCARB AND ITS TOXIC METABOLITES,

Forest Pest Management Inst., Sault Sainte Marie (Ontario).
S. Y. Szeto, K. M. S. Sundaram, and J. Feng.
Journal of Environmental Science and Health JPFCD2, Vol. B20, No. 5, p 559-579, October 1985. 2 fig, 1 tab, 21 ref.

Descriptors: *Insecticides, *Trout, *Fish Physiology, *Pesticide Toxicity, Aminocarb, Metabolites, Toxicity, Aerial Spraying.

In vitro inhibitions of brain AChE in brook trout, Salvelinus fontinalis, by aminocarb (4-dimethylamino-m-tolyl N-methylcarbamate) and its toxic metabolites, MAA (4-methylamino-m-tolyl N-methylcarbamate), AA(4-amino-m-tolyl N-methylcarbamate), MFA (4-methylformamido-m-tolyl N-methylcarbamate) and FA(4-formamido-m-tolyl N-methylcarbamate) were investigated. The molar concentrations of inhibitors causing 50% inhibition were AA (3.62 x 10 to the minus 6th power) < MAA (7.92 x 10 to the minus 6th power) < aminocarb (1.01 x 10 to the minus fifth power) < MFA (4.29 x 10 to the minus fifth power) < FA (7.11 x 10 to the minus fifth power). After exposure of fish to various concentrations of aminocarb (25, 250 and 2500 ppb) and MAA (25, 250, 500 and 2500 ppb) at 9 C in dechlorinated tap water for 96 hr, inhibitions of brain AChE ranged from 13 to 77%. Mortality occurred only in fish exposed to 500 ppb (8 of 36 fish) and 2500 ppb (all 36 fish) of MAA. Enzyme activities recovered to the control levels 12 to 96 hr after the fish had been transferred to clean water for clearing; in survivors of the 500-ppb MAA exposure, however, AChE activities decreased again thereafter. Since MAA has never been detected in natural water after aerial spray and tissue residues of MAA can be eliminated rapidly in fish, it is concluded that any adverse effect of brain AChE due to MAA as a result of aerial sprays would be very unlikely. (Peters-PTT)
W86-04261

POTENTIAL HEALTH IMPLICATIONS FOR ACID PRECIPITATION, CORROSION, AND METALS CONTAMINATION OF DRINKING WATER,

Pennsylvania State Univ., University Park. School of Forest Resources.
W. E. Sharpe, and D. R. DeWalle.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 71-78, November 1985. 6 fig, 1 tab, 10 ref.

Descriptors: *Drinking water, *Acid rain, *Corrosion, *Water pollution sources, *Metals, Water pollution effects, Cisterns, Surface waters, Ryznar Index, Copper, Lead.

Potential health effects of drinking water quality changes caused by acid precipitation are presented. Several different types of water supplies are and their roles in modifying acid rain impacts on drinking water are explained. Sources of metals contamination in surface water supplies and some results from previous research into acid rain impacts on roof-catchment cisterns, small surface water supplies, and lead mobilization in acid soils are discussed. A good correlation was obtained between cistern water corrosivity as measured by the Ryznar Index (RI) values and standing tapwater copper concentrations. However, lead concentrations in tapwater did not correlate well with cistern water RI. A modified linear regression model that accounted for Ryznar Index change during storage in vinyl-lined cisterns, was used to predict

the Ryzner Index value at a copper concentration of 1000 micrograms/l. The predicted RI was greater than the RI of precipitation with a pH of 5.3, indicating that anthropogenically acidified precipitation may result in cistern tapwater copper concentrations in excess of the 1000 micrograms/l suggested drinking water limit. Good correlations between tapwater Ryznar Index and tapwater copper and lead concentrations were not obtained for the small surface water supply. Aluminum concentrations in reservoir water were similar to those in stream source water. Limited data were also presented that indicated lead was present in acid forest soil leachate and streams draining such soils in relatively small concentrations. Where appropriate, recommendations for future research are included with the discussion of research results. (Lantz-PTT)
W86-04264

EFFECTS OF ACIDIFICATION ON METAL AVAILABILITY TO AQUATIC BIOTA, WITH SPECIAL REFERENCE TO FILAMENTOUS ALGAE,

Toronto Univ. (Ontario). Inst. for Environmental Studies.
P. M. Stokes, R. C. Bailey, and G. R. Groulx.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 79-87, November 1985. 10 fig, 3 tab, 27 ref.

Descriptors: *Acidic water, *Metals, *Aquatic biota, *Algae, *Acid rain, Stress, Toxicity, Zinc, Lead, Aluminum, Mercury, Water pollution effects, Nickel, Copper, Ontario, Quebec, Hydrogen ion concentration, Manganese, Pollution load.

A survey of 34 shield lakes in Ontario and Quebec, pH 4.4 to 7.1, was made to evaluate which metals should be considered of concern as a risk to aquatic biota or consumers when lakes are acid stressed. A set of predictions, concerning the mobilization by man, the mobility, the chemical speciation, and the toxicity or bioaccumulation of metals in acid-stressed waters, were used as a basis for designing the study and organizing the results. Attached algae were used as biomonitors to assess metal bioavailability. Zinc, manganese and aluminum increased as pH decreased; zinc and aluminum have reached potentially toxic concentrations in the surface waters surveyed, while manganese which is much less toxic has not. Zinc accumulation in algae decreased at low pH, even though the concentration of zinc increased, while manganese in algae showed a trend towards increasing at low pH. Aluminum in algae did not follow any pattern, but there may be technical problems. Copper and nickel in water increased as pH decreased, and algal copper and nickel both increased as pH decreased or metal increased. These relationships were, however, driven by the factor of local loadings of nickel and copper from a smelter complex. Lead in water showed no relationship with pH, but algal lead tended to increase as pH decreased. Mercury was low to undetectable in surface waters, yet algal mercury showed a number of significant correlations, notably with dissolved ions (negative), dissolved carbon (positive), and fish mercury (positive). (Lantz-PTT)
W86-04265

ALUMINUM IN ACIDIC SURFACE WATERS: CHEMISTRY, TRANSPORT, AND EFFECTS,

Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04267

POTENTIAL IMPACT OF ACID PRECIPITATION ON ARSENIC AND SELENIUM,

North Carolina Univ. at Chapel Hill. Dept. of Pathology.
P. Mushak.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 105-113, November 1985. 2 fig, 58 ref.

Descriptors: *Acid rain, *Environmental effects, *Arsenic, *Selenium, Drinking water, Acidic water, Groundwater pollution, Water pollution effects, Soil chemistry, Hydrogen ion concentration.

The potential impact of acidic precipitation on the environmental mobility of the metalloids arsenic (As) and selenium (Se) has not been given much attention and is poorly understood. As with other elements, the interest here is the potential effect of environmental acidification on environmental behavior in ways that are relevant to human exposure to these metalloids. Available information on acid precipitation and the environmental behavior of these metalloids do, however, permit some preliminary conclusions to be drawn. Both As and Se appear to be mobilized from household plumbing into tap water by the corrosive action of soft, mildly acidic water, while surface water catchment systems in areas impacted by acidic deposition may contain elevated soluble As levels. Acidification of aquatic ecosystems that are drinking water sources may pose the prospect of enhanced release of As from sediment to water as well as reduction in water levels of Se. Acidification of groundwaters, where As appears to be especially mobile, is of particular concern in this regard. The potential impact of acidic deposition on As and Se in soils cannot readily be assessed with respect to human exposure, but it would appear that the behavior of these metalloids in poorly buffered, poorly immobilizing soils, e.g., sandy soils of low metal hydrous oxide content, would be most affected. The effect is opposite for the two elements; lowered pH would appear to enhance As mobility and to reduce Se availability. (Lantz-PTT)
W86-04268

EFFECTS OF ACIDIFICATION ON THE MOBILITY OF METALS AND METALLOIDS: AN OVERVIEW,

Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
J. M. Wood.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 115-119, November 1985. 1 fig, 1 tab, 35 ref. NIH AM 18101.

Descriptors: *Acid rain, *Path of pollutants, *Metals, *Metalloids, Sediments, Soils, Acidic water, Aquatic biota, Environmental effects, Kinetics, Thermodynamics, Arsenic, Selenium, Mercury, Aluminum, Fish, Japan, China, Guam, Drinking water.

The exchange rates for metals and metalloids between sediments, soils, water and aquatic biota are discussed in terms of normal and acidified ecosystems. Where it is possible, the pathways for a number of toxic elements are presented with special emphasis on the impact of acidification on changing chemical speciation, and on the potential toxicity of such acid-generated chemical species. The pathways taken by each element involve many chemical species, and the distribution of these species is determined by thermodynamic and kinetic considerations. Those species which are stable thermodynamically can often be isolated and quantitated. Ideally the precise chemical structures of each of these stable compounds, or complexes, should be analyzed in that matrix where they exist naturally. Unfortunately, in the stressed system entropy increases and there is a concomitant increase in instability in both the physical and biological context. The acidification of the aqueous environment has already been shown to cause significant stress on ecosystems. As diversity of populations decrease to only a few acid tolerant species, then the normal balance for the cycling of elements changes appreciably. This has already been shown to be the case for mercury and aluminum, and may well be the case for the metalloids arsenic and selenium. The net effect of this instability is an increase in the concentration of methylmercury in predatory fish and an increase in the concentration of soluble aluminum species in surface waters. The consumption of methylmercury-contaminated fish has already been the cause of major health problems in Japan and more recently in China, and the consumption of drinking water containing high concentrations of aluminum is implicated in the epidemiology of Alzheimer's disease in Guam. (Lantz-PTT)
W86-04269

INFLUENCE OF ACID RAIN UPON WATER PLUMBOSOLVENCY,

Glasgow Univ. (Scotland). Dept. of Medicine.
M. R. Moore.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 121-126, November 1985. 3 fig, 1 tab, 36 ref.

Descriptors: *Acid rain, *Acidic water, *Plumbing, Lead, Hydrogen ion concentration, Closed-loop systems, Glasgow, Ayr, Scotland, Water pollution effects.

The West of Scotland has had particular problems in the past associated with soft acidic water supplies and uptake of lead from domestic plumbing systems by such water. As a consequence of this, health problems related to overexposure to lead have been identified. The current debate on acidification of ground waters by acid rain is therefore particularly pertinent to this area. Studies have shown that even a modest decrease in pH will result in very substantial increase in plumbosolvency. This was found to be of particular importance in the city of Glasgow and town of Ayr, where prior to water treatment, pH values were 6.3 and 5.4, respectively, and where, consequently, large numbers of homes did not comply with lead in water standards (that lead in water should only provide less than 10% of the overall daily exposure to lead). Closed-loop lime-dosing systems were introduced in both Glasgow and Ayr to increase the pH with an immediate decrease in the lead content of the water and, subsequently, blood lead concentrations of the subjects living in these areas. Such closed-loop systems will compensate for any acidity in water supplies, whether of natural origin or originating from acid rain precipitation. However, when such treatment has not been applied, any increase in water acidity due to acid rain will worsen a situation which is, in many cases, already unacceptable. (Lantz-PTT)
W86-04270

WATER CONTENT OF ALUMINUM, DIALYSIS DEMENTIA, AND OSTEOMALACIA,

Virginia Univ., Charlottesville. School of Medicine.
M. R. Wills, and J. Savory.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 141-147, November 1985. 52 ref.

Descriptors: *Aluminum, *Dialysis, *Water pollution effects, *Acid rain, Kidneys, Drinking water, Tissue analysis, Toxicity, Tissue accumulation, Osteomalacia.

A high concentration of aluminum in drinking water has been implicated as a factor in the etiology of a neurological syndrome in one specific geographical area. The role of aluminum as a toxic agent in other neurological disorders, where renal function is normal, is controversial. Aluminum is absorbed from the gastrointestinal tract and is normally excreted by the kidneys in the urine. In patients with chronic renal failure, aluminum appears to be of proven toxicological importance. In these patients the accumulation of aluminum in tissues causes an encephalopathy, a specific form of metabolic bone disease, and an anemia, and also plays an etiological role in some of the other complications associated with end-stage chronic renal failure. The majority of chronic renal failure patients who develop aluminum toxicity are on long-term treatment with either hemo- or peritoneal dialysis; some patients develop toxicity who are only on treatment with aluminum-containing phosphate-binding agents. Aluminum in the dialysate appears to be the major source of the metal in chronic renal failure patients who develop aluminum toxicity. The aluminum content of the dialysate depends primarily on the content of the water with which it is prepared; there may be some contribution from the chemicals used in the concentrate which is added to the water. Some domestic tap-water supplies contain aluminum in high concentration, either naturally or because aluminum has been added as a flocculant in the purification process. Acid rain markedly increases the 'natural' aluminum content in water. (Lantz-PTT)
W86-04271

HEALTH RISKS FROM ACID RAIN: A CANADIAN PERSPECTIVE,

Environmental Health Directorate, Ottawa (Ontario).
C. A. Franklin, R. T. Burnett, R. J.P. Paolini, and
M. E. Raizenne.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 155-168, November 1985. 7 fig, 8 tab, 40 ref.

Descriptors: *Acid rain, *Environmental effects, *Canada, *Health risks, Long-Range Transport of Airborne Pollutants, Sulfur dioxide, Air pollution, Saskatchewan, Manitoba, Asthma, Copper, Lead, Water quality control.

Acid rain is causing serious environmental damage in eastern Canada. The revenues from forest products, tourism and sport fishing are estimated to account for about 8% of the gross national product. The impact on human health is not as clearcut and a multi-department program on the Long-Range Transport of Airborne Pollutants (LRTAP) was approved by the federal government in June 1980. The objectives of the LRTAP program are to reduce wet sulfate deposition to less than 20 kg/ha/yr in order to protect moderately sensitive areas. This will require a 50% reduction in Canadian SO2 emissions east of the Saskatchewan/Manitoba border and concomitant reductions in the eastern U.S.A. The objectives of the health sector of the program are to assess the risk to health posed by airborne pollutants which are subjected to long-range transport and to monitor the influence of abatement programs. Studies on the indirect effects of acid deposition on water quality have shown that acidified lake water left standing in the plumbing system can adversely affect water quality and that federally set guidelines for copper and lead are exceeded. Flushing of the system before using the water rectifies the situation. Additional studies are planned to further delineate the magnitude of the health effects of acidified lake water. (Lantz-PTT)
W86-04272

IMPACT OF EFFECTS OF ACID PRECIPITATION ON TOXICITY OF METALS,

Umea Univ. (Sweden). Dept. of Environmental Hygiene.
G. F. Nordberg, R. A. Goyer, and T. W. Clarkson.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 169-180, November 1985. 1 tab, 79 ref.

Descriptors: *Acid rain, *Toxicity, *Metals, *Water pollution effects, Drinking water, Hydrogen ion concentration, Corrosion, Plumbing, Lead, Cadmium, Copper, Aluminum, Dialysis, Kidneys.

Human metal exposures via drinking water may be increased by acid precipitation. Decreasing pH increases corrosiveness of water enhancing the mobilization of metal salts from soil; metallic compounds may be mobilized from minerals, which may eventually reach drinking water. Also, the dissolution of metals (Pb, Cd, Cu) from piping systems for drinking by soft acidic waters of high corrosivity may increase metal concentrations in drinking water. Exposures have occasionally reached concentrations which are in the range where adverse health effects may be expected in otherwise healthy persons. Dissolution from piping systems can be prevented by neutralizing the water before distribution. Increased aluminum concentrations in water is a result mainly of the occurrence of Al in acidified natural waters and the use of Al chemicals in drinking water purification. If such water is used for dialysis in patients with chronic renal failure, it may give rise to cases of dialysis dementia and other disorders. A possible influence on health of persons with normal renal function (e.g., causing Alzheimers disease) is uncertain and requires further investigation. While all of the mentioned possibilities for increased metal exposures due to acid precipitation do exist, information that allows a quantitative estimation of their importance is almost entirely lacking and more research is needed. For an evaluation of the impact to human health of increased metal exposures, present knowledge about relationships between dose (or exposure) and the risk for adverse effects are reviewed. It is concluded that improved knowledge would be desirable for several of the metals discussed. Particularly, for an evaluation of possible adverse effects of aluminum in persons with normal renal function, present knowledge is inadequate and more research is needed. (Lantz-PTT)
W86-04273

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE IN SUBSURFACE SOILS,

Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
T. W. Federle, D. C. Dobbins, J. R. Thornton-
Manning, and D. D. Jones.
Ground Water GRWAAP, Vol. 24, No. 3, p 365-374, May-June 1986. 4 fig, 4 tab, 23 ref.

Descriptors: *Biomass, *Subsurface soils, *Microenvironment, *Soil contamination, Water pollution effects, Soil environment, Phospholipids, Fatty acids, Regression analysis, Statistical analysis.

Biomass and community structure were determined by analyzing the fatty acids of the extractable phospholipids, in four soil types common to Alabama. Activity was estimated by measuring the rate of enzymatic hydrolysis of fluorescein diacetate (FDA). In all four soils, biomass and activity declined with increasing depth; however, the magnitude and pattern of this decline varied as a function of soil type. Biomass concentrations in the lower Ap horizon ranged from 8.2 to 18.0 nanomoles phospholipid/g dry wt soil. In the deepest subsoil horizons, the range was 0.0085 to 0.059 nanomoles phospholipid/g dry wt soil. The rate of FDA hydrolysis was highly correlated with biomass (r = 0.90). Polyenoic fatty acids, which are present only in eukaryotic microorganisms, were found in all horizons. However, their relative abundance differed as a function of soil type. Stepwise regression analysis revealed that soil characteristics could explain 89 and 82% of the variation in biomass and activity, respectively. The results indicated that the vertical distribution of microorganisms in a soil profile differs greatly as a function of soil type. Hence, soil type may be an important determinant as to whether potential groundwater pollutants are biodegraded as they pass through the unsaturated zone of a soil profile. (Lantz-PTT)
W86-04281

INDUSTRIAL WASTES AND PUBLIC HEALTH: SOME HISTORICAL NOTES, PART I, 1876-1932,

Carnegie-Mellon Univ., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W86-04327

EVALUATION OF CONVENTIONAL TREATMENT PROCESSES FOR REMOVAL OF MUTAGENIC ACTIVITY FROM MUNICIPAL WASTEWATERS,

Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5D.
W86-04330

PATHOMORPHOLOGICAL CHANGES IN GILLS OF FISH FINGERLINGS (CIRRHINA MRIGALA) BY LINEAR ALKYL BENZENE SULFONATE,

Industrial Toxicology Research Centre, Lucknow (India).
V. Misra, H. Lal, G. Chawla, and P. N.
Viswanathan.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 302-308, December 1985. 3 fig, 17 ref.

Descriptors: *Gills, *Fish toxins, *Alkylbenzene sulfonate, *Fish physiology, Water pollution effects, Industrial wastewater, Environmental effects.

Synthetic detergents used in household cleaning have been shown to be toxic to fish and aquatic invertebrates. The foci of local action of detergents are the gills, gastrointestinal canal, and to a lesser extent the gonads. Gills, a primary site of osmoregulation and respiration, are the main targets for the aquatic toxicant, and is the most seriously affected organ. Presence of surfactants are known to cause destruction of the gill epithelium and reduction of the surface tension, and as a results many fish may die. The study focuses on the behavior pattern of fish as a primary indicator of toxicity as well as the impact of synthetic detergents on gills with the help of scanning electron microscopy. Fish fingerlings (Cirrhina mrigala) exposed to 0.005 ppm (25% of LC sub 50) concentration to detergents (linear alkyl benzene sulfonate) showed marked behavioral changes and distorted appearance of primary and secondary lamellae along with damage to gill epithelium under scanning electron microscopy at various magnifications. Mucosal cells of gills were found to secrete mucus showing primary reactions for membrane damage leading to dysfunction in respiration and osmoregulation. (Lantz-PTT)
W86-04357

TOXICOLOGY OF SELENIUM IN A FRESHWATER RESERVOIR: IMPLICATIONS FOR ENVIRONMENTAL HAZARD EVALUATION AND SAFETY,

Wake Forest Univ., Winston-Salem, NC. Dept. of Biology.
A. D. Lemly.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 314-338, December 1985. 13 fig, 5 tab, 63 ref.

Descriptors: *Toxicity, *Reservoirs, *Selenium, *Population exposure, *North Carolina, Fishkill, Fish toxins, Fish populations, Lakes, Tissue analysis, Fish behavior, Survival.

A study was conducted to document patterns of accumulation, and toxicity of selenium, to organisms in a power plant cooling reservoir in North Carolina. Selenium entered the reservoir by way of effluent from the coal ash disposal basin, which contained 100-200 micrograms Se/liter. Concentrations of selenium in the lake water averaged 10 micron g/liter, but were accumulated from 519 times (periphyton) to 3975 times (visceral tissue, largemouth bass) in the biota. The pattern and degree of accumulation was essentially complete within 2 years after the initial operation of the power plant, and persisted throughout the remainder of the study: fishes > insects > annelids > mollscs > crustaceans > plankton > periphyton. Of the 20 species of fish originally present in the reservoir, 16 were entirely eliminated, 2 were rendered sterile but persisted as adults, 1 was eliminated but managed to recolonize from a relatively uncontaminated headwater area as sterile adults, and 1 was unaffected. Two nonnative fish species were accidentally introduced and established reproducing populations. Abundance and diversity of biota other than fishes was not affected. Relative to control habitats, the contaminated reservoir had concentrations of waterborne selenium that were 20-30 times background levels; the flora and fauna contained about 10-15 times background. The results show that selenium can accumulate and be biologically magnified to toxic levels in a reservoir even though waterborne concentrations are in the low microgram per liter range. (Lantz-PTT)
W86-04358

AQUATIC TOXICITY EVALUATED USING HUMAN AND MONKEY CELL CULTURE ASSAYS,

Shimane Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
K. Mochida.
Bulletin oF Environmental Contamination and Toxicity BECTA6, Vol. 36, No. 4, p 523-526, April 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Toxicity, *Bioassay, *Cell lines, *Cadmium, *Zinc, *Copper, Heavy metals, River water, Diatoms, Rivers, Groundwater, Japan, Culturing techniques.

A cell culture assay is described in which cultures of the human established cell line KB and primary African green monkey kidney (AGMK) cells are

used to assess toxicity of river and ground water. With Cd, Cu, and Zn as model heavy metals, Cd was more toxic than Cu and Zn with both types of cultured cells. The present assay system was found to be more sensitive than one using diatoms. Samples of river and ground water from Japan (five sources of each) were not toxic in bioassays with either cell type (ie, percentage inhibition of growth never reached %5 in 5 monthly tests of each water source). (Rochester-PTT)
W86-04362

ACCUMULATION OF SEDIMENT-BOUND PCBS BY FIDDLER CRABS,

Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5B.
W86-04365

ACUTE METAL TOXICOLOGY OF OLFACTION IN COHO SALMON: BEHAVIOR, RECEPTORS, AND ODOR-METAL COMPLEXATION,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
B. C. Rehnberg, and C. B. Schreck.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 579-586, April 1986. 2 fig, 2 tab, 16 ref. Sea Grant College Program NA81AA-D-00086.

Descriptors: *Mercury, *Copper, *Zinc, *Olefaction, *Odor-metal complexation, *Salmon, *Behavior, *Toxicity, Upstream movements, Metal-serine complexes, Juvenile salmon, Y-trough, Assay.

A behavioral assay of olfaction based on avoidance of L-serine in a two-choice Y-trough was employed in an attempt to determine the acute toxicities of Hg, Cu, and Zn to juvenile coho salmon (Oncorhynchus kisutch) olfaction. The detection of L-serine by juvenile coho salmon was inhibited by Hg and Cu, but not by Zn. None of the metals interfered with serine detection by formation of nonstimulatory metal-serine complexes. The mechanism of action of Cu remains unclear, whereas Hg appears to act at the level of the olfactory receptor. The likelihood of a fish swimming upcurrent into either Y-trough arm was depressed by the presence of Zh, Cu, or Hg. This depression of swimming behavior seemed to be related only to the presence of the metal, not to its concentration, because the smallest effects were seen at the highest metal concentrations. Zn had no observable effect on olfaction. The apparent decline in serine avoidance at 10(-7) Molar Zn probably resulted from small sample size. Avoidance of serine was inhibited at all test concentrations of Cu and Hg. (Rochester-PTT)
W86-04366

EFFECTS OF 1,2,4-TRICHLOROBENZENE ON ESTUARINE MACROBENTHIC COMMUNITIES EXPOSED VIA WATER AND SEDIMENT,

Environmental Research Lab., Gulf Breeze, FL.
M. E. Tagatz, G. R. Plaia, and C. H. Deans.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 351-360, December 1985. 1 fig, 5 tab, 14 ref.

Descriptors: *Trichorobenzene, *Estuaries, *Macrobenthic ecosystem, *Ecological effects, Water pollution effects, Sediments, Toxicity, Larvae, Mollusks, Arthropods, Annelids, Echinoderms, Population exposure.

Macrobenthic animal communities that colonized sand-filled aquaria were exposed to 1,2,4-trichlorobenzene (TCB), a recent replacement for polychlorinated biphenyls in the electrical industry. In one test, communities established by planktonic larvae entrained in continuously supplied unfiltered seawater for 50 days were exposed to waterborne TCB for 6 days. In the second test, the toxicant was added to the sediment before 8 weeks of colonization. Concentrations that affected community structure were usually two orders of magnitude lower for waterborne TCB than for sediment-bound TCB, but the same types of organisms were affected by each route of exposure. The lowest TCB concentrations (measured) that affected average numbers of individuals exposed via the water were 0.04 mg/l for mollusks, 0.4 mg/l for arthropods, and 4 mg/l for annelids. The average number of species was significantly lower than the control at 4 mg/l. The TCB exposures via the sediment, the lowest concentrations (nominal) that affected average numbers of individuals were 100 micrograms/gm for mollusks and echinoderms, and 1000 micrograms/gm for arthropods and annelids. The average number of species in experimental aquaria was significantly lower than the control at > 100 micrograms/gm. TCB persisted in sediments, but some leached into water throughout the 8-week exposure via sediment. (Lantz-PTT)
W86-04398

EFFECTS OF THE HERBICIDE ATRAZINE ON AQUATIC INSECT COMMUNITY STRUCTURE AND EMERGENCE,

Kansas Univ., Lawrence. Museum of Natural History.
S. L. Dewey.
Ecology ECOLAR, Vol. 67, No. 1, p 148-162, February 1986. 8 fig, 3 tab, 73 ref, 1 append. EPA Grant No. CR808804-02-0.

Descriptors: *Atrazine, *Aquatic insects, *Ecological effects, Herbicides, Water pollution effects, Community structure, Experimental ponds, Macrophytes, Algae.

The herbicide atrazine was applied to 0.045-ha experimental ponds in two replicate concentrations of 0, 20, 100, and 500 micrograms/L each. Physical, chemical, and biological variables were measured and aquatic insect community structure was monitored in the eight ponds using partially submerged funnel emergence traps. Atrazine had no effect on water temperature or oxygen concentration. Mean turbidity did increase significantly with atrazine concentration, but turbidity could not be correlated with abundance or species richness of emerging insects. Macrophyte production decreased with increasing herbicide concentration; however, the macroalga Chara sp. showed resistance up to 100 micrograms/L. The benthic insect community was also negatively affected by atrazine. Abundance of emerging individuals of the chironomid Labrundinia pilosella was significantly reduced at atrazine concentrations as low as 20 micrograms/L, while other, less abundant species showed similar declines. Benthic insect species richness (S), species equitability (J prime), and total emergence all declined significantly with atrazine addition. In general, abundances of nonpredatory insects were greatly reduced with the addition of atrazine (20 micrograms/L), while predatory insects showed no response to the herbicide. In addition, emergence periods of several herbivorous insect species shifted to an earlier time in atrazine-treated ponds; the shift was statistically significant for Oxyethira pallida. (Lantz-PTT)
W86-04401

EPIDEMIC CAMPYLOBACTERIOSIS ASSOCIATED WITH A COMMUNITY WATER SUPPLY,

Georgia Dept. of Human Resources, Atlanta.
J. J. Sacks, S. Lieb, L. M. Baldy, S. Berta, and C. M. Patton.
American Journal of Public Health AJHEAA, Vol. 76, No. 4, p 424-429, April 1986. 2 fig, 3 tab, 33 ref.

Descriptors: *Epidemics, *Campylobacteriosis, *Municipal water, *Water supply, Water quality, Water pollution sources, Water pollution effects, Bacteria, Birds, Campylobacter jejuni, Greenville, Florida.

In May 1983, an estimated 865 cases of epidemic gastrointestinal disease occurred in Greenville, Florida. Surveillance of pharmacy sales of antidiarrheal medicines suggested that the outbreak was confined to Greenville and its immediate vicinity. Surveys demonstrated that the gastrointestinal illness attack rates inside and outside the city limits were 56% (72/128) and 9% (7/77), respectively (relative risk (RR) = 6.2); consumption of city water was associated with illness (RR = 12); and as water consumption increased, the attack rate also increased ($p < 0.001$). Four adults were hospitalized and one outbreak-related case of Guillain-Barre' syndrome was identified. Campylobacter jejuni was isolated from specimens from 11 ill persons, with serologic studies showing the development of Campylobacter-specific antibodies. Fecal coliforms were found in water samples, but Campylobacter was not recovered from water. The city water plant, a deep well system, had numerous deficiencies including an unlicensed operator, a failure of chlorination, and open-top treatment towers. Birds were observed perching on the open-top treatment tower. Of 38 birds trapped seven weeks later, 37% harbored C. jeuni. However, plasmid and serotyping studies showed that strains were not the same as the common strain from ill persons. This outbreak suggests that water systems that are unprotected from contact with birds may become contaminated and a source of outbreaks of human campylobacteriosis. (Lantz-PTT)
W86-04403

GROUNDWATER QUALITY CHANGES RESULTING FROM A SURFACE BROMIDE APPLICATION TO A PASTURE,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5B.
W86-04419

TIME SCALES OF CATCHMENT ACIDIFICATION,

Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 5B.
W86-04423

WATER HARDNESS AND CARDIOVASCULAR MORTALITY RATE IN ABRUZZO, ITALY,

Aquila Univ. (Italy). Faculty of Medicine.
V. Leoni, L. Fabiani, and L. Ticchiarelli.
Archives of Environmental Health AEHLAU, Vol. 40, No. 5, p 274-278, September/October, 1985. 1 fig, 4 tab, 30 ref.

Descriptors: *Water quality, *Mortality, *Cardiovascular disease, Abruzzo, Italy, Water hardness, Physiological effects, Nutrients, Water pollution effects.

For the years 1969-1978, the authors studied the pattern of mortality resulting from cardiovascular diseases (390-438 International Classification of Disease (ICD)), ischemic heart diseases (410-414 ICD), and cerebrovascular diseases (430-438 ICD), and then correlated mortality rate with water hardness. The study took place in the region of Abruzzo, Italy, which has a population of 594,323. The study found that: (1) an inverse correlation can be seen in relatively small non-metropolitan areas, but with the population uniformly distributed in relation to the 'hardness of water' variable. It was considered important that in those areas the differences in diet and lifestyles are negligible, and that the demand for food is almost exclusively provided for locally; and, (2) the inverse correlation can be seen despite the fact that the waters considered do not fall below 10 F of hardness, where an excessive mortality rate is clearly evident. Therefore, the 'soft water-hard arteries' hypothesis is strengthened with respect to the dose-effect relationship. (Lantz-PTT)
W86-04434

PCBS HAVE DECLINED MORE THAN DDT-GROUP RESIDUES IN ARCTIC RINGED SEALS (PHOCA HISPIDA) BETWEEN 1972 AND 1981,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 5B.
W86-04440

EFFICACY AND CHEMICAL PERSISTENCE OF TWO HIGHLY ACTIVE CARBAMATE DEVELOPMENTAL INHIBITORS,

California Univ., Parlier. Mosquito Control Re-

search Lab.
C. H. Schaefer, W. H. Wilder, E. F. Dupras, Jr., and R. J. Stewart.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 33, No. 6, p 1045-1048, November/December 1985. 9 tab, 8 ref. USDA Cooperative Agreement No. 82-CRSR-2-1010.

Descriptors: *Carbamates, *Insecticides, *Chemcontrol, *Mosquitos, Larvae, Tissue analysis, Mature growth stage, Water pollution effects, Fish, Temperature effects, Hydrogen ion concentration.

Ro16-1294, 2-(p-(m-chlorophenoxy)phenoxy)ethyl ethylcarbamate, and Ro16-1295, 2-(p(m-fluorophenoxy)phenoxy)ethylcarbamate, show very high efficacy against immature mosquitoes in laboratory and field trials. When mosquito larvae are exposed to either compound, there is no direct toxicity but mortality occurs in the pupal stage; at even lower doses, adults emerge from the pupal cases but are unable to leave the water surface and die there. These compounds are stable in water over a wide range of temperature and pH. Ro16-1294 appears to be lost from water by the effects of sunlight and adsorption onto organic matter. Fish accumulate Ro16-1294 from water into their tissues more than 300-fold the water concentration, but the residues steadily decline when exposed fish are placed in untreated water. The efficacy and chemical persistence properties of Ro16-1294 offer good potential for its use as a mosquito control agent. (Lantz-PTT)
W86-04465

PROSPECTIVE STUDY OF SWIMMING-RELATED ILLNESS: 1. SWIMMING-ASSOCIATED HEALTH RISK,

Toronto Univ. (Ontario). Dept. of Microbiology.
R. P. Seyfried, R. S. Tobin, N. E. Brown, and P. F. Ness.
American Journal of Public Health AJHEAA, Vol. 75, No. 9, p 1068-1070, September 1985. 2 tab, 23 ref.

Descriptors: *Swimming, *Waterborne disease, *Water pollution effects, *Public health, Statistical analysis, Epidemiology, Pseudomonas aeruginosa, Bacterial infections.

During the summer of 1980, both swimmers and nonswimmers were enlisted in a prospective epidemiological study to determine the relationship between swimming, water quality, and the incidence of illness. Results of 4,537 telephone follow-up interviews showed that crude morbidity rates were 69.6 per 1,000 swimmers versus 29.5 per 1,000 nonswimmers. There was little alteration in the symptom rates when they were adjusted for factors of sex, contact person, age, and swimming shortly before or after the interview. Swimmers who put their head under water were found to have higher rates of ear illness. This finding supports the results of an earlier investigation that demonstrated a relationship between ear infections and the presence of Pseudomonas aeruginosa in the water. The higher morbidity rates observed here among swimmers under the age of 20 have also been noted in other studies. Swimmers experienced respiratory ailments most frequently, followed by gastrointestinal, eye, ear, skin, and allergenic symptoms, respectively. (See also W86-04467) (Lantz-PTT)
W86-04466

PROSPECTIVE STUDY OF SWIMMING-RELATED ILLNESS: 2. MORBIDITY AND THE MICROBIOLOGICAL QUALITY OF WATER,

Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, R. S. Tobin, N. E. Brown, and P. F. Ness.
American Journal of Public Health AJHEAA, Vol. 75, No. 9, p 1071-1075, September 1985. 3 fig, 4 tab, 27 ref.

Descriptors: *Swimming, *Waterborne disease, *Water pollution effects, *Public health, Statistical analysis, Epidemiology, Coliforms, Streptococci, Pseudomonas aeruginosa, Staphlococci, Ontario.

Periodic closure of public beaches in North America has emphasized the need for the development of adequate microbiological standards for recreational waters. Current guidelines for fecal coliforms, the bacteriological indicator of choice in North America, vary by jurisdiction. In Ontario, Canada, the maximum limit is a geometric mean density of 100 fecal coliforms per 100 ml of water, where as in most other Canadian provinces and American states, the limit is 200 fecal coliforms per ml of water. A prospective cohort epidemiological-microbiological study was carried out at 10 beaches in Ontario, Canada. Lake water and sediment samples collected at the beaches were analyzed for fecal coliforms, fecal streptococci, heterotrophic bacteria, Pseudomonas aeruginosa, and total staphylococci. Mean fecal coliform levels in the surface water of the lakes were within accepted guidelines. Bacterial densities were found to be approximately 10 times higher in the sediment than in the corresponding surface water samples. Morbidity among swimmers was shown to be related to staphylococcal counts, to fecal coliform levels, and, somewhat less strongly, to fecal streptococcal counts. Total staphylococci appeared to be more consistent indicators for predicting total morbidity rates among swimmers. (See also W86-04466) (Lantz-PTT)
W86-04467

ENVIRONMENTAL ANALYSIS OF IRON-PRECIPITATING BACTERIA IN GROUND WATER AND WELLS,

Smith (S.A.) Consulting Services, Columbus, OH.
S. A. Smith, and O. H. Tuovinen.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 45-52, Fall 1985. 1 fig, 49 ref.

Descriptors: *Environmental effects, *Iron bacteria, *Groundwater, *Wells, Literature review, Aquifer characteristics, Public health, Biomass, Water analysis, Bacterial degradation, Corrosion.

Iron-precipitating bacteria are frequently cited as being involved in economically serious well and aquifer degradation that may also have a public health impact. The problems of bacterial degradation, clogging and corrosion in aquifers and wells is an old one that still persists on a geographical scale at least comparable to chemical pollution of groundwater. Conceptually, the current base of information and study methods to expand the data base greatly resemble the problems of monitoring and modeling chemical groundwater pollution. Quantifying the populations of the iron-precipitating bacteria present in groundwater is a complex problem not yet resolved. A survey of historical and modern environmental literature provides numerous descriptions of iron bacteria in aquifers and wells, along with physicochemical data collected during bacterial sampling. These data are not conclusively linked with iron bacteria occurrence. Iron bacteria is a concept encompassing may genera and species of bacteria with varying morphology and physiology. Methods to detect bacteria and to quantify bacterial biomass in aquifers are being developed, but representative sampling remains a problem. Predictive analysis of iron bacterial growth awaits additional physiological and sampling research. (Lantz-PTT)
W86-04470

BIOLOGICAL ACCUMULATION AND MONITORING OF CHEMICAL WASTES IN ARCTIC WATERS,

Solway Marine Investigations, Maryport (England).
For primary bibliographic entry see Field 5B.
W86-04475

ACCUMULATION OF AIRBORNE TRACE POLLUTANTS BY ARCTIC PLANTS AND SOIL,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5B.
W86-04479

EFFECTS OF ENGINEERING CONTROLS ON METHANE FERMENTATION TOXICITY RESPONSE,

For primary bibliographic entry see Field 5D.
W86-04501

SEASONAL AND SPATIAL DISTRIBUTION OF BACTERIA, CHLOROPHYLL, AND NUTRIENTS IN NEARSHORE LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W86-04526

RELATIONSHIPS BETWEEN CHLORINATED HYDROCARBON CONCENTRATIONS AND REARING MORTALITY OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EGGS FROM LAKE MICHIGAN,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. P. Giesy, J. Newsted, and D. J. Garling.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 82-98, 1986. 1 fig, 8 tab, 45 ref.

Descriptors: *Chlorinated hydrocarbons, *Chinook salmon, *Lake Michigan, Oncorhynchus tshawytscha, Water pollution effects, Polychlorinated biphenyls, Statistical analysis, Aroclor, Toxaphene, fish toxins, Fish physiology, Mortality.

A study was conducted to investigate a possible correlation between chlorinated hydrocarbon concentrations and rearing mortality of chinook salmon. Eggs, collected from adult Lake Michigan chinook salmon in October 1982, were analyzed for chlorinated hydrocarbon concentrations and rearing mortality. Polychlorinated biphenyls (PCB), toxaphene, and fifteen other chlorinated hydrocarbons were quantified. Also, concentrations of individual PCB congeners were quantified. We found 78 quantifiable PCB congeners, only three of which were non-ortho substituted. Mean concentrations of Aroclor 1242, 1254, and 1260 were 1.7, 5.4, and 1.1 micrograms/g, respectively. The concentration of toxaphene-like material was 3.3 micrograms/g, and the mean concentration of the total DDT complex was 1.0 micrograms/g. Concentrations of chlorinated hydrocarbons ranged approximately 10-fold among individual fish. An analysis of variance components demonstrated that this variability represented among-fish variation and was not due to errors in sampling or quantification. Duplicate studies of egg viability and fry mortality, conducted at 10, 11, and 15 C, correlated with residue concentrations. While some residue concentrations were significantly negatively correlated with egg viability and survival of fry, others were positively correlated. Thus, we observed no consistent trends in Pearson, pairwise-correlations between either egg viability or survival of fry to swim-up stage and individual residue concentrations. When the residues were classified into four principal components, two of the principal components which contained primarily the toxaphene and PCB concentrations were negatively correlated with survival of fry to the swim-up stage. (Author's abstract)
W86-04528

ALGAE REACTIONS TO MINERAL AND ORGANIC MICROPOLLUTANTS, ECOLOGICAL CONSEQUENCES AND POSSIBILITIES FOR INDUSTRIAL-SCALE APPLICATION: A REVIEW (REVUE DES REACTIONS DES ALGUES AUX MICROPOLLUTANTS MINERAUX ET ORGANIQUES; CONSEQUENCES ECOLOGIQUES ET POSSIBILITIES D'APPLICATIONS INDUSTRIELLES),

Societe Degremont, Rueil-Malmaison (France).
P. Mouchet.
Water Research WATRAG, Vol. 20, No. 4, p 399-412, April 1986. 1 fig, 5 tab, 121 ref.

Descriptors: *Algae, *Water pollution effects, *Organic compounds, *Industrial wastewater, *Minerals, Ecological effects, Chaetocurus calcitrans, Hydrocarbons, Phenols, Pesticides, Lagoons, Biological degradation, Heavy metals, Polychlorinated biphenyls, Reviews.

An aquatic ecosystem may react to pollution in different ways, some of which combat the pollution actively; in particular, algae participate by developing various substances capable of complexing or degrading numerous organic or mineral pollutants. When heavy metals are not directly accumulated in algae, they can often be complexed by their extracellular metabolites, e.g. hydroxamates, to form organo-metallic compounds; the ecological consequences of these phenomena most often due to the presence of Cyanophyceae are varied. Organic micropollutants are often metabolized or even assimilated by algae. For example: Hydrocarbons are assimilated by marine algae such as the diatom Chaetoceros calcitrans, or by fresh water algae; Phenols are metabolized so far as to completely remove them through the action of phenoloxidases which induce the formation of transient degradation products, in particular quinones; Pesticides, which are most often accumulated in algae, are sometimes partially degraded by certain algae. However, this may results in the temporary appearance of metabolites more toxic than the initial product (e.g. DDE from DDT); and, PCBs which are so stable they are fixed without being metabolized, by living algae, and even dead ones. These various reactions show that in nature, certain algae prove specifically tolerant to various industrial wastes that contain mineral pollutants, or organic pollutants. These observations, made both in the laboratory and in the field, could well lead to new applications in the biological treatment of industrial waste water. Such possibilities have already been proved for vascular plants, such as for the removal of heavy metals or phenols. The new generation of biological treatments of industrial effluents will be based on selected algae species acting in symbiosis with bacteria in traditional lagooning or through more intensive processes, such as 'activated algae' or culture of algae immobilized in agar beads or on rotating discs. (Lantz-PTT)
W86-04568

EVALUATION OF MANAGEMENT ASPECTS OF A HYPERTROPHIC AFRICAN IMPOUNDMENT,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5G.
W86-04569

SOURCES OF WATER TO THE SEAWATER WELL WHICH SUPPLIES THE FISH PONDS IN EILAT: IMPLICATIONS FOR FISHPOND MANAGEMENT,

National Mariculture Centre, Eilat (Israel).
For primary bibliographic entry see Field 5B.
W86-04576

SIMULATION OF WATER-BLOOM IN A EUTROPHIC LAKE - IV: MODELING THE VERTICAL MIGRATION IN A POPULATION OF MICROCYSTIS AERUGINOSA,

Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Chemical Engineering.
M. Okada, and S. Aiba.
Water Research WATRAG, Vol. 20, No. 4, p 485-490, April 1986. 2 fig, 2 tab, 14 ref.

Descriptors: *Simulation analysis, *Eutrophication, *Lakes, *Model studies, *Vertical distribution, *Microcystis aeruginosa, Migration, Blue-green algae, Algal colonies, Extinction coefficient, Mixing, Specific growth rate, Light intensity.

Simulation of the water-bloom dominated by Microcystis (blue-green algae) was carried out by modifying the mathematical model presented previously on the rising and sinking of the algal colonies through a still water column. In contrast to the earlier work on the simulation of single colonies, an overall behavior of many algal colonies, having not only the size distribution but also having distribution initially throughout the water column was simulated. The points of the model modified are (1) the specific growth rate was shown by a quadratic function of light intensity that takes the inhibitory effect into account and (2) the extinction coefficient incorporated the light-shielding effect by the algal cells existent depthwise in the water column rather than a linear function of the concentration of suspended materials in the water. The numerical solutions of the model (280 dimensions) were in agreement qualitatively with the observations ever reported on Microcystis behavior in eutrophic lakes. Factors relevant to the extinction coefficient underwater, i.e. the concentrations of either microcystis colonies or other suspended materials were significant from the viewpoint to control the algal growth as a whole, assuming that no nutrients specific growth rate especially when the concentrations of colonies or other materials were large. Consequently, an artifical aeration was suggested to be a commendable means to ward off the water-bloom. (Author's abstract)
W86-04579

BIOLOGICAL HALF-LIVES OF EIGHT POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN RAINBOW TROUT (SALMO GAIRDNERI),

Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and V. Palazzo.
Water Research WATRAG, Vol. 20, No. 4, p 503-507, April 1986. 3 tab, 33 ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Rainbow trout, *Biological half-lives, Regression analysis, Statistical analysis, Phenanthrene, Fluorene, Anthracene, Fluoranthene, Benzo-a-pyrene, Benz-a-anthracene, Chrysene, Pyrene, Tissue analysis, Toxicity.

Adult rainbow trout were exposed to a single oral dose containing a mixture of eight polycyclic aromatic hydrocarbons (PAHs), and fish were sampled at intervals between 5-48 days after exposure. Regression analyses on whole fish indicate levels declined significantly in four of the compounds monitored. Their biological half-lives were estimated as 9 days for phenanthrene, 7 days for fluorene and anthracene and 6 days for fluoranthene. No reliable estimates could be derived for benzo(a)pyrene, bene(a)anthracene, chrysene or pyrene because of low or nondetectable concentrations at the first sample interval although it could be suggested that their half-lives would be less than several days. The data also suggested that these PAHs are poorly absorbed by trout. (Author's abstract)
W86-04582

DEVICE FOR THE CONTINUOUS MEASUREMENT OF ALGAL PHOTOSYNTHETIC RESPONSE TO LIGHT,

Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
C. L. Gallegos, and F. R. Schiebe.
Water Research WATRAG, Vol. 20, No. 4, p 509-516, April 1986. 5 fig, 35 ref.

Descriptors: *Continuous measurement, *Photosynthesis, *Algae, *Light intensity, *Light penetration, *Measuring instruments, Phytoplankton, Eutrophic waters, Water quality, Dissolved oxygen.

A device is described for continuously monitoring the photosynthetic response to light of phytoplankton in eutrophic waters. Water is pumped from the system being monitored, and flows in parallel into 8 chambers that are placed in a light gradient. Dissolved oxygen is measured periodically at the inflow and outflow of each chamber. Solution of the dynamic mass balance equation for a well mixed system provides an estimate of net photosynthetic oxygen evolution as a function of light intensity. The last chamber is darkened with opaque plastic thereby providing a continuous estimate of community dark respiration. The primary assumption made in the design of the system (complete mixing within the chambers) is verified by tracer studies. The utility of the system is demonstrated by comparison with in situ incubations, and by results of monitoring phytoplankton growth in turbid waters. (Author's abstract)
W86-04583

INTEGRATED ANALYSES OF ACIDIFICATION IN EUROPE,

National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W86-04589

SUMMARY OF WATERBORNE ILLNESS TRANSMITTED THROUGH CONTAMINATED GROUNDWATER,

Environmental Protection Agency, Cincinnati, OH.
G. F. Craun.
Journal of Environmental Health JEVHAH, Vol. 48, No. 3, p 122-127, November/December 1985. 4 fig, 12 tab, 2 ref.

Descriptors: *Groundwater pollution, *Water pollution effects, *Human diseases, *Drinking water, Water pollution sources, Viruses, Well water, Septic tanks, Disinfection, Fate of pollutants, Public health.

The use of contaminated, untreated or inadequately treated groundwater was responsible for 51% of all waterborne outbreaks and 40% of all waterborne illness reported in the United States during 1971-82. Contaminated, untreated or inadequately disinfected groundwater caused 65% of the waterborne outbreaks and 66% of the waterborne illness which occurred in noncommunity and individual water systems but only 32% of the outbreaks and 31% of illness in community water systems. Illnesses most frequently transmitted through groundwater included acute gastroenteritis of undetermined etiology, chemical poisonings, hepatitis A, shigellosis, and viral gastroenteritis. Waterborne outbreaks in water systems using untreated well water were caused primarily by the overflow of seepage of sewage from septic tanks or cesspools, chemical contamination, and surface runoff contamination. An increase in the number of outbreaks resulting from the use of untreated, contaminated well water was noted during the summer months. (Author's abstract)
W86-04610

EFFECTS OF CD(II) AND CU(II) ON A BIOFILM SYSTEM,

Missouri Univ.-Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-04643

RESPONSE OF PHOTOSYNTHETIC PARAMETERS TO ENVIRONMENTAL FACTORS IN SIGGEFORASJON, SWEDEN,

Uppsala Univ. (Sweden). Limnologiska Institutionen.
U. Heyman.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 155-175, April 1986. 8 fig, 9 tab, 35 ref.

Descriptors: *Photosynthesis, *Environmental effects, Lake Siggeforasjon, *Sweden, Assimilative capacity, Biomass, Chlorophyll, Chemical analysis, Phytoplankton, Light intensity, Regression analysis, Statistical analysis.

Primary productivity, phytoplankton biomass and species composition, zooplankton biomass, chlorophyll and environmental parameters were measured from composite samples on 44 occasions during 1977 and spring 1978. The parameters of the equation, assimilation maximum (A sub m) and photosynthetic efficiency (alpha), were divided by phytoplankton biomass, chlorophyll or expressed per unit water volume. These values as well as chlorophyll concentration and chlorophyll per biomass were related to water chemistry, light and plankton biomass and composition by means of multiple regression. The chlorophyll content per unit biomass varied in a fairly predictable way to temperature, and the average light intensity over the two days that preceded sampling. A sub m was dependent on temperature, biomass and species composition but not on chlorophyll. A sub m per unit biomass could be shown to covary with the phosphorus content per unit biomass, and up to 80% of the variation could be explained by the

regression. The division of A sub m by chlorophyll only increased the unexplained variation, indicating that the algae adapted their chlorophyll content to the rate of dark reactions, which was also indicated by the variation in chlorophyll per biomass. The use of assimilation number (A sub m/chlorophyll) as an indicator of adaptation and general status of the phytoplankton was thus of no value in this study. Alpha was relatively independent of chlorophyll and was mainly determined by light intensity, the rate of dark reactions (A sub m) and species composition. I sub k (A sub m/alpha) covaried with the average light intensity but regression equations could only explain half of the variance. The regression equations explained large parts of the variation and rather good agreement between measured and predicted integrated assimilation was found. (Lantz-PTT)
W86-04647

EFFECTS OF FOREST FIRE AND OTHER DISTURBANCES ON WILDERNESS LAKES IN NORTHERN MINNESOTA: 1. LIMNOLOGY,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 4C.
W86-04648

MACROPHYTE DECOMPOSITION IN TWO TROPICAL LAKES,

Fisheries Research Inst., Szarvas (Hungary).
S. Ayyappan, J. Olah, S. L. Raghavan, V. R. P. Sinha, and C. S. Purushothaman.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 219-231, April 1986. 3 fig, 5 tab, 27 ref.

Descriptors: *Macrophytes, *Decomposition, *Lakes, *Tropical regions, Cellulose, Protein, Water hyacinth, Decomposing organic matter, Temperature effects, Cycling nutrient, India.

Seasonal and vertical variations in the decomposition rates of an aquatic macrophyte and two other substrates (filter paper cellulose and silk protein) provided as its ingredients in two representative freshwater lakes of India, are discussed. An in situ procedure to measure the weight losses was developed that provides a simple means of obtaining quick estimates. Of the three substrates, water hyacinth showed maximum decomposition rates ranging from 40 to 11 daily percent of weight loss in the pond and from 1.1-6.3 in the lake. The values for cellulose ranged from 0 to 3.6 in the pond and from 0.1 to 3.5 in the lake. Weight loss of protein was smaller, ranging from 0 to 3 in the pond and from 0 to 1.2 in the lake. Seasonal maxima developed during temperature maxima for hyacinth, and during minima for model substrates with some deviations. Weight losses were higher in bottom water and at the sediment-water interface. Decomposition was compared and discussed with the measured physico-chemical environment and bacterial communities in the two water bodies as well as with weight loss magnitude known for other water bodies. Decomposition under these tropical conditions was much higher than in the temperate zone, with rapid decomposition an important function in mineral recycling in nutrient deficient tropical waters. (Lantz-PTT)
W86-04649

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES: 4. LINDANE (GAMMA-HEXACHLOROCYCLOHEXANE),

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. W. J. Green, K. A. Williams, and D. Pascoe.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 263-273, April 1986. 1 fig, 2 tab, 33 ref.

Descriptors: *Lindane, *Macroinvertebrates, *Pesticide toxicity, Gamma-Hexachlorocyclohexane, Trichopterans, Platyhelminths, Mollusks, Crustaceans, Plecopterans, Ephemeropterans, Dipterans, Oligochaetes, Lethal limit, Water pollution effects, England.

The acute toxicity of lindane to ten species of macroinvertebrates was examined. Species tested included a trichopteran, platyhelminth, and mollusk, to represent taxa for which there is no available literature on lindane toxicity. Plecopteran, ephemeropteran, dipteran, crustacean, and oligochaete species, (for which there is some information, at least on taxonomically related species) were also tested. Considerable interspecific differences in sensitivity were observed. The most sensitive species tested was Baetis rhodani (96 hr LC50 34 microgram lindane/l, where LC50 is the media lethal concentration), and the most tolerant species were Polycelis tenuis and Physa fontinalis which showed no mortality in up to 21 days when exposed to 430 microgram lindane/l. The relative sensitivity of species determined in this study is not radically different from that which emerges from an inspection of the literature, but is appears that species used in this study exhibit higher 48 hr and 96 hr LC50's than related species tested in other investigations. Possible reasons for these differences are discussed. Concentrations of lindane in United Kingdom freshwaters, generally lower than 1 micrograms lindane/l, are unlikely to bring about short term mortality in the species tested in this study. However, the possible release of lindane in high concentrations, and in combination with other pesticides, suggests that further investigations of its toxicity, both individually and in mixtures, should be carried out in order to determine the amounts required to kill macroinvertebrates after brief exposure to high concentrations. (Lantz-PTT)
W86-04651

STUDIES ON THE ACUTE AND CHRONIC EFFECT OF A 2,4-D-CONTAINING HERBICIDE (DIKONIRT) ON EUDIAPTOMUS GRACILIS (G. O. SARS) (CRUSTACEA, COPEPODA),

Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
M. Presing, and J. E. Ponyi.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 275-286, April 1986. 4 fig, 2 tab, 24 ref.

Descriptors: *Toxicity, *Lethal limit, *Herbicides, *Eudiaptomus gracilis, Crustaceans, Dikonirt, Lake Balaton, Hungary, Dichlorophenol, Sodium, Physiological ecology, Water pollution effects.

The spring generation of Eudiaptomus gracilis proved to be more susceptible 2,4-D-containing herbicide (Dikonirt) in Lake Balaton, than those generations present during other seasons. Mean lethal concentration (LC50) values for the examination periods in winter, spring, summer and autumn were the following: 90.9, 68.6, 75.2, 81.9 mg/l, respectively. Examinations of the spring generation showed the effective agent (2,4-D) of the herbicide and its Na-salt to be less toxic on E. gracilis (LC50 = 144.1 and 173.4 mg/l, respectively) than the commercial product (LC50 = 68.6 mg/l). The contaminant dichlorophenol with LC50 96 hr of 6.3 mg/l proved to be the most toxic. The toxicity of Dikonirt, containing about 2% dichlorophenol and 71.1% 2,4-D, was due to the synergistic effect of the two compounds. At a concentration ten times lower than LC50 (i.e. at concentrations lower than the so called harmless one) Dikonirt diminished the number of eggs of the animals of the autumn and summer generations. During the 3-week studies, the females two times carried sacs of the experimental animals, which were observed. In the autumn experiments, the average number of eggs of animals living in a 2.5 mg/l Dikonirt concentration was significantly smaller than in the control. During the summer investigations, at 2.5 mg/l concentration, the average number of eggs was significantly smaller during both clutches, than in the case of animals living in the control Balaton Lake water. (Lantz-PTT)
W86-04652

EFFECT OF THREE DRILLING FLUIDS ON GROUND WATER SAMPLE CHEMISTRY,

Geological Survey, San Antonio, TX. Water Resources Div.
R. B. Brobst, and P. M. Buszka.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 62-70, Winter 1986. 7 fig, 2 tab, 16 ref.

Descriptors: *Groundwater pollution, *Drilling fluids, *Chemical analysis, Guar bean, Bentonite, Sulfates, Monitoring wells, Antigo, Wisconsin.

Three monitoring wells were installed in borings that were constructed using water-based drilling fluids containing either (1) guar bean, (2) guar bean with breakdown additive, or (3) bentonite. These fluids were selected to observe their effect on the chemistry of subsequent water samples collected from the wells. The wells were installed to depths of 66 feet, 100.5 feet and 103 feet, respectively, in fine-to-medium sand and gravel outwash deposits near Antigo, Wisconsin. The bentonite and guar drilling fluids caused temporarily elevated concentrations of chemical oxygen demand (COD) in groundwater samples collected from the monitoring wells. Using standard development, purging and sampling procedures, elevated COD concentrations persisted for about 30 days for the well bored with the guar-with-additive fluid, 140 days for the bentonite well and 320 days for the guar well. Unfiltered groundwater samples for all wells had greater concentrations of COD than samples filtered through a 0.45 micron filter. Sulfate concentrations also decreased with time in the guar-with-additive well and bentonite well, but not in the guar well. The elevated COD concentrations are attributed to large concentrations of oxidizable carbon present in the guar bean drilling fluid and in the organic polymers present in the bentonite drilling fluid. Future research should evaluate the physical and geochemical interaction of different drilling fluid compositions with a variety of geologic matrices and drilling, well development and well purging techniques. (Lantz-PTT)
W86-04655

EFFECTS OF O3 AND ACIDIC RAIN ON PHOTOSYNTHESIS AND GROWTH IN SUGAR MAPLE AND NORTHERN RED OAK SEEDLINGS,

Boyce Thompson Inst. for Plant Research, Ithaca, NY.
P. B. Reich, A. W. Schoettle, and R. G. Amundson.
Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 1, p 1-5, January 1986. 2 fig, 4 tab, 24 ref.

Descriptors: *Ozone, *Acid rain, *Photosynthesis, *Plant growth, Environmental effects, Simulated rainfall, Chlorophyll, Maple trees, Red oak trees, Air pollution.

Two-year-old sugar maple Acer saccharum and northern red oak Quercus rubra seedlings were exposed to all combinations of several levels each of ozone (O3) and simulated acidic rain. Deposition rates and amounts of simulated rain were normal for eastern North America (12.5 mm of rain twice/wk) and levels of acidity in the various treatments ranged between pH 5.6 and 3.0. Plants were exposed to O3 for 7 hr/day, 5 d/wk. Concentrations of O3 were constant and ranged between 0.02 and 0.12 microliters/l in the various treatments. Ozone treatments caused significant declines in net photosynthesis in both species, with the largest reductions observed (30% in maple and 20% in oak) after two months in the highest O3 treatment (0.12 microliters/l). Reductions in growth as a result of O3 treatments occurred in sugar maple, but apparently due to the relatively short duration of the pollution treatments, growth reductions were not observed in red oak. Chlorophyll contents in sugar maple leaves increased as a result of O3 exposure. Simulated acidic rain treatments had no effect on either net photosynthesis or growth in either species and no interactive effects of the two pollutants were observed. (Lantz-PTT)
W86-04660

EXAMINATION OF ENVIRONMENTALLY SAFE LEVELS OF ZINC (II), CADMIUM (II) AND LEAD (II) WITH REFERENCE TO IMPACT ON CHANNELFISH NURIA DENRICUS,

Centre for Water Resources Development and Management, Kunnamangalam (India).
S. A. Abbasi, and R. Soni.

Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 1, p 37-51, January 1986. 4 fig, 4 tab, 45 ref.

Descriptors: *Environmental effects, *Lead, *Zinc, *Cadmium, *Channelfish, Heavy metals, Toxicity, Survival, Water quality standards.

As a continuation of earlier studies on the impact of heavy metals on aquatic organisms, the behavioral responses and survival of the teleost Nuria denricus exposed to different levels of zinc (II), cadmium (II) and lead (II) were studied. Safe concentration (SC) values of the metals were determined with the help of computer-aided long-term bioassays. Comparisons of the SC with the minimum allowable levels of the corresponding metals in drinking water, effluents, irrigation water and fisheries revealed that, except for a few cases, the existing national and international water quality standards for various water uses are higher than the SC. A significant decrease in survival was observed in all zinc concentrations except 1.0 and 5.0 mg/l. With cadmium a significant decrease in survival was noted in concentrations above. 0.05 mg/l with 100% mortality observed within 50, 720 and 1100 hr in the 10, 5 and 1 mg/l exposures, respectively. In lead exposures, the mortality of the animals was significantly higher (43-100%) in concentrations above 0.5 mg/l. At lower concentrations, 0.05 and 0.5 mg/l, the mortality after 1100 hr was 30% and 17%, respectively. The disparity between the SC and the permitted levels of zinc and cadmium was especially noteworthy, indicating the need for a thorough re-evaluation of the toxicity and safe levels of these metals. (Lantz-PTT)
W86-04661

REVIEW OF TOXICITY TESTING AND DEGRADATION STUDIES USED TO PREDICT THE EFFECTS OF DIFLUBENZURON (DIMILIN) ON ESTUARINE CRUSTACEANS,

Research Triangle Inst., Research Triangle Park, NC. Center for Environmental Systems.
P. A. Cunningham.
Environmental Pollution EPEBD7, (Series A), Vol. 40, No. 1, p 63-86, January 1986. 1 fig, 4 tab, 44 ref.

Descriptors: *Toxicity, *Diflubenzuron, *Crustaceans, *Estuaries, Chemical degradation, Dimilin, Insect control, Saline water, Fresh water, Biological analysis, Environmental effects, Mosquitoes, Hydrogen ion concentration, Temperature effects.

This review surveys the pertinent literature on the effects of diflubenzuron (DFB)(Dimilin) on nontarget crustacean species when applied for mosquito control to freshwater and saltwater habitats. Freshwater research has focused on field testing, while estuarine research has been limited almost exclusively to laboratory toxicity studies. Several experimental design factors may affect the toxicity and persistence of diflubenzuron. These factors include formulation, frequency of application (exposure), presence of organic matter and sediment in the test system, pH, and water temperature. Biological factors such as the age of the test organism and the frequency and synchrony of moulting during the exposure period also influenced the observed response of the experimental crustacean population. Assessment of the impact of DFB on estuarine crustaceans is difficult as few studies have been conducted under conditions appropriate to its use in saltmarsh mosquito control. (Author's abstract)
W86-04662

GAS METABOLISM EVIDENCE IN SUPPORT OF THE JUXTAPOSITION OF HYDROGEN-PRODUCING AND METHANOGENIC BACTERIA IN SEWAGE SLUDGE AND LAKE SEDIMENTS,

Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
R. Conrad, T. J. Phelps, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 595-601, September 1985. 6 fig, 1 tab, 35 ref. DOE Grant AC02-80ER1075.

Descriptors: *Gas metabolism, *Methane bacteria, *Hydrogen bacteria, *Septic sludge, *Lake sediments, Kinetics, Anaerobic digestion, Lake Mendota, Wisconsin.

Developed are new techniques to measure dissolved H2 and H2 consumption kinetics in anoxic ecosystems that were not dependent on headspace measurements or gas transfer-limited experimentation. These H2 metabolism parameters were then compared with measured methane production rates, and estimates of H2 production and interspecies H2 transfer were made. The H2 pool sizes were 205 and 31 nM in sewage sludge from an anaerobic digestor and in sediments (24 m) from Lake Mendota, respectively. The H2 turnover rate constants, as determined by using in situ pool sizes and temperatures, were 103 and 31/h for sludge and sediment, respectively. The observed H2 turnover rate accounted for only 5 to 6% of the expected H2CO2 dependent methanogenesis in these ecosystems. Results are in general agreement with the results reported previously and are used to support the conclusion that most of the H2-dependent methanogenesis in these ecosystems occurs as a consequence of direct interspecies H2 transfer between juxtapositioned microbial associations within flocs or consortia. (Lantz-PTT)
W86-04665

MODELING THE RESPONSE OF GREENHOUSE-GROWN RADISH PLANTS TO ACIDIC RAIN,

Argonne National Lab., IL. Environmental Research Div.
P. M. Irving.
Environmental and Experimental Botany EEBODM, Vol. 25, No. 4, p 327-338, November 1985. 6 fig, 9 tab, 12 ref. EPA Agreement No. DW930126-01-0 and EPRI Contract No. RP 1908-1.

Descriptors: *Acid rain, *Radishes, *Model studies, Simulated rainfall, Greenhouses, Hydrogen ion concentration, Crop yield, Crop production, Photosynthesis, Environmental effects.

Many dose response studies have occurred in recent years, emphasizing the need to assess and determine the impacts of acid rain. Experimental design parameters and model evaluation play important roles in the overall conclusions of such studies. To illustrate the importance of some of these factors, three dose-response studies on radish (Raphanus sativas L.) plants exposed to simulated rain were performed in a greenhouse. Significant negative effects on marketable yield occurred from simulated rain having pH levels below 3.8 in one experiment and below 3.4 in another. The apparent threshold level may have been dependent on environmental conditions which affected overall growth rates. In modeling the experimental results, treatments have very high levels of acidity had an overwhelming influence on the dose-response function used to describe the results. Plants treated with the highest acidity levels had reduced leaf area which resulted in lower photosynthesis per plant and may have been responsible for the reduced yields of plants. In addition to acidity, the sulfate to nitrate ratio in simulated rain also influenced radish response. Nitric acid appeared to have a greater effect than sulfuric acid in reducing yield at pH 3.0. (Lantz-PTT)
W86-04668

RESPONSES OF THREE WHEAT CULTIVARS TO SIMULATED ACID RAIN,

Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Johnston, and D. S. Shriner.
Environmental and Experimental Botany EEBODM, Vol. 25, No. 4, p 349-353, November 1985. 2 fig, 3 tab, 15 ref. DOE No. 40-740-78, EPA No. 79-N0533, and DOHER Contract No. DE-AC05-84OR21400.

Descriptors: *Acid rain, *Wheat, *Simulated rainfall, Sulfuric acid, Nitric acid, Seedlings, Hydrogen ion concentration, Environmental effects, Grain crops, Crop production.

Seedlings of three wheat (Triticum aestivum L.) cultivars (Arthur 71, Abe, and Oasis) were exposed to simulated rain acidified to pH 5.6, 4.3, 4.0, 3.3, 3.0, or 2.3 with sulfuric and nitric acids. The parameters measured included foliage weight, tiller number, and the number of leaves with more than 10% necrosis per pot. The results showed that acid rain at average ambient levels (pH 4.3 or 4.0) caused reduced growth of Arthur 71 and Abe and had no effect on Oasis. At levels of acidity (pH 2.3) higher than those normally encountered in rain, all three cultivars exhibited enhanced growth. Tillering increased with rain acidity for Abe, but was relatively constant for both Arthur 71 and Oasis. The number of leaves with more than 10% tip necrosis increased with rain acidity for each cultivar. These results showed that differences in cultivar sensitivity may be important in efforts to assess the impact of acid rain on crop productivity. (Author's abstract)
W86-04669

MICROBIAL DECOMPOSITION OF CELLULOSE IN ACIDIFYING LAKES OF SOUTH-CENTRAL ONTARIO,

Toronto Univ. (Ontario). Dept. of Microbiology.
J. F. M. Hoeniger.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 315-322, August 1985. 6 fig, 2 tab, 52 ref.

Descriptors: *Microbial degradation, *Cellulose, *Acid rain, *Acidic water, *Ontario, Lakes, Bacterial analysis, Sediments, Water columns, Hydrogen ion concentration, Bacteria, Plankton, Ecological effects.

The rate of cellulose breakdown and density of bacterial populations were measured in the epilimnetic sediments and water columns of lakes in central Ontario that differ in pH, alkalinity, and nutrient status and are particularly sensitive to acidic inputs from atmospheric decomposition. There was no significant difference in decomposition rate in either oxic or anoxic sediment when mean epilimnetic pHs were in the range 5.5 to 6.9. The importance of these findings for the breakdown of autochthonous detritus in Canadian Shield lakes is discussed. Furthermore, the results of these experiments, in which dyed strips of cellophane (regenerated cellulose) were used as substrate, were compared with results of earlier decomposition studies carried out with coarse litter (leaves, twigs). Acridine orange direct counts of bacteria in the top 1 cm of sediment ranged from 5.5 times 10 to the 8th power to 1.0 times 10 to the 9th power/gm, and in planktonic water samples from 1,100,000 to 1,800,000/ml. Bacterial densities were significantly higher in both the shallow sediment ($P < 0.01$) and the water column ($P < 0.05$) of dystrophic lakes than at these sites in oligotrophic lakes. (Lantz-PTT)
W86-04672

INCIDENCE OF VIBRIO CHOLERAE AND RELATED VIBRIOS IN A COASTAL LAGOON AND SEAWATER INFLUENCED BY LAKE DISCHARGES ALONG AN ANNUAL CYCLE,

Valencia Univ. (Spain). Dept. of Microbiology.
E. Garay, A. Arnau, and C. Amaro.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 426-430, August 1985. 3 fig, 2 tab, 27 ref.

Descriptors: *Coastal lagoons, *Seawater, *Lake discharges, *Annual cycle, Vibrio cholerae, Albufera Lake, Valencia, Spain, Water temperature, Nutrients.

Most probable numbers of Vibrio cholerae and related vibrios were determined in Albufera Lake, Valencia, Spain, and in coastal waters under the influence of the lake discharges over the course of an annual cycle. The objective of this study was to evaluate the incidence of V. cholerae and related vibrios in a lake and in coastal waters south of Valencia influenced by the lake discharges over the course of a year. The effect of water temperature, type of water, and load of vibrios discharged by the lake into the sea was also evaluated. Maxi-

mum recovery of vibrios reached 1,000/ml in both types of waters analyzed. V. cholerae numbers reached 1,000 in one of the coastal sites. Frequently during the warm season, all vibrios isolated were identified as V. cholerae. Occasionally, no V. cholerae was recovered. The recovery of vibrios was significantly influenced by the temperature of the water and the type of water analyzed. Most of the V. cholerae isolates were included in Heiberg groups I and II, and nearly 50% of the strains used chitin as sole carbon source. Indole was not produced by 100% of the strains. All strains tested were non-O1 serovars. (Lantz-PTT)
W86-04674

SURVIVAL AND ENUMERATION OF THE FECAL INDICATORS BIFIDOBACTERIUM ADOLESCENTIS AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W86-04675

BACTERIAL BIOMASS, METABOLIC STATE, AND ACTIVITY IN STREAM SEDIMENTS: RELATION TO ENVIRONMENTAL VARIABLES AND MULTIPLE ASSAY COMPARISONS,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 5A.
W86-04677

5D. Waste Treatment Processes

ADIPIC ACID-ENHANCED LIME/LIMESTONE TEST RESULTS AT THE EPA ALKALI SCRUBBING TEST FACILITY,
Bechtel National, Inc., San Francisco, CA.
D. A. Burbank, and S. C. Wang.
Capsule Report EPA 625/2-82-029, April 1982. 21 p, 9 fig, 11 tab. Contract No. EPA 68-02-3114.

Descriptors: *Air pollution, *Fly ash, *Sulfur, Sulfur compounds, Adipic acid, Electric powerplants, Waste treatment, Industrial wastes, Economic aspects.

The results of testing adipic acid-enhanced lime and limestone for gas scrubbing at the Shawnee Power Station Test Facility are described. As background information, earlier adipic acid additive test results from a 0.1 MW pilot plant study are summarized. Also, the preliminary results from a 100 MW full-scale demonstration, and from a 27 MW equivalent industrial boiler test are reported. The results of the tests showed adipic acid to be very effective in improving SO2 removal efficiency, even when operating at chloride levels as high as 17,000 ppm. A TCA scrubber, which removed 82% of the inlet SO2 without the additive, yielded 89% SO2 removal with 700 ppm adipic acid, 91% removal with 1,000 ppm, and 93% with 2,000 ppm adipic acid. The limestone utilization was concurrently increased from 77% without the additive to 91% with 1,600 ppm adipic acid. The observed effects thus confirmed the theoretical expectations in all respects. In addition, the tests showed no serious interference by adipic acid on the performance of the oxidizer, operation at pH 6.1. The quality of the oxidized sludge was similar to that obtained when operating without adipic acid, although small differences were detected. (Halterman - PTT)
W86-03901

NEW AQUEOUS WASTE TREATMENT FACILITY AT ROCKY FLATS,
Atomics International Div., Golden, CO. Rocky Flats Plant.
K. G. Peter.
Report RFP--3259, 1982. 9 p, 1 ref.

Descriptors: *Wastewater treatment, *Radioactive wastes, *Water conservation, Water reuse, Cooling water, Evaporation, Clarification, Chemical precipitation, Boiler water, Sludge disposal, Flocculation, Rocky Flats.

The new waste treatment facility at Rocky Flats, Building 374, removes radioactive and chemical contaminants from aqueous process effluents collected from operations throughout the plant. Solids are separated from liquids in a three-stage precipitation process, each of which consists of a reactor, a flocculator, and a clarifier. Acidic wastes are made basic and filtered before being introduced into the first stage feed tank along with the basic wastes. Less hazardous wastes are introduced into the second or third stage. Sludge from the clarifiers is stored in a filter fed tank and fed into a rotary-drum vacuum filter. The filtrate is recycled to the first stage feed tank. The sludge is dried, cooled, and packaged for shipment offsite. The supernatant fluid from the three-stage precipitation process is filtered and fed into holding tanks, then into a multiple-effect evaporator. The water recovered from the evaporator is used as boiler feed water or cooling tower water. The concentrate is sent to a spray dryer and filter. The total average solids output is 400 kg/hr from an average feed rate of 14,900 liters/hr. Average dried sludge production is 80 kg/hr; average evaporator salt production is 320 kg/hr. (Casear - PTT)
W86-03904

FINE PORE (FINE BUBBLE) AERATION SYSTEMS,
American Society of Civil Engineers, New York. Committee on Oxygen Transfer.
Summary Report EPA/625/8-85/010, October 1985. 50 p, 19 fig, 11 tab, 82 ref.

Descriptors: *Aerators, *Wastewater, *Waste, Wastewater treatment, Waste management, Waste treatment, Industrial wastewater, Municipal wastewater, Aeration.

Fine pore aeration is one of the most widespread methods used to treat wastewater. A description of currently used devices includes types of materials, types of fine pore diffusers, diffuser layout and characteristics of fine pore media. A summary of performance characteristics is presented for both clean water and process water performance. Operation and maintenance considerations include the impact of system design, installation, and fouling phenomena. A discussion of retrofit considerations includes design factors and economic analyses. (Halterman - PTT)
W86-03914

COMPOSTING OF MUNICIPAL WASTEWATER SLUDGES,
Eastern Research Group, Inc., Arlington, MA.
J. Connery.
Seminar Publication EPA 625/4-85-014, August 1985. 68 p, 82 fig, 23 tab, 21 ref.

Descriptors: *Sludge disposal, *Composting, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Land application, Municipal wastewater.

General principles for the design of municipal wastewater sludge composting facilities are presented. Specific subjects covered include public relations aspects, aesthetic and environmental considerations, marketing and distribution, economic aspects, facility design considerations, site specifications, public health considerations, and process monitoring. Case histories, covering a variety of types and locations of composting facilities, are presented. Static pile composting operations, windrow facilities, and in-vessel composting are detailed in these case studies. Finally, federal and state regulations, pertaining to composting of municipal wastewater sludges, are reviewed. (Halterman - PTT)
W86-03917

MICROBIAL REMOVAL OF TRACE ORGANICS DURING RAPID INFILTRATION RECHARGES OF GROUND WATER,
Rice Center, Houston, TX.
S. R. Hutchins, and C. H. Ward.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 18-21, 2 fig, 3 tab, 25 ref.

Descriptors: *Organic compounds, *Trace levels, *Recharge, *Fate of pollutants, *Biodegradation, Rapid infiltration recharge, Groundwater, Soil, Induced infiltration, Water reuse, Artifical recharge.

Soil column tests and field experiments were designed to evaluate microbial removal of trace organics during rapid infiltration recharge of ground water. Column tests using acclimated soil from an operational system demonstrated good removal of trace organics. Increased concentrations of target compounds in the feed did not always results in corresponding increases in the column effluent. Microbial adaptation was evident for some compounds. Other compounds appeared to exhibit a minimum concentration below which biodegradation did not proceed. Microbial activity was confirmed as a fate mechanism for several target compounds using radiolabels. In direct correlation with field results, the induction of anaerobiosis in the soil columns resulted in increased fractional breakthrough of trace organics. (Author's abstract)
W86-04046

DENITRIFICATION DURING WASTEWATER RENOVATION GROUNDWATER RECHARGE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. C. Lance.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 22-24, 2 fig, 11 ref.

Descriptors: *Denitrification, *Groundwater recharge, *Wastewater renovation, Groundwater, Recharge, Experiments, Laboratory testing, Nitrates, Artificial recharge, Water reuse.

Ground water recharge is an effective way to renovate sewage water but recharge systems must be carefully designed and managed to avoid ground water contamination and to produce reclaimed water suitable for reuse. Nitrate can be removed from wastewater by alternating wetting and drying cycles in flooding basins to promote nitrification during the dry periods and denitrification during subsequent flooding periods. The proportion of nitrogen removed by denitrification depends upon the carbon content of the sewage water and the infiltration rate of the recharge basins. Ground water recharge is an effective way to renovate sewage water but recharge systems must be carefully designed and managed to avoid ground water contamination and to produce reclaimed water suitable for reuse. Field studies where groundwater recharge basins were intermittently flooded with secondary sewage effluent showed that systems with high infiltration rates (30 to 60 cm/day) removed most of the fecal microorganisms, organic material, and phosphates. Initial laboratory experiments showed that the NH4-N was adsorbed by the soil exchange complex during one flooding period and held until the dry period when oxygen entered the soil and nitrification occurred. The nitrate formed during the dry period was leached from the soil during the next flooding period, and the incoming sewage water provided organic carbon for some denitrification, while the NH4-N of the sewage water was adsorbed at the same time. The difficulty with this approach has been that nitrate which formed during the dry period is leached through the soil in a concentrated peak, and the concentration of organic carbon in the sewage water is too low for complete denitrification. Thirty percent of the nitrogen was removed when the loamy sand columns were flooded with secondary sewage effluent at infiltration rates of 30 to 40 cm/day, which agrees well with estimates of nitrogen removed by field recharge basins at comparable loading rates. (Lantz - PTT)
W86-04047

MICROBIAL ECOLOGY OF A HAZARDOUS WASTE DISPOSAL SITE: ENHANCEMENT OF BIODEGRADATION,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.

M. D. Lee, and C. H. Ward.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 25-27, 5 fig, 1 tab, 8 ref.

Descriptors: *Biodegradation, *Groundwater, *Waste disposal, Microbial activity, Aromatic compounds, Oxygen, Nutrients.

Pollution of ground water by organic compounds is a serious threat to the nation's water supply. Biodegradation of organic contaminants by the indigenous microbial population is one of the most effective methods for removing these contaminants. However, microbial activity in aquifers may be limited by the levels of dissolved oxygen, nutrients, or the numbers of microorganisms capable of degrading the contaminants. The effects of nutrient and oxygen addition on biodegradation were tested on ground water collected aseptically from a well at an abandoned wood-creosoting operation in Conroe, Texas. The ground water from this well is contaminated with 10-500 micrograms/liter levels of several polynuclear aromatic compounds including naphthalene, dibenzofuran, fluorene, 2-methyl naphthalene, and phenanthrene. To one sample, nutrients (nitrogen, phosphorus, potassium, carbonate, magnesium, calcium, manganese, sulfate, and iron) and dissolved oxygen were added. To another sample, dissolved oxygen alone was added to distinguish the effects of nutrient addition. One sample was incubated under nitrogen to simulate the oxygen limited conditions found in the aquifer. A sterile control was prepared by filter sterilization and the addition of 1% sodium azide. Results from the experiment indicate that the compounds were degraded most rapidly in the sample with nutrients and dissolved oxygen, but that the overall removal was as high in the sample supplied with dissolved oxygen. There was little or no removal in the control and no microbial growth. Microbial numbers increased most rapidly in the sample with added nutrients with a concurrent drop in the concentration of the contaminants. (Author's abstract)
W86-04048

BIODEGRADATION OF HALOAROMATIC SUBSTRATES IN A SHALLOW ANOXIC GROUND WATER AQUIFER,

Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
J. M. Suflita, and S. A. Gibson.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 30-32, 3 fig, 2 tab, 17 ref. Contract No. CR811146-01-0.

Descriptors: *Biodegradation, *Groundwater reservoirs, *Groundwater pollution, *Water pollution treatment, *Haloaromatic substrates, Groundwater, Aquifers, Water pollution, Degradation, Path of pollutants, Fate of pollutants.

Anaerobic ground water aquifers receive a variety of xenobiotic contaminants, but the eventual fate of these chemicals is uncertain. We investigated whether several halogenated benzoates, phenols and phenoxy-acetic acid herbicides could be degraded in microcosms innoculated with anoxic aquifer material sampled from two sites near the municipal landfill in Norman, Oklahoma. One site was actively methanogenic, whereas carbon flow in the other site was apparently dominated by sulfate-reducing processes. After two months, benzoate and phenol were completely metabolized in samples from both sites, but phenoxyacetate persisted in sulfate-reducing microcosms. The methanogenic aquifer samples showed more than 80% conversion of 9 of 10 halobenzoates, 5 of 7 chlorophenols, and 2 of 2 phenoxyacetic acid herbicides. The sulfate-reducing aquifer samples showed no ability to transform the halogenated substrates during the initial period. High pressure liquid chromatography and mass spectral evidence indicated that the primary degradation pathway for these chemicals involved the loss of an aryl halide and its substitution by a hydrogen atom. Complete dehalogenation was required before the substrates could be completely mineralized. These results indicate that the microflora of anoxic aquifers have the potential to reductively metabolize xenobiotic chemicals under the proper environmental conditions. (Author's abstract)
W86-04050

MODELLING OF NITROGEN REMOVAL IN THE VADOSE ZONE,

Murdoch Univ. (Western Australia). School of Environmental and Life Science.
For primary bibliographic entry see Field 5B.
W86-04070

USE OF AN UPFLOW FIXED BED REACTOR FOR TREATMENT OF A PRIMARY SETTLED DOMESTIC SEWAGE,

Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
D. Amar, J. Partos, C. Grasset, G. M. Faup, and J. M. Audic.
Water Research WATRAG, Vol. 20, No. 1, p 9-14, January 1986. 10 fig, 6 tab, 13 ref.

Descriptors: *Domestic wastes, *Aerobic treatment, *Fixed bed reactor, Wastewater treatment, Wastewater facilities, Design operations.

The study presents and demonstrates results obtained from an half full scale upflow fixed bed reactor (UFBR) treating a primary settled domestic sewage. This study used expanded clay with an effective size of 2.7 mm containing hematite and magnetite as a granular medium. The content of TSS in the effluent treated was always between 10 and 20 mg/l for bed depths ranging from 2 to 3 m and filtration rates of 3-6 cu m/m/hr. The profiles taken all along the reactor show that the activity of the biomass is constant over the whole height of the reactor. Moreover, an air/water volume ratio of 22:1 is amply sufficient to satisfy the oxygen demand of the biomass. The average removal efficiency based on the soluble COD remains virtually unchanged as a function of the filtration rate at about 70% of the influent. For a final BOD sub 5 of 30 mmg/l, loadings of 4.5-8 kg BOD sub 5/cum can be applied. This corresponds to filtration rates of 3-6 cu m/m/hr. The removal efficiencies for BOD sub 5 are then about 80%. After optimization of the backwashing conditions, the consumption of backwash water is about 5% of the volume of filtered water. Sludge measurements carried out during our experiments indicate an excess sludge production of 1 kg/kg BOD sub 5 eliminated. The nature of these sludges is very similar to the biological sludges produced in the high rate activated sludge process. This study has made it possible to establish design parameters of an UFBR and to develop technology for applications. These results are applied to two wastewater treatment plants which began to operate in 1984; these plants serve population equivalents of 40,000 and 11,000. (Author's abstract)
W86-04102

DEVELOPMENT OF A METHOD FOR THE RECOVERY OF ENTEROVIRUSES FROM AEROBICALLY DIGESTED WASTEWATER SLUDGES,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. R. Scheuerman, S. R. Farrah, and G. Bitton.
Water Research WATRAG, Vol. 20, No. 1, p 15-19, January 1986. 4 tab, 23 ref.

Descriptors: *Enteroviruses, *Aerobic digestion, *Sludge digestion, Wastewater treatment, TCA-lysine procedure, Elution, Sodium trichloroacetate, Poliovirus, Cost Analysis, Enterovirus recovery, Virus concentration.

A method was developed for virus recovery from aerobically digested sludge. This method, hereafter named the TCA-lysine procedure, consists of eluting virus from sludge with sodium trichloroacetate + lysine at pH 9.0. The eluates are further processed by two successive concentration steps. Comparison of this procedure was made to other methods. This procedure recovered 82% of added poliovirus from aerobic sludges. The range for the other procedures tested ranged from 1.1 to 66% recovery. Recovery of indigenous enteroviruses was found to be equal to or greater than other methods tested for both aerobically and anaerobically digested sludges. The TCA - lysine procedure is potentially more sensitive and cost effective than other methods tested due to the smaller concentration volume. In addition bacterial contamination of cell cultures used for viral assays was not as severe as with other procedures tested. (Author's abstract)
W86-04103

BATCH METAL REMOVAL BY PEAT - KINETICS AND THERMODYNAMICS,

Agence Financiere de Bassin Seine-Normandie, Paris (France).
T. Gosset, J.-L. Trancart, and D. R. Thevenot.
Water Research WATRAG, Vol. 20, No. 1, p 21-16, January 1986. 7 fig, 2 tab, 24 ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Heavy metals, *Peat, Ion exchange, Cadmium, Copper, Nickel, Zinc, Kinetics, Thermodynamics.

Peat moss, a natural inexpensive material, is able to play an important role in treatment processes of metal-bearing industrial effluents since it adsorbs, complexes or exchanges various metal cations. This paper presents kinetics and thermodynamics of batch metal removal reactions by 50 g/l (dry wt) eutrophic or oligotrophic peat particles using Cu(+), Cd(-), Zn(+) and Ni(+) concentrations ranging from 0.01 to 100 mM. Metal cation removal reactions are moderately rapid in 10 millimole metal unbuffered solutions: the forward kinetic constant ranges between 00.005 and 0.17/M/s, and equilibrium is reached within about 1 hr. Under these conditions of pH (2.2-4.2) and concentrations, apparent binding equilibrium constants were found to range between 2 and 3150/M depending upon the peat origin and the metal cation. In 0-6.5 pH-buffered metal cation solutions, the four cations binding reactions behaved differently demonstrating that metal binding equilibrium constant decrease in the order Ni2+ > Cu2+ > Cd2+ > = Zn2+. When pH is higher than 6.7, more than 90% of a 10 mM metal cation solution is removed by 50 gl-1 peat particles and metal binding capacities equal 200 mmol kg-1 dry wt, whatever the metal nature and the peat origin. Except for nickel cation which is very strongly bound to peat, all metal cations are completely released when pH is fixed below 1.5. (Author's abstract)
W86-04104

BEHAVIOR OF CHLOROPHENOXY HERBICIDES DURING THE ACTIVATED SLUDGE TREATMENT OF MUNICIPAL WASTE WATER,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
N. P. Hill, A. E. McIntyre, R. Perry, and J. N. Lester.
Water Research WATRAG, Vol. 20, No. 1, p 45-52 January 1986. 4 figs, 3 tabs, 33 refs.

Descriptors: *Herbicides, *Activated sludge process, *Municipal wastewater, *Biodegradation, Chlorophenoxy herbicides, Adsorption, Sludge, Pilot plants, Organic compounds, Legislation.

The potential of the activated sludge treatment process for the removal of chlorophenoxy herbicides (CPH) from domestic waste water has been investigated. A series of laboratory jar tests and pilot plant experiments were performed using real settled sewage fortified with 10 microns/l of each of six CPH. The experiments were designed with the objective of assigning any CPH removal which might occur to a particular removal mechanism. In particular, the effect of varying the sludge age between each pilot plant experiment was studied, in view of the importance of sludge age in determining the biodegradative potential of activated sludge. Generally, activated sludge treatment proved ineffective in removing CPH contaminants from settled sewage. Statistical treatment of the data suggested that neither adsorption nor catabolic biodegradation were responsible for those signif-

least CPH removals that did occur. Indeed, there was no evidence of acclimatization of the mixed liquor to the presence of CPH contaminants. Furthermore, there was no obvious effect of sludge age on the efficiency of CPH removal from settled sewage. However, the extent and pattern of substitution of CPH appeared to be important in determining the efficiency of CPH removal, which implies that a biological mechanism was involved. The likelihood that co-metabolism was responsible for CPH removal has been considered. The possible implications of poor CPH removal by activated sludge treatment have been discussed, with reference to the relevant EEC legislation. (Author's abstract)
W86-04107

MERCURY REMOVAL FROM PETROCHEMICAL WASTES,

Universita degli Studi 'La Sapienza', Rome (Italy). Dept. of Chemistry.
L. Campanella, E. Cardarelli, T. Ferri, and B. M. Petronio.
Water Research WATRAG, Vol. 20, No. 1, p 63-65, January 1986. 1 fig, 3 tab, 14 ref.

Descriptors: * Wastewater treatment, *Mercury, *Petrochemical wastes, Oil wastes, Industrial wastes, Flocculation, Sedimentation, Starch xanthate.

The precipitation of mercury as mercury-starch-xanthate is studied. The process is studied in terms of optimum mercury-xanthate molar ratio, of influence of flocculation sedimentation times, and of interferences (aluminum, iron, silica, chloride, organic substances and suspended solids). The studied reaction is advantageously applied to mercury removal from petrochemical wastes. The use of starch xanthate gives very interesting results both for the high mercury removal (>99%) obtained, and for the very low cost of this natural compound. Because the formation rate of mercury-starch xanthate product is higher than the degradation one, it seems that starch-xanthate is stabilized by mercury. The optimized process is applied both to a simulated and to a real wastewater, coming from a petrochemical industry. (Lantz-PTT)
W86-04109

DEGRADATION OF MCPA BY OZONE AND LIGHT,

California Univ., Davis. Dept. of Environmental Toxicology.
J. L. Benoit-Guyod, D. G. Crosby, and J. B. Bowers.
Water Research WATRAG, Vol. 20, No. 1, p 67-72, January 1986. 3 fig, 3 tab, 36 refs.

Descriptors: *Degradation, *Ozonation, *Light, Ultraviolet Radiation, 4-chloro-2-methyl-phenoxyacetic acid, Degradation products, Ozone, Herbicides, Aromatic compounds, Hydrocarbons.

The degradation of dilute aqueous solutions of the herbicides, MCPA (4-chloro-2-methyl-phenoxyacetic acid), by ozone has been examined in the presence and absence of very low energy ultraviolet light (>300nanometers) to identify early benzenoid intermediates. In the dark, ozonolyses proceeded rapidly, and a series of benzenoid intermediates could be isolated, including 4-chloro-2-methyl-phenol, its formate ester, 5-chlorosalicylaldehyde and 5-chlorosalicyclic acid. Isolation of 5-chloro-3-methylbenzene-1,2-diol from dark ozonolysis suggests the operation of two distinct ozonolysis pathways: ring-hydroxylation and cleavage by molecular ozone in the dark, and side-chain oxidation by hydroxyl radicals under irradiation. (Author's abstract)
W86-04110

EFFECT OF OPERATION CONDITIONS ON BIOLOGICAL FE(2+) OXIDATION WITH ROTATING BIOLOGICAL CONTACTORS,

Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-04111

CONCENTRATION OF ROTAVIRUS BY ULTRAFILTRATION,

Queen Elizabeth II Medical Center, Nedlands (Australia). Combined Clinical Microbiology Service.
For primary bibliographic entry see Field 5G.
W86-04112

ANAEROBIC PURIFICATION OF WASTE WATER FROM A POTATO-STARCH PRODUCING FACTORY,

Groningen Rijksuniversiteit (Netherlands). Dept. of Microbiology.
H. J. Nanninga, and J. C. Gottschal.
Water Research WATRAG, Vol. 20, No. 1, p 97-103, January 1986. 1 fig, 5 tab, 53 ref.

Descriptors: *Anaerobic digestion, *Food-processing Wastes, *Industrial wastewater, *Potato starch factory, DeKrim, Netherlands, Sedimentation basins, UASB methane reactor, Sludge, Upflow reactor, Fermentation, Sulfate reduction.

The waste water of the potato-starch factory of the AVEBE in DeKrim (The Netherlands) passed through, during the anaerobic purification, a sedimentation pond, a first upflow reactor (in which there was practically no sludge retention) and a UASB methane reactor. The fermentation of free-amino acids and smaller peptides occurred in the sedimentation pond and first reactor. Proteins and longer peptides were degraded in the first reactor and in the methane reactor. The decrease in COD and TOC content of the waste water between influent sedimentation pond and effluent methane reactor was 83 and 71%, respectively. In the effluent of the first reactor, 60% of the inorganic sulfur was present as sulfide. (Author's abstract)
W86-04115

BATCH COAGULATION OF A LAGOON FOR FECAL COLIFORM REDUCTIONS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
G. R. Finch, and D. W. Smith.
Water Research WATRAG, Vol. 20, No. 1, p 105-112, January 1986. 3 fig, 9 tab, 28 ref.

Descriptors: *Batch treatment, *Coagulation, *Wastewater lagoons, *Coliforms, Aluminum sulfate, Hydrogen ion concentration, Alum, Wastewater treatment, Phosphorus, Suspended solids, Biochemical oxygen demand.

Research on the factors affecting fecal coliform removal from lagoon wastewater by batch treatment with aluminum sulphate was based on factorial designs and jar tests to determine the statistically significant factors controlling the removal of fecal coliform bacteria. Temperature, chemical dose, pH, rapid mixing and flocculation were examined at two different laboratory scales. The results indicated that alum dose and pH were the only significant parameters. A design chart was developed for the wastewater tested enabling dose determination for a desired fecal coliform reduction. This chart was used to select the dose for a full scale field trial to reduce fecal coliforms to <10/100 ml. The design dose was 300 ml/l Al2(SO4)3 18H2O and a final pH of 6.4 was predicted. The field trial used liquid alum (Al2(SO4)3 14.2 H2O) delivered by tanker truck and distributed by motor boat. The treatment reduced fecal coliforms by 99.9%, total phosphorus by 97%, total suspended solids (TSS) by 90% and 5-day carbonaceous biochemical oxygen demand (CBOD5) by 35%. (Author's abstract)
W86-04116

ANAEROBIC TREATMENT OF PHENOLIC COAL CONVERSION WASTEWATER IN SEMICONTINUOUS CULTURES,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Fedorak, and S. E. Hrudey.
Water Research WATRAG, Vol. 20, No. 1, p 113-122, January 1986. 8 fig, 8 tab, 25 ref.

Descriptors: *Anaerobic digestion, *Phenols, *Coal conversion, *Wastewater treatment, *Cultures, Industrial wastewater, Methane, Coal gasification, p-cresol, m-cresol.

High strength wastewater (7600 mg/l phenolics) from the H-coal liquefaction process was diluted and fed to anaerobic, methane-producing cultures. Total phenolic concentrations of 150 and 300 mg/l were added to 50 ml semicontinuous cultures with hydraulic retention times of 12.5, 16.7 and 25 days. The rates of methane production and effluent concentrations of three fermentable phenolics (phenols, p-cresol and m-cresol) were monitored over 188-day period. After acclimation to the wastewater, stable periods followed during which each of the six cultures removed essentially all of these fermentable phenolics. The duration of the stable periods decreased with increasing phenolic mass loading rates. m-Cresol was the first phenolic to appear in the effluent and its presence served as the first indicator of reduced phenolic removal capability. The effluent m-cresol concentrations from cultures receiving 300 mg/l total phenolics followed simple washout curves suggesting that its degradation stopped abruptly. Later, p-cresol and ultimately phenol appeared in the effluents from the cultures which received the highest phenolic mass loadings. (Author's abstract)
W86-04117

GRAPHICAL REPRESENTATION OF A NEW LINEAR FORM OF THE LANGMUIR ADSORPTION ISOTHERM (REPRESENTATION GRAPHIQUE D'UNE NOUVELLE FORME LINEARISEE DE L'EQUATION DE l'ISOTHERME DE LANGMUIR),

Limoges Univ. (France). Lab. de Genie Chimique, Traitement des Eaux.
P. Lafrance, M. Mazet, D. Villessot, and J.-C. Thomas.
Water Research WATRAG, Vol. 20, No. 1, p 123-129, January 1986. 3 fig, 5 ref.

Descriptors: *Mathematical equations, *Graphical analysis, *Langmuir isotherm, *Isotherms, Adsorption, Drinking water, Industrial wastewater, Water pollution treatment, Langmuir equation, Graphical methods.

A graphical representation of a new linear form of the Langmuir equation, for single-solute adsorption, is presented. Since there is a mathematical similarity between the Langmuir equation and the Michaelis-Menten equation used to describe enzyme kinetics, it is proposed that a recent description of a particular method of plotting enzyme kinetic results may be extended to adsorption equilibrium studies. For a single-solute adsorption equilibrium, the Langmuir equation can be rearranged to show the dependance of gamma(omega) on K(-1), giving the relation: gamma(omega) = gamma + gamma/c(K(-1)). Previous experimental results concerning the static adsorption, on powdered activated carbon, of micromolar quantities of 2-naphtol alone and in presence of increasing concentration of sodium dodecyl sulphate (SDS), are presented by the method of 'direct linear plots'. It can be seen from this representation that: (1) In a real experiment computing many values of gamma, the point of intersection of corresponding straight lines gives, a satisfactory evaluation of the absolute value of gamma(omega) and absolute value of K(-1), in comparison with results obtained from the classical Langmuir isotherm; (2) for a particular adsorption isotherm, the scattering of the intersection point provides a clear representation of experimental errors and/or the validity of the linear form of the Langmuir equation to describe experimental data; (3) a qualitative and quantitative picture of the variation of equilibrium parameters for 2-naphtol in the presence of an increasing concentration of SDS, shows the effect of a multi-component system on the adsorptive capacity and affinity of the carbon for a particular solute; and (4) if the linearity of the classical Langmuir isotherm is assumed, direct linear plots can focus attention directly on values of equilibrium parameters as a function of system characteristics. (Lantz-PTT)
W86-04118

ACTIVATED SLUDGE RESPIROMETRIC MEASUREMENTS,

United Nations Development Programme.
J. Suschka, and E. Ferreira.
Water Research WATRAG, Vol. 20, No. 2, p 137-144, February 1986. 11 fig, 2 tab, 10 ref.

Descriptors: *Activated sludge, *Respirometry, *Biological oxygen demand, *Oxygen probe, Oxygen demand, Oxygen uptake, Respiration, Kinetics, Substrate removal.

Respirometric measurements of activated sludge were shown to be a valuable source of information with respect to the kinetics of substrate biooxidation. Two new techniques were elaborated which used an oxygen probe to enable determination of different rates of oxygen consumption. It would appear possible to determine the biochemical oxygen demand of a given substrate based on short period oxygen consumption measurements. The two techniques applied have shown consistency, both in evaluation of oxygen consumption rates as an operational parameter at an activated sludge treatment plant and in determination of substrate biochemical oxygen demand rate. The respirometric measurement, as shown can also be used to evaluate the biomass yield coefficient. (Author's abstract)
W86-04120

NITROGEN REMOVAL IN A SEMI-CONTINUOUS PROCESS,

Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman.
Water Research WATRAG, Vol. 20, No. 2, p 173-183, February 1986. 7 fig, 2 tab, 9 ref, append.

Descriptors: *Denitrification, *Wastewater treatment, *Semi-continuous process, *Activated sludge, Nitrification, Retention Time.

Laboratory tests using synthetic feed were conducted to evaluate the nitrogen removal capabilities of the continuously fed intermittently decanted (CFID) process. Experimental results were in general agreement with theoretically predicted values. Ammonia removal is governed by the extent of nitrification during aeration, and the level of leakage during settling and decantation. The former is controlled by the aerobic SRT, with the critical value being approximately 5 days at 13-18 C. Ammonia leakage is controlled by hydraulic parameters. For a given nominal hydraulic residence time, short cycle, short settling and short decantation times are conducive to low leakage. Total removal of nitrogen can be obtained if a well nitrifying system is allowed to denitrify. Denitrification is affected primarily by the anoxic fraction of the cycle. The specific denitrification rate ranged from 0.014 to 0.037 g N S/S day, which is comparable to reported values for internal or endogenous denitrification in conventional systems. (Author's abstract)
W86-04124

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - I: OZONE CONSUMPTION AND OZONATION PRODUCTS,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, S. Guyon, H. Sugimitsu, and M. Dore.
Water Research WATRAG, Vol. 20, No. 2, p 197-208, February 1986. 11 fig, 6 tab, 20 ref.

Descriptors: *Ozonation, *Naphthalene, *Ozone, Surface water, Aromatic compounds, High performance liquid chromatography, Gas chromatography, Mass spectroscopy, Chemical analysis.

Ozonation of a polyaromatic compound, naphthalene, was studied in a dilute aqueous medium, in order to determine the consumption of ozone and to quantify by High Performance Liquid Chromatography (HPLC) the ozonation by-products. An identification of by-products by Gas Chromatography/Mass Spectrometry GC/MS techniques was undertaken from a concentrated solution of naphthalene in a H2O/Ch3OH mixture. Ozonation of aqueous solution of naphthalene (0.00025 mol/l, pH = 5.9) was carried out in a continuous semibatch reactor. The HPLC analysis of naphthalene and of ozonation by-products and the determination of ozone consumed showed that, when naphthalene has completely disappeared. The analyzed products represent only 30% of the initially introduced organic carbon. Later separation and identification of ozonation by-products from a more highly concentrated solution of naphthalenead in a mixture H2O/CH3OH (50/50v/v) allowed the identification of: oxalic acid, oxomalonic acid, a cyclic peroxide, phthalic acid and phthalaldehydic acid. Taking into account the consumption of 2 mol of ozone per mol of compound removed, the identified oxidation products and the data found in the literature, three reactional pathways are proposed for the initial attack of ozone on naphthalene: 1) an electrophilic substitution of ozone on carbon 1 (or 2) of the naphthalene, 2) two simultaneous 1,3-dipolar cycloaddition of ozone on 1,2 bond of naphthalene. (See also W86-04127) (Author's abstract)
W86-04126

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - II: KINETIC STUDIES OF THE INITIAL REACTION STEP,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, H. Sugimitsu, S. Guyon, and M. Dore.
Water Research WATRAG, Vol. 20, No. 2, p 209-214, February 1986. 5 fig, 3 tab, 6 ref.

Descriptors: *Ozonation, *Naphthalene, *Kinetics, Activation energy, Chemical analysis, Batch reactors, Aromatic compounds, Hydrogen Ion Concentration.

The kinetic study of naphthalene (N) ozonation in aqueous solution was carried out in order to specify the pathway of the initial ozonation step of this compound. The study was carried out mainly at pH 5.6 at 1 C in a batch reactor. The initial concentrations of reactants were chosen so that the opening of a second aromatic ring of naphthalene would not be significant, and were: 1) (naphthalene)sub 0 = 0.000004-0.000007 mol/l, and (ozone)sub 0 = 0.000006-0.00001 mol//l. All the results obtained at pH 5.6, by analysis of ozone and naphthalene consumed showed that: 1) the stoichiometry of the initial reaction step was 2 mol of ozone by mol of naphthalene, 2) a two-order kinetic law was verified for a large period of time and with different initial concentrations (linear correlation about 0.99), and 3) the average of rate constant values (1 C, pH 5.6) was 550 + or - 80 l/mmol/s. These data exclude, on the one hand, the hypothesis of an electrophilic substitution, which requires a stoichiometry at least equal to three, and on the other the hypothesis of two simultaneous 1,3-dipolar cycloaddition which implies a three-order kinetic reaction. The same experiments carried out at pH 4.3 and 6.8 showed a low increase of k sub N between pH 4.3 and 5.6. However, k sub N increased in fact at pH 6.8. This phenomenon is probably the consequence of the decomposition of ozone in water at neutral pH. The kinetic study made at different temperatures allowed determination of the value of the activation energy (E sub a approximately equal to 8 kcal/mol at pH at 5.6). So, the value of the rate constant at 20 C and pH 5.6 (k sub N approximately equal to 1500 l/mol/s) is practically the same as the previously mentioned values when the reaction is carried out at 20 C with pH 2 in presence of radical scavengers. Finally, the rate constant values of 1-chloro naphthalene and 2-methyl naphhthalene, allowed us to predict that the initial attack of ozone on 1,2 bond of naphthalene is of an electrophilic nature. (See also w86-04126) (Author's abstract)
W86-04127

INVESTIGATIONS INTO THE SCOPE AND LIMITATIONS OF THE BISMUTH ACTIVE SUBSTANCES PROCEDURE (WICKBOLD) FOR THE DETERMINATION OF NONIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES,

Unilever Research Port Sunlight Lab. (England).
For primary bibliographic entry see Field 5A.
W86-04131

PREDICTION OF MULTICOMPONENT ADSORPTION EQUILIBRIA USING IDEAL ADSORBED SOLUTION THEORY,

J. C. Crittenden, P. Luft, D. W. Hand, J. L. Oravitz, and S. W. Loper.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1037-1043, November 1985. 6 fig, 3 tab, 26 ref. NSF Grant Nos. CEE-7924589 and CEE-8300213.

Descriptors: *Adsorption, *Organic compounds, *Mathematical studies, *Activated carbon, Separation techniques, Error analysis, Water treatment, Wastewater treatment, Organic wastes, Organic carbon, Prediction, Chemical reactions, Theoretical analysis, Ideal Adsorbed Solution Theory, Chloroform, Bromoform, Trichlorethene, Tetrachloroethene, Chlorodibromomethane, Freundlich equation.

The capability of ideal adsorbed solution theory (IAST) to predict multicomponent competitive interactions between the following volatile organic chemicals was tested: chloroform, bromoform, trichloroethane, tetrachloroethene, 1,2-dibromoethane, and chlorodibromomethane. A total of seven mixtures that contained various combinations of two, three, and six solutes were tested for three commercially available activated carbons. The predictions were satisfactory for the 256 isotherm data that were collected. An error analysis was performed for various isotherms that are used to represent single solute data in IAST calculations. This analysis demonstrated that the Freundlich equation was sufficiently accurate in representing the data under certain simplifying assumptions, and the use of the Freundlich equation in IAST calculations resulted in a relatively straightforward expression to describe the multicomponent data. The multicomponent data for the mixtures were plotted as total organic halogen and total organic carbon, and, when the mixture data were plotted in this manner, appeared to behave as a pseudo single solute. (Author's abstract)
W86-04136

ROLE OF COAGULATION IN THE KINETICS OF SEDIMENTATION,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
K. J. Farley, and F. M. M. Morel.
Environmental Science and Technology, Vol. 20, No. 2, p 187-195, February 1986. 14 fig, 2 tab, 21 ref, append. NOAA Grant NA79AA-D-00077 and EPA Grant CR-811181-01-01.

Descriptors: *Coagulation, *Kinetics, *Sedimentation, Differential settling, Shear, Brownian motion, Power law relationships.

The combined results of analytical, numerical, and laboratory studies are used in examining the kinetic behavior of sedimentation in well-mixed systems. The rate of mass removal of solids, dC/dt, as a function of mass concentration C, can be described as the sum of three power laws, dc/dt = -B sub dsC(2.3) - B sub shC(1.9) - B sub bC(1.3), each term of which corresponds to a settling, shear, and Brownian motion. Empirical relationships for the coefficients B sub ds, B sub sh, and B sub b as a function of system parameters are provided. Laboratory rate coefficients for seawater experiments compare reasonably well with our rate coefficient relationships for collision efficiencies ranging from 0.2 to 1.0. Additional work on floc porosity and collision efficiencies however is needed. In applying the proposed power law removal equation to field conditions, only the differential settling term and the shear term are expected to be important. Removal rates could therefore be approximated reasonably well by a second-order expression. However, it should be emphasized that (whether by direct calculations from system parameters or by extrapolation from laboratory observations) the proposed power law relationship provides a better estimation of removal rates. Finally, in applying these results, particularly for the case of ocean disposal, questions concerning initial sedimentation behavior, mixing depths, and vertical mass concentration gradients should be addressed. (Lantz-PTT)

W86-04229

SELECTIVE RECOVERY OF GOLD AND OTHER METAL IONS FROM AN ALGAL BIOMASS,

New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 5B.
W86-04231

OCCURRENCE, GROWTH, AND SUPPRESSION OF SALMONELLAE IN COMPOSTED SEWAGE SLUDGE,

Maryland Environmental Service, Annapolis.
For primary bibliographic entry see Field 5B.
W86-04234

OCCURRENCE OF MULTIPLE-ANTIBIOTIC-RESISTANT ENTERIC BACTERIA IN DOMESTIC SEWAGE AND OXIDATION LAGOONS,

North Dakota Univ., Grand Forks. Dept. of Microbiology and Immunology.
M. V. Walter, and J. W. Vennes.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 930-933, October 1985. 2 fig, 3 tab, 19 ref.

Descriptors: *Coliforms, *Sewer Systems, *Oxidation Lagoons, *Grand Forks, North Dakota, Antibiotics, Public Health, Water Quality Standards, Microorganisms, Bacterial Analysis.

The coliform bacterial population in the Grand Forks, N. Dakota sewage system was examined for multiple-antibiotic-resistant organisms over a 1 year period. Multiple-antibiotic-resistant coliforms were common in the sewage, and their numbers remained fairly constant relative to the total coliform population throughout the year. Resistance to kanamycin, tetracycline, and ampicillin was transferable at variable rates. Transfer rates were temperature sensitive and were optimal at 35 C. Although 75% of the multiple-antibiotic-resistant coliforms were capable of transferring resistance at rates >0.001 transconjugants per initial donor, the results indicate that if total coliform levels are kept within prescribed standards, the multiple-antibiotic-resistant coliform levels will be reduced to a level at which they will probably not pose a major health hazard. (Author's abstract)
W86-04235

FERMENTATIVE AND OXIDATIVE TRANSFORMATION OF FERULATE BY A FACULTATIVELY ANAEROBIC BACTERIUM ISOLATED FROM SEWAGE SLUDGE,

Stanford Univ., CA. Dept. of Civil Engineering.
D. Grbic-Galic.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 1052-1057, October 1985. 4 fig, 26 ref. NSF CEE 84-04369.

Descriptors: *Aromatic Compounds, *Sludge, *Anaerobic Bacteria, *Ferulate Biodegradation, Lignin, Enterobacter, Microbiological Studies, Bacterial Analysis.

A facultatively anaerobic, gram-negative, nonsporeforming, motile rod-shaped bacterium was isolated from methanogenic consortia degrading 3-methoxy-4-hydroxycinnamate (ferulate). Consortia were originally enriched from a laboratory anaerobic digester fed sewage sludge. In the absence of exogenous electron acceptors anaerobic conditions (N2-CO2 gas phase). Ferulate (1.55 mM) was demethoxylated and dehydroxylated with subsequent reduction of the side chain, resulting in production of phenylpropionate and phenylacetate. Under aerobic conditions, the substrate was completely degraded, with transient appearance of caffeate as the first aromatic intermediate and beta-ketoadipate as an aliphatic intermediate. The pure culture has been tentatively assigned to the genus Enterobacter with the type strain DG-6. (Author's abstract)
W86-04237

SELECTIVE MEDIUM FOR THE ISOLATION OF OPPORTUNISTIC FLAVOBACTERIA FROM POTABLE WATER,

National Hansen's Disease Center, Carville, LA.
For primary bibliographic entry see Field 5F.
W86-04239

EFFECT OF CALCIUM ION ON SLUDGE CHARACTERISTICS,

Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, S. Kitamura, T. Shirakashi, and M. Kuriyama.
Journal of Fermentation Technology, Vol. 63, No. 3, p 263-270, June 1985. 7 fig, 3 tab, 11 ref.

Descriptors: *Activated sludge, *Calcium, *Metals, *Flocculation, *Wastewater treatment, Aluminum, Iron, Magnesium, Zinc, Manganese, Sludge, Sludge thickening.

Concentrations of the metals in sewage activated sludge were examined over a 1-yr period. The sludge contained relatively large amounts of calcium (14-16 mg/g suspended solids), aluminum (11-28 mg/g SS), and iron (11-30 mg/g SS). The relative contents of the metals in the sludge decreased in the following order: Fe>Al>Ca>Mg>Zn>Mn. The solution of mixed liquor in the aeration tank contained relatively high concentrations of Ca(++) (17-23 mg/l) and low concentrations of Mg(++) (3-6 mg/l). Most of the calcium in sewage activated sludge was easily extracted with weak acid (pH 3) but little iron and aluminum were extracted under the same conditions. Therefore, the acid-treated sludge was used to examine the effect of Ca(++) on sludge characteristics. With increasing amounts of Ca(++) added, 30-min settled sludge volume and the turbidity of the supernatant after 30-min settling decreased. The maximum amount of Ca(++) bound to the acid-treated sludge was nearly equal to the amount of Ca(++) extracted by the acid treatment. These results indicated that Ca(++) binds to sludge surface materials and plays an important role not only in flocculation in sewage activated sludge but also in determining sludge characteristics such as thickness. (Author's abstract)
W86-04247

COMPOSTING REACTION RATE OF SEWAGE SLUDGE IN AN AUTOTHERMAL PACKED BED REACTOR,

Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
For primary bibliographic entry see Field 5E.
W86-04248

CHANNEL FLOW SYSTEM FOR WASTEWATER TREATMENT AND FOOD PRODUCTION,

Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, K. Furukawa, and Y. Ozaki.
Journal of Fermentation Technology, Vol. 63, No. 4, p 343-356, August 1985. 12 fig, 11 tab, 19 ref.

Descriptors: *Aquatic Plants, *Wastewater Treatment, *Fish Harvest, Tilapia, Pah-Bungh, Organic Carbon, Nitrogen Removal, Phosphorus Removal, Biological Wastewater Treatment.

Research was conducted on a channel flow wastewater treatment system which uses a natural hydraulic head and incorporates Tilapia and Pak-Bung for the simultaneous removal of total organic carbon (TOC), total nitrogen (T-N), and total phosphorus (T-P). Treatment of diluted synthetic wastewater at a surface loading rate of 0.16-0.66 g/sq m/day and synthetic night soil resulted in mean TOC, T-N, and T-P removal of >90%, 14-43% and 7-58%, respectively with a retention time of 2.8 days. Under optimum conditions, the crop yield of Pak-Bung was maintained at 1.5 kg/week/3.15 sq m and the harvested Pak-Bung contained abundant vital amino acids and vitamins. The crop yield was strongly influenced by water and atmospheric temperature and light intensity. When these conditions were satisfied artificially in winter, crop yield was maintained at 1.2 kg/week/3.15 sq m. Tilapia showed satisfactory growth in water channels without feeding at temperatures of 23.5 C and higher with net-type contact materials. These results indicate the benefit of channel flow treatment with Pak-Bung and Tilapia for simultaneous advanced wastewater treatment and food production. (Peters-PTT)
W86-04249

RESPONSE OF ACTIVATED SLUDGE PROCESS TO STEPWISE SHORTENING OF BIOLOGICAL SOLIDS RETENTION TIME,

Himeji Inst. of Tech. (Japan). Dept. of Chemical Engineering.
S. Hasegawa, K. Fukui, Y. Maeda, and M. Nakajima.
Journal of Fermentation Technology, Vol. 63, No. 4, p 357-362, August 1985. 7 fig, 2 tab, 14 ref.

Descriptors: *Activated Sludge Process, *Retention Time, *Sludge Volume Index, Microbiological Studies, Bacterial Analysis, Microorganisms, Nitrification, Hydrogen Ion Concentration.

Laboratory experiments were made to examine the effects of stepwise shortening of the biological solids retention time (SRT) on microbial aspects of activated sludge growing on an artificial wastewater containing starch and peptone as carbon and nitrogen sources, respectively. SRT was controlled automatically by intermittent drawing of the mixed liquor, and was suddenly changed from 20 to 15, 10 and 5 days. The value of sludge volume index (SVI) increased with the shortening of the SRT. Microscopic observations revealed that the high SVI was caused by excessive filamentous bacteria of Types 0961 and 1701 in Eikelboom's classification. Type 0961 is characterized by slightly bent, multicellular, unbranched, Neisser-negative and Gram-negative filaments. The cylindrical cells have a uniform diameter of 1.1-1.4 micro m. Type 1701 is a sheath-forming, Neisser-negative and Gram-negative organism with a clearly visible septa and a diameter of 0.7-0.9 micro m. Wastewater with a high C/N ratio favored filamentous growth. When the content of nitrogen source was raised, filamentous growth was suppressed apparently by active nitrification accompanied by a considerable drop of the mixed liquor pH. (Peters-PTT)
W86-04250

SELECTIVE DETECTION AND ENUMERATION OF FECAL COLIFORMS IN WATER BY POTENTIOMETRIC MEASUREMENT OF LIPOIC ACID REDUCTION,

Laboratoire Municipal d'Hygiene, Le Havre (France).
For primary bibliographic entry see Field 5A.
W86-04252

PHYSICAL AND CHEMICAL CORRELATES OF MICROBIAL ACTIVITY AND BIOMASS IN COMPOSTING MUNICIPAL SEWAGE SLUDGE,

Cincinnati Univ., OH. Dept. of Biological Sciences.
V. L. McKinley, and J. R. Vestal.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1395-1403, December 1985. 2 fig, 5 tab, 40 ref. EPA Grant CR-807852-01-0.

Descriptors: *Biomass, *Sludge Disposal, *Municipal Wastes, *Microbial Degradation, *Composting, Chemical Properties, Physical Properties, Temperature, Moisture Content, Hydrogen Ion Concentration, Proteins, Organic Carbon, Nitrogen Compounds, Lipids, Phosphates, Bacterial Analysis.

Various physical and chemical parameters were monitored to evaluate their influence on the microbial communities present in composting municipal sewage sludge. Temperature, moisture content, depth, pH, protein content, total nitrogen, total carbon, lipid phosphate biomass, and the rates of microbial incorporation of substrates into lipids were measured at several times throughout the 17-

to 19-day composting runs. Temperature had the most consistent and dramatic effect on microbial activity and biomass. When temperatures exceeded 55-60 C, microbial activity fell dramatically, usually by more than 1 order of magnitude. Microbial activity was generally greatest in samples taken from the 35-50 C areas of the composting piles. Changes in the composition of the compost over time included increased pH, increased protein content, and decreased total organic content. The changes in these parameters appeared to reflect the microbial activity and biomass present. The results indicate that the rate of composting may best be optimized by controlling the composting temperatures, provided that the other parameters fall within reasonable limits in the starting material. (Author's abstract)
W86-04254

EFFECT OF TEMPERATURE ON COMPOSTING OF SEWAGE SLUDGE,

Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
For primary bibliographic entry see Field 5E.
W86-04259

NUTRIENT REMOVAL POTENTIAL OF SELECTED AQUATIC MACROPHYTES,

Central Florida Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5G.
W86-04262

TRACE ANALYSES OF THIOSULFATE IN CORRODED CONCRETE SEWERS BY DIFFERENTIAL-PULSE-ANODIC-STRIPPING VOLTAMMETRY,

Hamburg Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie.
D. Knittle, P. Valenta, M. Aydin, and W. A. Konig.
Fresenius Z Anal Chem, Vol. 322, No. 6, p 581-582, November 1985. 2 fig, 13 ref.

Descriptors: *Corrosion, *Electrochemistry, *Pipes, *Sulfates, *Thiobacillus, *Pipelines, *Corrosion, Electrodes, Sewers, Trace levels, Sewer systems.

Thiosulfate, a potential substrate for sulfuric acid forming thiobacilli, could be detected and quantitatively determined in corroded concrete sewer systems by differential pulse anodic-stripping voltammetry (DPASV). The principle of this technique is based on the possibility of obtaining an ambiguous electrical signal specific for the presence of thiosulfate ions by reduction, adsorption on a Hg surface and oxidation of these ions. Cathodic polarization of a hanging Hg drop causes enrichment of a reduced sulfur species at the Hg surface which is oxidized at a more positive potential. Samples of dried corroded concrete sewage pipes are extracted with bidistilled H2O and filtered before DPASV determination. Sodium acetate buffer in a polarographic cell serves as basic electrolyte. The method proved to be specific and gave reproducible results for concentrations from 5 ppb to 3 ppm of thiosbiosulfate in aqueous media. (Geiger-PTT)
W86-04284

SECRETS TO THE SUCCESS OF ANAEROBIC DIGESTION,

Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
J. S. Jeris, and I. J. Kugelman.
Water Engineering and Management, Vol. 132, No. 7, p 32-35, July 1985. 3 fig, 2 tab.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Anaerobic conditions, *Process control, Hydrogen ion concentration, Temperature, Biological wastewater treatment, Sludge digestion, Digestion, Stage digestion, Mixing, Fermentation, Training.

With proper operation and maintenance attention, the anaerobic digestion process in wastewater treatment need not be difficult to control. pH and alkalinity must be controlled in a narrow range. This is usually done by buffering. If the waste material does not contain alkaline compounds, or precursors of alkaline compounds, these must be added to maintain the pH in the correct region. Alkalinity is often added to the system by the use of sodium or potassium bicarbonate. Temperature must also be strictly controlled. Mixing, another essential feature in anaerobic digesters, is accomplished by gas recirculation or mechanical methods. The tests that should be periodically performed on raw and digested sludge to provide optimum functioning of the anaerobic digestion system are listed. Gas production and composition measurements are important in detecting upsets to the system. Digester failure incidents can also be drastically reduced by operator training. (Geiger-PTT)
W86-04288

MILE-DEEP REACTOR DESTROYS SLUDGE WITH EASE,

Vertech Treatment Systems, Denver, CO.
For primary bibliographic entry see Field 5E.
W86-04289

COMPUTER ASSIST FOR ACTIVATED SLUDGE PROCESS,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
H. S. Keck, T. M. Keinath, and S. C. Stratton.
Water Engineering and Management, Vol. 132, No. 10, p 30-33, 36, 37, September 1985. 7 fig, 4 ref.

Descriptors: *Wastewater treatment, *Computer programs, *Computers, *Activated sludge process, *Biological wastewater treatment, Suspended solids, Process control, Automation, Systems engineering, Activated sludge.

A computer program was developed using BASIC language and an IBM PC microcomputer system to aid in the control of the activated sludge process of wastewater treatment facilities. The software system developed consists of three major programs and two data files: a master maintenance program, a solids inventory/SRT control program, an optional graphical display program, a master data file, and a previous input parameter data file. Relatively permanent information is entered into the system through the master maintenance program. Such data includes available recycle pumping flow rate, desired solids retention time, system of units, selected recycle control strategy, average influent flow rate, location of wasting point, method of wasting and aeration basin volume. Mathematical analysis of the operating state of a clarifier is performed by the solids inventory control program to establish the loading condition and generate recommendations for any change in recycle and/or wasting flow rates. The system was tried at the Coneross Creek Wastewater Treatment Facility near Seneca, South Carolina, from June through August, 1981. A dramatic reduction in both the mean concentration as well as the variability of effluent total suspended solids was observed after teh inception of the computer-assisted control strategy during May. In addition to this activated sludge/clarifier control program, seven other software programs have been developed at Clemson University to assist in the operation and management of wastewater and potable water treatment facilities. (Geiger-PTT)
W86-04290

MAKING EFFECTIVE USE OF EXISTING COLLECTION CAPACITY,

RJN Environmental Associates, Inc., Wheaton, IL.
R. E. Nelson, and R. J. Jozsi.
Water Engineering and Management, Vol. 132, No. 10, p 38-40, September 1985. 3 fig, 1 tab.

Descriptors: *Sewer systems, *Sewers, *Relief sewers, *Computers, Sewer districts, Sewer hydraulics, Evaluations, Cost analysis, Flow pattern, Project planning.

Determining relief transport capacity requirements is an important consideration in evaluating improvement alternatives for wastewater collection systems. Computer-assisted engineering analysis techniques such as the Sewer System Evaluation (SSEM) can be used to evaluate alternatives such as parallel relief sewers and rerouting relief sewers. Selection of the least-cost sewer routing approach is usually the preferred method. Steps for flow rerouting analysis include identifying overloaded sewers, selecting rerouting alternatives, creating new sewers in SSEM model, performing computer capacity analysis, and analyzing outputs. For sewer lines slightly overloaded during peak flow events, the feasibility of transporting flow existing sewer lines under surcharge conditions must be considered by evaluating sewer elevation, sewer size, surface elevation, and basement elevation. Projects that have realized cost savings as a result of a computerized capacity analysis include the City of Lockport, the Village of Hoffman Estates, and the County Farm Road Area of the Wheaton Sanitary District, all of northeastern Illinois. To optimize a relief sewer plan, the considerations that should be evaluated include flow rerouting, transport of peak flow with surcharge, and parallel or replacement sewers. (Geiger-PTT)
W86-04291

SAGGING SEWERS: A SERIOUS PROBLEM GETTING WORSE,

South Stickney Sanitary District, Burbank, IL.
S. Chatterjee, and F. DeCarlo.
Water Engineering and Management, Vol. 132, No. 10, p 42-44, September 1985. 3 fig, 4 ref.

Descriptors: *Sewers, *Sewer systems, *Pipelines, Pipes, Sewer hydraulics, Clogging.

Sanitary sewer pipelines can sometimes develop sags (or dips) as a result of faulty design, construction or maintenance of the wastewater collection system of which they are a part. The primary causes of sewer sag are: poor bedding/foundation, poor haunching/improper backfill, poor pipe material, loading conditions, embankment strength, dewatering of the trench, railroad crossings, stream crossings, and traffic arteries. A significant sag can cause a serious crack or rupture, and/or collapse of the pipe at the crown as well as along the spring line or side. This may create a trap for solids, floating materials, grease, and other materials, or create instability in the backfill and potential for clogging due to sand-slide. Long term effects of sags range from gradual decay and collapse to frequent blockage, back ups and even blowups at certain locations in the collection system. Measures that would help prevent sagging are thorough foundation investigations during construction, properly conducted compaction and bearing tests for the final bedding at selected locations, possibly every 100 ft, and finally, proper compaction tests for haunching materials in every sewer construction or rehabilitation project. (Geiger-PTT)
W86-04292

DESIGN CONSIDERATIONS FOR CERAMIC FINE BUBBLE GRID DIFFUSER SYSTEMS,

Houck (D.H.) Associates, Inc., Silver Spring, MD.
D. H. Houck.
Water Engineering and Management, Vol. 132, No. 8, p R1-R13, July 1985. 5 fig, 17 ref.

Descriptors: *Aeration, *Aerators, *Wastewater treatment, *Design criteria, Cost analysis, Maintenance, Bubbles, Mixing, Dissolved oxygen.

With rising cost for energy, there has been an increasing interest in North America and Europe in more efficient aeration systems. The design and operation of ceramic fine bubble dome and disk diffuser systems is examined in relation to their use at wastewater treatment facilities. The performance of fine bubble diffusers is measured by oxygen transfer efficiency. Process considerations that influence their performance include plant influent characteristics, treatment plant processes, and loading conditions. Sliming or bio-fouling may occur at plants treating specific wastes. Higher loading rates need not cause decreased efficiency if the loads are accounted for in design. Aeration tank design is important in achieving proper aer-

ation and mixing. The number of diffusers needed to supply the required air flow rate is determined by the air flow rate per diffuser and system flexibility. Correct diffuser distribution within the tank is also important for proper aeration. Proper installation of ceramic grid diffuser systems is necessary to prevent damage to equipment. System performance can be tracked through mass balance measurements of system oxygen demand and measurements of air flow and power consumption. Aeration power consumption may be reduced 40 to 50% when converting from coarse bubble equipment to a ceramic grid diffuser system, and maintenance costs are only increased moderately if sound preventive maintenance is practiced. (Geiger-PTT)
W86-04293

SLUDGE MANAGEMENT METHOD GETS UPDATED,

Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5E.
W86-04298

PILOT STUDIES INDICATE COMPOSTING CHOICES,

Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5E.
W86-04299

SMALL PLANT CAPTURES GAS ECONOMICALLY,

Lakeville Sewage Treatment Plant, NY.
G. Herington.
Water Engineering and Management, Vol. 132, No. 13, p 32-34, December 1985. 2 tab.

Descriptors: *Methane, *Cost analysis, *Recycling, *Wastewater treatment, Wastewater facilities, Storage tanks, Anaerobic digestion.

Although many small municipal wastewater treatment plants have methane gas available from anaerobic digestion, few can use it effectively due to the high price of gas storage systems. The Lakeville, New York treatment plant typified this situation until it acquired a used gas storage tank and installed a gas collection system for under $40,000. The system features a water-ring compressor that draws methane from the existing accumulator when pressure in the accumulator reaches 6 in. in the water column, and shuts it off when it drops to 3 in. The shrouded rotor swirls a ring of water in an oval chamber, and water alternately fills and empties the spaces between the rotor blades with the effect of pistons. The water removes such pollutants as hydrogen sulfide and absorbs the heat of compression. The system will pay for itself in 4.5 yr of operation and contribute to savings in oil usage. (Geiger-PTT)
W86-04300

CHEMICAL BID PACKAGE CUTS COSTS, IMPROVES CONTROL,

Manatee County Water Treatment Plant, Bradenton, FL.
J. J. Chase.
Water Engineering and Management, Vol. 133, No. 1, p 25, 28-30, January 1986. 1 fig, 2 tab.

Descriptors: *Wastewater treatment, *Water treatment, *Coagulants, *Cost analysis, *Disinfectants, Chemical treatment, Lime, Sulfates, Costs, Activated carbon, Odor control, Color, Ammonia, Chlorine.

A methodology for the chemical bid process has been developed and is currently used by the Manatee County Public Utilities System water treatment section in southwestern Florida. The utility solicits yearly bids from a selected list of some 55 vendors who have made on-site investigations of plant needs and can demonstrate the ability to satisfy the plant's accounts. The water treatment section of the bid package places all chemicals into six major groups: coagulants, coagulant aids, pH control chemicals, taste and odor control chemicals, corrosion inhibitors and disinfectants. Three coagulants - aluminum sulfate, ferric sulfate and ferric chloride - have proven effective at the Manatee plant. Vendors are required to submit bids on a price-per-pound (Al3+) or Fe(3+) basis. Bid ratios are then applied to the quoted price to establish cost effectiveness. Each product has a comprehensive written specifications which contains product quality minimums, shipping restrictions, minimum concentrations and other chemical requirements. A screening process is used to limit the number of coagulant aids that may be bid on. pH control chemicals such as lime are assessed a 2% monetary penalty for each 1% that the product falls below the 92% available CaO standards. For taste and odor control, research is underway which will allow for the establishment of bid ratios based on geosmin and 2-methylisoborneol adsorption rates for all activated carbons to be bid upon. Bid practices for corrosion inhibitors and disinfectants are discussed. (Geiger-PTT)
W86-04301

EVALUATION OF CONVENTIONAL TREATMENT PROCESSES FOR REMOVAL OF MUTAGENIC ACTIVITY FROM MUNICIPAL WASTEWATERS,

Health Effects Research Lab., Cincinnati, OH.
J. R. Meier, and D. F. Bishop.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 999-1005, October,1985. 7 fig, 3 tab, 14 ref. 63-08-2977.

Descriptors: *Wastewater treatment, *Toxicity, *Municipal wastewater, *Chlorination, Organic compounds, Primary wastewater treatment, Wastewater analysis, Bioassays, Effluents, Salmonella, Raw wastewater, Water pollution effects.

The ability of conventional wastewater processes to remove mutagenicity from municipal wastewaters was studied at the Mill Creek and Muddy Creek Treatment Plants in Cincinnati, Ohio, and at the EPA Test and Evaluation Facility adjacent to Mill Creek Plant. Composite samples of raw wastewater, primary and secondarily treated wastewater from the facilities were tested for mutagenicity using the Ames test. Cytotoxicity of wastewater extracts to bacteria used in the Ames test decreased markedly following secondary treatment. Chlorination of the secondary effluent had little influence on either the level of extractable organics or on the specific mutagenicity for strains TA98, but it did seem to significantly increase the TA 100 mutagenicity levels. Additional bacterial strains were included in the testing for one of the secondary effluent extracts to examine strain specifically for mutation induction. The influence of S9 on mutagenicity levels of the extracts varied greatly between samples. Comparisons of total mutagenic activities associated with the different treatments showed that the overall removal of mutagenic activity during treatment varied among test series from no removal to a reduction of as much as two-thirds of the activity. The only detectable mutagenic activity in the primary effluent was found in the acid/neutral fraction. For the secondary effluent, the highest specific mutagenic activity was associated with the base fraction. (Geiger-PTT)
W86-04330

FACTORS CONTROLLING SENSITIVITY IN ULTRAVIOLET DISINFECTION OF SECONDARY EFFLUENTS,

Georgia Univ., Athens. Inst. of Ecology.
R. G. Qualls, S. F. Ossoff, J. C. H. Chang, M. H. Dorfman, and G. M. Dumais.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1006-1011, October 1985. 3 fig, 4 tab, 21 ref. EPA Grant R809593010, NSF Grant CEE82-05274.

Descriptors: *Disinfection, *Ultraviolet radiation, *Biological wastewater treatment, *Effluents, *Particulate matter, Coliforms, Suspended solids, Particle size, Turbidity, Water quality, Wastewater composition, Wastewater treatment, Chemical oxygen demand, Filtration.

Samples of unchlorinated secondary effluent were gathered on six occasions from each of five municipal wastewater treatment plants to use in studying the dosage of ultraviolet (UV) light needed for disinfection and to quantify the role of the number and size distributions of suspended particles in determining the differences in UV sensitivity in the effluents. The survival of the coliforms as a function of UV dose was determined by irradiating samples in a small petri dish with stirring in a collimated beam of UV light using four low pressure mercury lamps. The dose required to yield -2 log survival units was a mean value of 6.5 mW-sec/sq cm for the unfiltered samples and a mean value of 5.7 mW-sec/sq cm for the 10-micron filtered samples. The data at a dose of 26 mW-sec/sq cm was used to analyze the variation between samples caused by particles in unfiltered samples. Results showed that the number of surviving coliform at this dose was roughly correlated with the number of suspended particles >40-microns in diameter. Number and size of particles are directly related to survival, but a more easily measured surrogate parameter such as solids concentration or turbidity would be more practical. A multiple regression using both COD and turbidity as independent variables gave a good prediction of UV absorbance. The average survival curves of coliform generated in this study may be useful to plan equipment needs for UV disinfection of wastewater treated by biological floc formation. (Gieger-PTT)
W86-04331

START-UP OF A HIGH-PURITY, OXYGEN-ACTIVATED SLUDGE SYSTEM AT THE LOS ANGELES COUNTY SANITATION DISTRICTS' JOINT WATER POLLUTION CONTROL PLANT,

Los Angeles County Sanitation District, CA.
R. Wunderlich, J. Barry, D. Greenwood, and C. Carry.
Journal of the Water Pollution Control Federation, Vol.57, No. 10, p 1012-1018, October, 1985. 4 fig, 5 tab, 2 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Activated sludge process, *Anaerobic digestion, *Sludge thickening, Sludge drying, Dewatering, Training, Process control, Design criteria.

In 1976, an 8.77 cu m/sec high-purity oxygen activated sludge secondary treatment facility was constructed at the Joint Water Pollution Control Plant in Carson, California to comply with federal and state discharge requirements. Phase 1 of the start-up consisted of writing manuals for operation and maintenance and for training. Phase 2 involved equipment testing and began early in 1981. Some of the tests conducted were: leakage for all tanks, head versus capacity performance tests for pumps, vibration analyses and alignment checks for all rotating equipment, power consumption/efficiency tests for all large energy users, detailed noise analyses for large rotating equipment and cryogenic oxygen generation plants, and performance tests for biological reactors and dissolved air flotation unit. Phase 3 required staffing for the biological system, one cryogenic oxygen plant and the secondary effluent pump station. Phase 4 involved in-house training for the activated sludge process which was conducted by the districts' staff and supplemented with vendor training on flotation thickening, cryogenic oxygen generation, pumps, and other systems according to contract specifications. Process evaluations in Phase 5 showed that the plant produces the effluent quality expected at different flows under a variety of operating conditions. Sludge production and oxygen consumption were in line with predicted values. The digestion and dewaterability of different combinations of waste activated and primarily sludge will be studied for possible use in future operations. (Geiger-PTT)
W86-04332

IMPROVEMENT OF ACTIVATED SLUDGE FILTERABILITY,

Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, O. J. Hao, and K. C. Ou.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1019-1021, October, 1985. 4 fig, 1 tab, 6 ref. EPA Grant No. R807600-01.

Descriptors: *Activated sludge process, *Filtration, *Activated sludge, *Wastewater composition, *Biochemical oxygen demand, Microorganisms, Sulfates, Alum, Dewatering, Settleable solids, Sludge drying, Sludge conditioning, Wastewater treatment.

This study investigated the effects of reactor compartmentalization and growth condition on sludge dewaterability. The optimum dose of chemical conditioning agents (alum and ferric sulfate) for improving the filtering properties of activated sludge cultivated under various growth environments was also determined. It was concluded that the specific resistance of waste activated sludge is not only a function of wastewater characteristics such as BOD:N, operating parameters such as food-to-microorganism ratio (F/M) and sludge age, DO concentration, but also reactor configuration or DN (dispersion number). The specific resistance of the activated sludge generally decreased or the dewaterability of the activated sludge increased as the DN of the aerated bioreactor decreased under nitrogen-rich growth conditions when DO was not limiting. DO and nitrogen restrictions in an aeration tank associated with high DN caused overproduction of longer filamentous organisms in the activated sludge culture, and in turn, poor sludge settling or high specific resistance. Specific resistance could be reduced by adding chemical conditioner; the reduction was greater when the initial specific resistance was higher. The dewatering characteristics of the activated sludge were related to sludge settleability; the lower the sludge volume index (SVI), the lower the specific resistance. Under the nitrogen-limited growth condition, the specific resistance of the activated sludge was directly proportional to the SVI. (Geiger-PTT)
W86-04333

INFLUENCE OF WASTE ACTIVATED SLUDGE ON PRIMARY CLARIFIER OPERATION,

Winnipeg City Waterworks (Manitoba). Waste and Disposal Dept.
R. D. Ross, and G. V. Crawford.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1022-1026, October, 1985. 1 fig, 5 tab, 1 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Clarification, *Clarifiers, *Organic carbon, Suspended solids, Biochemical oxygen demand, Activated sludge, Sludge thickening, Effluents, Sludge drying, Dewatering.

Tests were carried out at the North End Water Pollution Control Center (NEWPCC) in Winnipeg, Manitoba, Canada to determine the primary sludge total solids concentration with and without the effects of the waste activated sludge sidestream, to compare the primary sludge concentration from a circular primary clarifier with that from a rectangular primary clarifier when both were operated without the waste activated sludge sidestream, and to monitor any difference in the biochemical oxygen demand (BOD), total organic carbon (TOC), and suspended solids (SS) concentrations of the effluents from the primary clarifiers being studied. With circular clarifiers of identical configurations, the separation of waste activated sludge from the primary clarification process at the NEWPCC resulted in a more concentrated primary sludge. With identical operating parameters and without the co-thickening of waste activated sludge, no difference was found between the primary sludge (underflow) concentration of a circular versus rectangular primary clarifier. The differences in primary effluent (overflow) SS concentrations between the three clarifiers, although statistically significant, were small relative to the variations in day-to-day concentrations. The difference in the primary effluent (overflow) BOD and TOC concentrations were not statistically significant. Since peak flows were not experienced during the test period, the effects of waste activated sludge addition during peak clarifier flow conditions were not examined . (Geiger-PTT)
W86-04334

ELIMINATION OF ODOR AT SIX MAJOR WASTEWATER TREATMENT PLANTS,

Hampton Roads Sanitation District, Norfolk, VA.
G. D. Waltrip, and E. G. Snyder.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1027-1032, October, 1985. 5 fig, 1 tab, 7 ref.

Descriptors: *Odor control, *Odors, *Wastewater treatment, *Wastewater facilities, *Design criteria, Chlorination, Chemical treatment, Sulfides, Aeration, Sodium hydroxide, Cost analysis.

A two year study by Hampton Roads Sanitation District was conducted to examine methods to eliminate off-site plant odors resulting from a force main collection system. Results showed that hydrogen peroxide addition was effective but very expensive. Ferrous sulfate addition was expensive and poor in performance. Upline chlorination and bacterial culture addition were not effective. Prechlorination was effective, but unattractive because of chemical cost and supply limitations. . Pre-aeration oxidized 80% of the influent sulfides; the remaining 20% are released with the air stream. Sulfides in the air stream can be removed using a packed-tower scrubber, preferably using caustic. Based on this study, design criteria were developed and used to design odor control facilities at the six treatment plants about which odor complaints were made. Odor control was very successful at the five plants that began using the new equipment in 1983. The sixth plant is also being redesigned to meet the required criteria. (Geiger-PTT)
W86-04335

NEUTRALIZATION OF WASTEWATERS CONTAINING CYANIDES: CONCLUSION: OTHER METHODS OF CYANIDE DESTRUCTION,

Marie Curie-Sklodowska Univ., Lublin (Poland). Dept. of Environmental Chemistry and Technology.
R. Gierzatowicz, L. Pawlowski, and E. Smolikowska.
Effluent and Water Treatment Journal, Vol. 26, No. 2, p. 51-52, 54, February 1986. 12 refs. Continued from Vol. 26, No. 1, p 25-31.

Descriptors: *Chlorination, *Oxidation, *Thermal decomposition, *Saponification, *Electrochemical oxidation, *Ion exchange, *Irradiation, *Biological decomposition, *Ozonation, *Cyan-cat method, Economics, Temperature, Pressure, Radiolysis, Electroplating, Peroxides, Chromates, Potassium permanganate, Oxygen, Pilot plants.

Various Methods of treating industrial wastes containing cyanide are discussed, including thermal decomposition (Cyan-Cat process), conversion with aldehydes and ketones, saponification and elevated temperatures and pressures, electrochemical oxidation, ion exchange, radiolysis, and biological decomposition. The various methods have their advantages and disadvantages. The Cyan-Cat method has a very dangerous stage of hydrogen evolution. Electrochemical oxidation is economical only for concentrated solutions. Cyanide conversion with aldehydes is economical for small electroplating plants where a bath system is possible. The cost of ozonation may be very high. High temperature burning has high effectiveness and low capital and operating costs. Radiolysis is inexpensive and simple, but is limited to lower cyanide concentrations and the presence of technology for applying ionizing radiation sources. Ion exchange is unprofitable and difficult to carry out. Biological decomposition may be useful for joint community-industrial waste disposal. Cyanogenic substance oxidation with such agents as peroxides, chromates, potassium permanaganate, and oxygen has only been studied in laboratories and on a pilot plant scale. (Rochester-PTT)
W86-04341

PROCESS SELECTION FOR OIL SEPARATION,

ESMIL Water Systems, High Wycombe (Enland).
J. Ryan.
Effluent and water Treatment Journal, Vol. 26, No. 2, p. 60-63, February 1986. 4 fig, 3 ref.

Descriptors: *Oil wastes, *Dissolved oil, *Gravity separation, *Coalescence, *Flotation, *Adsorption, *Biological treatment, Oil Tankers, Surface runoff, Process waters, Oil wells, Hydrocarbons.

For the purpose of discussing oil separation techniques, oil can be considered as being present in the carrier phase as one or more of the following: free floating oil, free oil droplets dispersed in the bulk of the carrier fluid, mechanically formed emulsions of oil in water, chemically stabilized emulsions of oil in water, and dissolved oil. Treatment techniques are gravity separation, coalescence, flotation, adsorption, and biological treatment. For an accurate prediction of an effluent quality resulting from a given process route it is essential to have a droplet size distribution together with a knowledge of the concentration and type of dissolved hydrocarbon. Sources of effluent need to be considered to assign a level of significance to the possible phases of oil. Sources include site leakage and spillage in runoff water, process waters containing oil, process waters containing significant levels of dissolved hydrocarbons, tank and tanker cleaning wastes, and produced water on an offshore production platform. A combination of experience with an application, knowing the 'history' of the carrier fluid, and a knowledge of what each type of process can achieve can lead to a satisfactory process selection. (Rochester-PTT)
W86-04342

NEW EFFLUENT TREATMENT SYSTEM AT HEATHROW AIRPORT,

Pollution Control Ltd., Telford (England).
R. J. Clark, and R. A. Walker.
Effluent and Water Treatment Journal, Vol. 26, No. 2, p. 66-69, February 1986. 1 fig, 1 tab, 2 ref.

Descriptors: *Food-processing wastes, *Dissolved air flotation, *Design, Efficiency, Reliability, Airport, Wastewater treatment, Grease, Suspended solids, Water temperature, Costs.

The new effluent treatment systems at Heathrow Airport, Great Britain, is described as a major example of employment of the dissolved air flotation technique. The main catering center for which this facility was designed covers approximately 100,000 sq ft. Performance specifications for the plant were as follows: (1) input conditions: peak flow, 35 1/sec, average grease content, 200-400 mg/l, average solid content, 60-700 mg/1, and temperature, 25-40 C, and (2) discharge conditions (including compliance with Thames Water limits): suspended solids, 400mg/l, grease, 100mg/l, and maximum temperature, 40 C. A three stage process was specified, including pumping station, screening, and dissolved air flotation. Three factors were high on the list of priorities in the plant design: reliability, minimum manual operation, and environmental acceptability. Work on the treatment facility was completed in May 1985. Although this plant was not intended to reduce costs, its operation can be expected to result in lower expenditure on effluent disposal than previously and any restriction of effluent discharge limits by the water authority in the future would enhance such savings. (Rochester-PTT)
W86-04343

HYDROGEN AS A PROCESS CONTROL INDEX IN A PILOT SCALE ANAEROBIC DIGESTER,

Agricultural and Food Research Council, Norwich (England). Food Research Inst.
D. B. Archer, M. G. Hilton, P. Adams, and H. Wiecko.
Biotechnology Letters BILED3, Vol.8, No.3, p 197-202, March 1986. 4 fig, 15 ref.

Descriptors: * Anaerobic digestion, *Hydrogen, *Biogas, *Process control, *Pilot plants, Volumetric shock loadings, Brewery effluent, Monitoring, Chemical oxygen demand, Suspended solids, Hydrogen ion concentration.

A 6 cu m pilot-scale anaerobic contact digester treating brewery effluent was subjected to four separate volumetric shock loadings and the con-

centration of hydrogen in the biogas was monitored. In 3/4 of the events there was a rapid rise in the hydrogen concentration, peaking after 3-6 hr. before declining to the normal steady -state levels. The ph remained between 6.8 and 7.1. The waste received on the day when the volumetric shock load did not induce an increase in hydrogen levels had a slightly lowered chemical oxygen demand and higher total suspended solids compared to the previous day's waste. Measurement of hydrogen has the potential to become a crucial method of process control in the operation of industrial anaerobic digesters. At present it should be regarded as a supplement to more conventional indicators of digester performance. (Rochester-PTT)
W86-04345

SELECTING PARTICLES FOR FLUIDIZED-BED BIOREACTORS WITH FLOCCULENT BIOMASS,

State Univ. of New York at Buffalo. Dept. of Chemical Engineering.
G. P. Andrews.
Biotechnology Progress, Vol. 2, No. 1, p 16-22, March 1986. 4 fig, 1 tab, 16 ref. NSF CPE 8204968.

Descriptors: *Biomass, *Flocculation, *Ethanol production, *Fluidized beds, *Anaerobic digestion, Particle size, Bioreactor, Wastewater treatment.

Designing a fluidized bed reactor for waste-water treatment of Ethanol production reduces to choosing the size and density of the support particle. Given the kinetic parameters of the biomass and the job to be done by the reactor (liquid flow rate, inlet and outlet substrate concentrations), the only variables left to be specified are the size and density of the particles in the bed. For floc particles these are fixed biologically; the designer can only select the strain with the best floc characteristics. A consideration of the mechanics of liquid fluidized beds (porosity and solid mixing) and of the effectiveness factors for biological particles enables the designer to specify types of support particles likely to maximize the reactor productivity for a particular application. Effectiveness factors for biological particles should be defined based on total volume because this gives a figure directly related to the local productivity of the reactor. For any support particle there exists a biofilm thickness that maximizes this effectiveness. (Rochester-PTT)
W86-04346

FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS, II,

Henkel K.G.a.A., Duesseldorf (Germany, F.R.). Dept. of Ecology.
For primary bibliographic entry see Field 5B.
W86-04356

TREATMENT OF SOLIDS AND PETROLEUM HYDROCARBONS IN STORM RUNOFF WITH AN ON-SITE DETENTION BASIN,

Rhode Island Univ., Narragansett. Graduate School of Oceanography.
J. S. Latimer, G. L. Mills, E. J. Hoffman, and J. G. Quinn.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 548-555, April 1986, 2 fig, 4 tab, 14 ref.

Descriptors: *Hydrocarbons, *Storm runoff, *Suspended solids, Runoff, Efficiency, Storms, Parking lots, Costs.

A detention basin was assessed for its effectiveness in treating petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and suspended solids from runoff at a shopping center parking lot. Treatment efficiencies varied greatly for suspended solids and for particulate and soluble hydrocarbons during the two storm events studied. Overall, they were higher for the summer storm and the particular fraction of the hydrocarbons was better treated than the soluble fraction. Negative treatment efficiency was observed for the soluble components during the spring storm, but these components represented only about 4% of the total hydrocarbons in the samples. Soluble effluent concentrations rivaled the influent concentrations during flush conditions, indicating poor treatment for soluble species during high flows. Treatment of hydrocarbons, polycyclic aromatic hydrocarbons, and suspended solids by the detention pond was 70%, 14%, and 36% better, respectively, than treatment efficiencies of a combined sanitary/storm municipal treatment plant in Providence, Rhode Island. With its relatively low construction and maintenance cost, the detention pond appears to be an economical way to treat urban runoff. (Rochester-PTT)
W86-04363

VARIANCE ANALYSES AND CRITERIA FOR TREATMENT REGULATIONS,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 34-49, March 1986. 6 fig, 11 tab, 55 ref.

Descriptors: *Waterborne disease, *Treatment regulations, *Filtration, *Disinfection, *Reservoir storage, *Performance evaluation, Giardia, Viruses, Diseases.

In order to develop the methodology for analyzing variances from required treatment regulations, the performance capabilities of filtration, disinfection, and reservoir storage are reviewed. Particular attention is focused on the removal and inactivation efficiencies for Giardia and viruses. The three variance analyses described here are based on estimating the percent of removal and inactivation of the target organisms in a particular system compared to standard treatment methods. For illustration, the methodology was applied in three cases. Factors influencing eligibility for variances include long contact times after chlorination, dual disinfection points with redundancy, and storage of raw water for long periods. A critical feature of disinfection for variance is to operate under cysticidal ranges for Giardia, but higher chlorine doses for larger contact time values must be constrained because of the possibility of exceeding the maximum contaminant limit for trihalomethanes. The same general principles can be applied to determine variances for groundwater systems, but inadequacies in modeling the transport of viruses in groundwater limit the semi-quantitative analysis. (Rochester-PTT)
W86-04369

BIOLOGICAL TREATMENT OF A LANDFILL LEACHATE IN SEQUENCING BATCH REACTORS,

Occidental Chemical Corp., Grand Island, NY.
W.-C. Ying, R. R. Bonk, V. J. Lloyd, and S. A. Sojka.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 41-50, February 1986. 4 fig, 12 tab, 32 ref.

Descriptors: *Leachates, *Chemical wastes, *Sequencing batch reactors, *Activated carbon, *Organic loading, *Suspended solids, *Aeration, *Mixing, *Temperature, *Process control, *Bacteria, Economics, Wastewater facilities, Pilot plants, New York.

Approximately 73,000 metric tons of chemical waste are contained in the Hyde Park, New York, landfill site. Leachate is collected, trucked to a nearby chemical manufacturing plant, and then treated with plant wastewaters by activated carbon adsorption. The leachate, which accounts for about 60% of the combined wastewater volume, but more than 80% of the total organic loading to the existing adsorption system, was found to be biodegradable easily. Excellent treatment of leachate and the combined wastewater was consistently accomplished in sequencing batch reactors SBRs), which were operated under a variety of operating conditions: wastewater total organic carbon, feed rate, variations of aeration and mixing strategies, hydraulic retention time, mixed liquor suspended solids concentration, organic loading, temperature, and cycle time. The SBR treatment performance was unaffected when wastewater feeding was suspended during weekends and holidays. Results obtained in the small bench-scale SBRs were reproduced in the pilot-scale units. An analysis of process economics indicated that significant cost saving was possible in meeting the future wastewater treatment requirements, if SBR biotreatment is implemented before the carbon adsorption. The integrated wastewater treatment system would produce a better quality effluent at a lower overall cost. Biodegradation rates for some of the more persistent wastewater constituents were enhanced in SBRs that were supplemented with strains of bacteria from the landfill site. (Rochester-PTT)
W86-04385

ALTERNATIVE RBC DESIGN—SECOND ORDER KINETICS,

Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
E. J. Opatken.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 51-56, February 1986. 3 tab, 5 ref.

Descriptors: *Rotating biological contactor, *Mathematical models, *Biochemical oxygen demand, *Oxygen, *Sanitary engineering, Wastewater facilities, Bacterial physiology.

An alternative design employing second-order kinetics and good engineering practice was used to specify a rotating biological contractor (RBC) process for secondary municipal wastewater treatment. The kinetics of the RBC process had been shown to follow a second-order rate expression when the disappearance of soluble biochemical oxygen demand (sBOD) was correlated with time. This relationship was combined with other RBC process limmitations to design an RBC system based on achieving final effluent sBOD requirements of less than 10 mg/liter. This alternative design approach can be used to determine the following: number of shafts, number of stages, shafts in each stage, sBOD in each stage, the effect on performance of diurnal fluctuations in flow from 50 to 200 percent of design flow, and when oxygen transfer. governs the kinetics. This paper demonstrates the design of an RBC plant by the second-order kinetics method and compares this with the procedure in the Autotrol Wastewater Treatment Systems Design Manual. (Rochester-PTT)
W86-04396

RESIDUAL CADMIUM FORMS IN ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,

Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-04414

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: I. A CASE STUDY,

Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W86-04417

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: II. RATE AND MECHANISM OF SEALING,

New Liskeard Coll. of Agricultural Technology (Ontario).
For primary bibliographic entry see Field 5B.
W86-04418

MICROBIOLOGICAL TREATMENT OF URANIUM MINE WATERS,

Kerr-McGee Corp., Oklahoma City, OK.
J. W. Kauffman, W. C. Laughlin, and R. A. Baldwin.
Environmental Science and Technology, Vol. 20, No. 3, p 243-248, March 1986. 3 fig, 4 tab, 13 ref.

Descriptors: *Wastewater treatment, *Uranium, *Mine drainage, *Microbial degradation, Mine wastes, Selenium, Uranium, Molybdenum, Sulfates, Clostridium, Ambrosia Lake, New Mexico, Field tests.

Percolation of uranium mine discharge water through Ambrosia Lake, NM, soil is shown to be an effective method for lowering selenium, uranium, molybdenum, and sulfate concentrations in the mine water. Selenium concentrations were lowered from approximately 1.6 to <0.05 mg/L by reduction of soluble selenate and selenite to insoluble selenium metal. This reaction is most likely performed by bacteria belonging to the genus Clostridium. In addition, sulfate-reducing bacteria in the soil, such as Desulfovibrio bacteria, metabolize sulfate to hydrogen sulfide, which reacts with uranyl and molybdate ions to form insoluble uranium and molybdenum species. During column start-up, minor variations in either temperature or flow rate impacted selenium removal. However, similar variations had virtually no effect on columns that had continuously removed selenium to less than 0.050 mg/L for at least several days. Selenium removal could be affected at flow rates up to the mechanical failure of the column bed (900 L/sq m/day) provided sufficient nutrients were available. Uranium and molybdenum removals were not observed until nutrients in addition to ones present in the soils were introduced. Nutrient concentration had the greatest impact on column performance. Acceptable contaminant removal could be achieved even with major excursion of other process variables provided an adequate supply of nutrients was available. The process was successfully field tested for 7 months in a soil column 1.5 m deep. (Lantz-PTT)
W86-04438

MICROBIAL ASPECTS OF THE INUVIK SEWAGE LAGOON,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry, and D. Prasad.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 117-128, 1986. 8 fig, 4 tab, 15 ref. Contract No. OST 84-00158.

Descriptors: *Wastewater lagoons, *Microbiological studies, *Inuvik, Northwest Territory, Arctic, Hydrogen in concentration, Solids, Suspended solids, Chemical oxygen demand, Biological oxygen demand, Wastewater treatment, Cold regions, Ice, Bacterial degradation.

A facultative sewage lagoon in Inuvik, N.W.T. was studied in August (ice free) and November (ice covered) 1984. Emphasis was placed on the microbiological aspects and their relation to lagoon performance. Analyses performed included, pH, total alkalinity, total solids, suspended solids, volatile solids, COD and BOD5 determinations. The microbiological tests included total plate counts (20 C) and psychrotrophic counts (1 C). Results indicated that the Inuvik sewage lagoon system achieved removal efficiencies, ranging from 90% BOD5 removal in summer to about 80% in winter. The total bacterial count was found to decrease in the liquid of the primary cells in the winter, but the bacterial count in the secondary cell was similar under both winter and summer conditions. No significant difference existed in bacterial counts in the sludge samples between primary and secondary cells. The total bacterial number decreased by one order of magnitude in the winter in sludges from all cells. A shift from mesophilic to psychrotrophic bacteria occurred in the winter. The percentage of psychrotrophs increased from less than 1% to over 80% with the change in season. The role of psychrotrophs in lagoon performance is discussed. (Author's abstract)
W86-04484

LAGOON TREATMENT OF MUNICIPAL SEWAGE EFFLUENT IN A SUBARCTIC REGION OF CANADA (YELLOWKNIFE, N.W.T.),

Government of the Northwest Territories, Yellowknife. Water Resources Div.
R. N. Sonissey, and R. Lemon.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 129-139, 1986. 10 fig, 2 tab, 8 ref.

Descriptors: *Wastewater lagoons, *Subarctic zone, *Yellowknife, *Northwest Territories, *Sewage effluents, Raw wastewater, Biological oxygen demand, Coliforms, Streptococci, Nickel, Zinc, Copper, Cadmium, Lead, Mercury.

The performance of a municipal sewage lagoon in a subarctic climate (Yellowknife, N.W.T.) was evaluated over a one period to determine its seasonal treatment capabilities. Raw sewage (influent) and treated effluent were analysed for several physicochemical and microbiological parameters. Effective removals of BOD5, total coliform, fecal coliform, fecal streptococci and heavy metals (Cu, Ni, Zn, Cd, Pb and Hg) were obtained from mid-June to mid-September. No evidence of treatment was observed when the lagoon was under ice cover (October to May). The concentrations of several heavy metals (Cu, Zn and Pb) were found to decrease gradually, reaching a low in summer, before rising again in the fall and winter. A system of managing cold climate lagoons, based on ambient temperature, is presented. (Author's abstract)
W86-04485

CONCENTRATION OF IMPURITIES DURING MELTING OF SNOW MADE FROM SECONDARY SEWAGE EFFLUENT,

British Columbia Univ., Vancouver. Dept. of Geological Sciences.
R. Zapf-Gilje, S. O. Russell, and D. S. Mavinic.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 151-156, 1986. 4 fig, 6 ref.

Descriptors: *Artificial snow, *Effluents, *Wastewater, *Nutrient removal, Cold regions, Freeze-thaw tests, Infiltration, Wastewater treatment.

When snow is made from sewage effluent, the impurities become concentrated in the early melt leaving the later runoff relatively pure. This could provide a low cost method of separating nutrients from secondary sewage effluent. Laboratory experiments showed that the degree of concentration was largely independent of the number of melt freeze cycles or initial concentration of impurity in the snow. The first 20% of melt removed with it 65% of the phosphorus and 90% of the nitrogen from snow made from sewage effluent; and over 90% of potassium chloride from snow made from potassium chloride solution. Field experiments with a salt solution confirmed in the laboratory results. (Author's abstract)
W86-04487

DEVELOPMENT OF AN ON-LINE ZERO CHLORINE RESIDUAL MEASUREMENT AND CONTROL SYSTEM,

Metro Renton Treatment Plant, WA.
R. E. Finger, D. Harrington, and L. A. Paxton.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1068-1073, November 1985. 5 fig, 2 tab, 18 ref.

Descriptors: *Dechlorination, *Monitoring, *Performance evaluation, Secondary wastewater treatment, Chlorine residual analysis, Sulfonation, Residual chlorine. Seattle, Washington.

A dechlorination system was developed for removal of chlorine used for disinfection and control of biofouling prior to the discharge of chlorinated effluents. An amperometric chlorine analyzer and sulfur dioxide dechlorination were employed, with development of feed-forward and feedback controls in which measurement of chlorine residuals much greater than zero is done in order to provide a more reliable signals. This approach was tested at the Metropolitan Seattle Renton treatment plant, where two continuous chlorine residual analyzers were provided to monitor and control residual, with two levels of backup provided. The plant chlorine residual limit of less than 1.0 mg/l daily (monthly average of less than 0.5 mg/l) has been met on all but 18/1,005 days of operation so far, with the highest recorded residual being 0.067 mg/l. In all cases, the high residuals were caused by factors outside the control system. These results demonstrate that a system that measures and controls chlorine at zero concentration can be built using conventional chlorine residual analyzers and simple flow proportioning equipment. The zero chlorine measurement and control system developed for the Renton treatment plant has had minimal operating problems during the first 25 months of its operation. (Rochester-PTT)
W86-04492

SMALL-DIAMETER, VARIABLE GRADE GRAVITY SEWERS,

Agricultural Research Service, Clemson, SC. Rural Housing Research Unit.
J. D. Simmons, and J. O. Newman.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1074-1077, November 1985. 4 fig, 6 ref.

Descriptors: *Septic Tanks, *Sewers, *Gravity sewers, *Domestic wastes, Wastewater lagoons, Performance evaltiation, Polyvinylchloride transport lines, Design criteria.

The concept of variable-grade gravity sewers (VGS) is explained, the design, operating characteristics, and performance of a 31-house system in Mount Andrew, Alabama, are described, and recommended design criteria for VGS systems are presented. The VGS line is laid out at a relatively constant depth, regardless of grade and has a profile with many uphill and downhill sections. The outlet is lower than the inlet in any house served by the sewer. The draining process involves delays, surcharging, and many transitions from full pipe to partial pipe flow, but after the lower sections are filled, all the liquid in the inlet will reach the outlet. The Mount Andrew system consists of modified septic tanks, small-diameter polyvinylchloride transport lines and a lagoon for final treatment. After several years, the system is operating well and requires little maintenance. The septic tanks functioned without major problems, although sludge accumulated quickly because of the small sludge storage volume of the first compartment. There have been no problems with the transport lines and no tank has failed to drain because of trouble with these lines. The most important design consideration is sizing the sewer line to accomodate the required number of houses. Slope is of little concern, but the entire system still requires a net positive grade. (Rochester-PTT)
W86-04493

EFFECT OF AERATION TANK CONFIGURATION ON NITRIFICATION KINETICS,

Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba, J. S. Cech, and P. Chudoba.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1078-1083, November 1985. 11 fig, 3 tab, 26 ref.

Descriptors: *Nitrification, *Aeration, *Activated sludge, *Respirometric measurements, *Nitride, *Hydraulics, *Flow patterns, Wastewater treatment, Mixed cultures, Bacterial physiology, Kinetics, Ammonium.

Kinetic constant of nitrification were determined by a simple respirometric method with two mixed cultures grown in hydraulically different reactors. Kinetic constants of the first stage of nitrification were considerably higher with mixed culture grown in a reactor with the plug-flow pattern than with mixed culture grown in a completely mixed (CM) reactor. Inhibition of the first stage of nitrification with mixed culture grown in the CM reactor occurred at concentrations of ammonium-N much lower than for mixed culture grown in the reactor with the plug-flow pattern. The compartmentalized system was much more suitable for nitrification than the completely mixed system. True values of kinetic constants for the second stage of nitrification cannot be determined directly by dosing nitrite into the reaction mixture because ammonia oxidation forms nitrite into the reaction mixture because ammonia oxidation forms nitrite inside the floc matrix. The constants can be computed from the data obtained during a batch exper-

isms with ammonia as a sole N substrate. (Author's abstract)
W86-04494

BACTERIOPHAGES AND FECAL BACTERIA AS INDICATORS OF CHLORINATION EFFICIENCY OF BIOLOGICALLY TREATED WASTEWATER,

Rijksinstituut voor de Volksgezondheid, Utrecht (Netherlands).
A. H. Havelaar, and T. J. Nieuwstad.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1084-1088, November 1985. 2 fig, 3 tab, 32 ref.

Descriptors: *Disinfection, *Viruses, *Fecal pollution, *Nitrification, *Chlorination, *Bioindicators, Wastewater treatment, Sulfite-reducing clostridia, Spores, Bacteriophage, Coliforms, Streptococcus.

The behavior of F specific bacteriophages was compared to that of somatic coliphages and conventional bacterial indicators of fecal pollution (thermotolerant coliforms, fecal streptococci, and spores of sulfite-reducing Clostridia). The effects of varying degrees of nitrification on reduction of bacteriophages and bacterial indicators by chlorine were compared. In general, both organic matter content and numbers of microorganisms decreased with increasing nitrification. Reduction of both F specific and somatic phages increased with increasing nitrification, whereas in all classes, F specific phages were more resistant to chlorine than somatic coliphages (up to almost one log unit in well-nitrified water). Thermotolerant coliforms were reduced by chlorination much more efficiently than bacteriophages. Resistance to reduction by chlorine was in the order: F specific bacteriophages greater than somatic coliphages greater than fecal streptococci greater than thermotolerant coliforms. Phage reduction was unrelated to chlorine residual, but correlated with chlorine dose. Highest kills were obtained in very well nitrified water, probably because of the extended life of transient free available chlorine. Chlorine does up to 5 mg/l and chlorine residuals up to 4 mg/l did not reduce spores of sulfite-reducing Clostridia. The search for disinfectant alternatives to chlorine should continue. (Rochester-PTT)
W86-04495

APPLICATION OF POLYSULFIDE FOR PRETREATMENT OF SPENT CYANIDE LIQUORS,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. J. Ganczarczyk, P. T. Takoaka, and D. A. Ohashi.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1089-1093, November 1985. 3 fig, 4 tab, 16 ref.

Descriptors: *Metal cyanide complexes, *Cyanide liquors, *Limesulfur, *Industrial wastewater, *Wastewater discharge, Copper, Cadmium, Nickel, Metal plating wastewater.

A simple method of treating highly concentrated cyanide liquors containing metal-cyanide complexes was developed to enable discharge of the wastewater into a municipal sewage system. Experiments consisted of: (1) treating 300 ml of Cu/Cd plating dragout wastewater with 37.1 of limesulfur; (2) treating 3000 ml of Cu/Ni plate stripper wastewater with 104 ml limesulfur; and (3) treating 300 ml of the stripper wastewater with 141 ml limesulfur. A rapid degradation of CN- occurred in all three experiments. In the first, CN- was reduced to nondetectable levels within 2 days at an initial cyanide:polysulfide ratio of 1:1.5. The residual CN- was reduced by 99.9% within 2 days in the second experiment, which was performed at the same ratio, but at a much higher initial CN-concentration. In the third experiment, which repeated the second except for a higher dosage of polysulfide-S, the heffective removal of CN- occurred within 3 days. The reaction used here effectively converted CN- to SCN- within 2-3 days at 3 C, broke down metal-cyanide complexes, and generally precipitated metals to the levels required by municipal sewer use by-laws. (Rochester-PTT)
W86-04496

CONSIDERATION OF FIRST-STAGE ORGANIC OVERLOADING IN ROTATING BIOLOGICAL CONTACTOR DESIGN,

Municipal Environmental Research Lab., Cincinnati, OH.
F. L. Evans, III.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1094-1098, November 1985. 2 fig, 2 tab, 8 ref.

Descriptors: *Design information, *Bacteria, *Biological wastewater treatment, *Fungi, Wastewater facilities, Process control, On-site investigations, Biomass, Organic loading, Dissolved oxygen, Aerobic treatment.

Improved design procedures that have been developed from field experience are documented, including problem description, available first-stage organic overloading data for rotating biological contractors (RBCs), process design considerations, and design considerations. When the first stage of RBC operation continues with high organic loading the film thickness increases and a white-gray biomass covers substantial portions (e.g., 40%) of the media surface. Nuisance organisms, including bacterial and fungal filaments, are present, and RBC units operating under these conditions are described as organically overloaded. Design criteria to minimize overloading include: design all stages of the total plant to operate within the same maximum first-stage load limits selected, with a review of loading on a stage-by-stage basis; include operational flexibility to accomodate variable hydraulic flow paths and organic loading considerations; include the ability to vary the shaft rotational speed to enable increased operational flexibility; include dissolved oxygen (DO) measuring instrumentation and load cells in the first stage as a minimum; possibly provide a system for supplemental aeration in the first stage and subsequent stages to increase bulk fluid DO levels, improve oxygen transfer capabilities, or regulate media biomass accumulations. (Rochester-PTT)
W86-04497

OPERATION AND MAINTENANCE OF THE UOSA WATER RECLAMATION PLANT,

CH2M/Hill, Reston, VA.
M. H. Robbins, Jr., and C. G. Ehalt.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1122-1127, December 1985. 2 fig, 10 tab, 9 ref.

Descriptors: *Wastewater renovation, *Advanced wastewater treatment, *Plant operations, *Labor costs, *Electrical costs, *Chemical costs, *Nitrogen removal, *Nitrifying conditions, *Secondary treatment, Chemical treatment, Equalizing basins, Filtration, Water treatment facilities, Virginia, Granular activated carbon, Ion exchange, Plant reliability, Operating costs, Virginia.

Operational characteristics, unit process operation and maintenance (O+M) costs, and plant reliability are described for the Upper Occoquan Sewage Authority (UOSA), Virginia, advanced water treatment plant. This plant renovates wastewater for discharge to the principal water supply reservoir in Northern Virginia, and its discharge limits are among the most stringent in the United States. The plant includes a secondary treatment system, chemical treatment system, equalization basins (ballast ponds), deep-bed, multimedia pressure filters, granular activated carbon filters, and ion exchange columns (final filtration). O+M costs are tabulated for the fiscal years 1983 and 1984, including labor, electrical power, process chemicals, other utilities, supplies, contract services, insurance, administration, and equipment replacement. The impact of N removal operations on the secondary treatment system, chemical treatment system, and carbon adsorption system are described, and N removal O+M costs are provided. A lognormal analysis of plant reliability also is presented. (Rochester-PTT)
W86-04499

BIOLOGICAL TREATMENT OF CRAB PROCESSING PLANT WASTEWATER,

Maryland Univ., College Park. MEES Program.
E. L. Geiger, F. W. Wheaton, R. B. Brinsfield, and J. E. Alleman.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1128-1133, December 1985. 3 fig, 6 tab, 10 ref.

Descriptors: *Food-processing wastes, *Biological wastewater treatment, *Dissolved solids, *Extended aeration, *Biological oxygen demand, *Chemical oxygen demand, Total suspended solids, Wastewater treatment facilities, Mixed liquor suspended solids, Aeration, Biomass.

A laboratory model wastewater treatment system was operated to: (1) characterize blue crab processing plant wastewater; (2) determine a treatment scheme to produce effluent in compliance with 'best conventional pollution control technology' guidelines; and (3) reduce the dissolved organics in the effluent. Blue crab processing wastewater contains high concentrations of dissolved organics and consistently has a pH between 7.8 and 8.0. Suspended solids did not settle out on prolonged quiescent conditions, probably because of their size and density characteristics. Biological treatment using extended aeration effectively reduced the dissolved organics in crab plant wastewater, provided that a high level of biological mass was present (3,000 to 7,000 mg/l mixed liquor suspended solids) in the reactor and settling of the biolgoical mass was performed prior to effluent discharge. If dissolved organics were not removed because of insufficient retention time, settling the bacterial mass in the biological reactor for more than one hour frequently caused inversion of the mass from gas bubble formation. A retention time of 16-24 hr in the biological reactor removed approximately 90% of dissolved organics. Intermittent addition of organics followed by a 24-hr retention time after the first addition decreased BOD sub 5 and total suspended solids (TSS) significantly compared with batch treatment. The concentration of BOD sub 5, COD, and TSS in the effluent of the biological reactor with moderate organic loading was lower than from the reactor with high organic loading. (Rochester-PTT)
W86-04500

EFFECTS OF ENGINEERING CONTROLS ON METHANE FERMENTATION TOXICITY RESPONSE,

J. Yang, and R. E. Speece.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1134-1141, December 1985. 11 fig, 3 tab, 10 refs.

Descriptors: *Anaerobic digestion, *Cyanide, *Toxins, *Methane bacteria, Serum bottle technique, Biomass, Temperature, Solids retention time.

The effects of toxicity on methane fermentation were investigated using methanogenic cultures enriched on acetate as the sole carbon source and cyanide as a model toxicant. The serum bottle technique was employed, using semi-batch or semi-continuous mode. The severity and duration of methane fermentation inhibition by a slug dose of cyanide was proportional to the toxicant concentration. The continuously-stirred tank reactor with the longest solids retention time (SRT) could recover from the highest dose of cyanide, and the system with the lowest SRT recovered from the lowest slug dose. A 25-day SRT culture recovered faster than a 50-day SRT culture at 2.5 and 5 mg/l of cyanide. Recovery from cyanide inhibition was inversely related to biomass concentration. Methane fermentation inhibition was related directly to the exposure period of biomass with cyanide, and toxicity reversal was demonstrated when biomass was separated from the supernatant fluid containing cyanide. Inhibition of methane fermentation by cyanide depended on cell age. The inhibition of methane fermentation was related to the cyanide administration pattern, with the severity of inhibition increasing in the following order: buildup, washout, and constant. Reduced temperature (25 C) significantly delayed recovery of gas production from slug doses of cyanide when compared to a warmer incubation temperature (35 C). (Rochester-PTT)

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W86-04501

EVALUATION OF FINE-BUBBLE ALPHA FACTORS IN NEAR FULL-SCALE EQUIPMENT,

California Univ., Los Angeles. Dept. of Civil Engineering.
H. J. Hwang, and M. K. Stenstrom.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1142-1151, December 1985. 16 fig, 2 tab, 46 ref.

Descriptors: *Sanitary engineering, *Activated sludge process, *Aeration, *Fine-bubble diffusers, Wastewater treatment facilities, Microbial oxygen uptake, Mixed liquor, Surfactants, Volumetric mass, Transfer coefficient, Mathematical models.

A practical method of measuring alpha factors for fine-bubble diffusers under rapidly changing conditions of water quality is discussed. An experimental method and mathematical models that can handle rapidly changing water quality under process conditions have been developed, along with suitable methods for parameter estimation. The models were verified experimentally with tap water containing surfactants and activated sludge mixed liquor. The pilot-scale aeration column with full-scale liquid depth under operating conditions could be used to simulate the full-scale aeration tank. The variation of alpha factor in the mixed liquor can be explained by a rapidly measured variable, microbial oxygen uptake rate (OUR). The alpha factor in detergent water for fine-bubble diffusers varied between 0.35 and 0.8, with the same concentration of surfactant. Microbial OUR in mixed liquor explained the variation of volumetric oxygen mass transfer coefficient in mixed liquor. As the water was treated, soluble substrate was removed and microbial OUR decreased to the value of endogenous phase, and the volumetric oxygen mass transfer coefficient increased. Alpha factors in mixed liquor increased significantly with increasing treatment. Alpha factors in tap water containing surfactant and mixed liquor decreased with increasing air flow rate. Alpha factors in mixed liquor decreased with increasing liquid depth. The volumetric mass transfer coefficient was linearly dependent on air flow rate in this study, a result which may be attributed to the height of the diffuser above the tank floor. (Rochester-PTT)
W86-04502

GROWTH PHYSIOLOGY OF THE FILAMENTOUS ORGANISM TYPE 021N AND ITS SIGNIFICANCE IN ACTIVATED SLUDGE BULKING,

California Univ., Berkeley. Sanitary Engineering Research Lab.
M. G. Richard, G. P. Shimizu, and D. Jenkins.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1152-1162, December 1985. 13 fig, 3 tab, 35 ref. NSF Water Resources and Engineering Program Grant CME-7918919.

Descriptors: *Bulking sludge, *Activated sludge process, *Process research, *Pseudomonas, *Bacterial physiology, *Ammonium, Wastewater treatment, Nutrient requirements, Reduced inorganic sulfur compounds, Lactate, Glucose, Low molecular weight organic acids, Leucothrix, Thiothrix.

Fourteen Type 021N isolates were obtained in axenic culture from bulking activated sludge samples and were characterized. Two closely-related organisms were represented among the isolates. One was classified tentatively in Leucothrix and the other (representing most of the isolates) was closely related to the genera Leucothrix and Thiothrix. The Type 021N isolated had a high affinity for glucose and lactate. They readily used low molecular weight organic acids as substrates for heterotrophic growth and grew mixotrophically on reduced inorganic S compounds. They seemed to possess a higher affinity for ammonium than did a representative floc-former, Pseudomonas sp. Type 021N, unlike the floc-former, had the ability, at N limitation, for unbalanced rapid assimilation and storage of ammonium. Low ammonium concentration per se did not seem to favor significantly Type 021N over the floc-former. When ammonium was fed intermittently rather than continuously, Type 021N successfully competed with the floc-former in dual-species chemostat studies at ammonium limitation, a capability which may provide it with a competitive advantage in N-limited activated sludge systems where the temporal BOD sub 5:N ratio varies significantly. (Rochester-PTT)
W86-04503

BIOLOGICAL TREATMENT OF HAZARDOUS WASTE IN SEQUENCING BATCH REACTORS,

CECOS International, Niagara Falls, NY.
P. A. Herzbrun, R. L. Irvine, and K. C. Malinowski.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1163-1167, December 1985. 4 fig, 6 tab, 7 ref. New York State Energy Research and Development Authority Contract.

Descriptors: *Bench-scale tests, *Fill-and-draw reactor, *Organic carbon, *Sequencing batch reactors, *Biological wastewater treatment, *Sanitary engineering, Cold weather simulation, Wastewater facilities, Wastewater treatment, Phenol augmentation experiment, Energy conservation.

Bench-scale studies of sequenching batch reactors (SBRs) for use in organic carbon removal from hazardous wastes included a cold weather simulation, a phenol augmentation experiment, and an energy conservation strategy. Nine bench-scale SBRs were operated; detention times of 1.25-10 days were studied, with acceptable results for all anticipated full-scale flows. Results with a SBR operated for 8 months at temperatures as low as 3 C were not as favorable as for an identical SBR operated at 21-25 C, but discharge limitations for total organic carbon (TOC) were maintained if the rate of temperature decrease was controlled. One reactor was operated with up to 6 hr of stirred, and unstirred, unaerated feed with favorable results. TOC degradation in a 1,900 cu m SBR averaged 76% and phenol degradation averaged 99.0% during the first month of operation, with all other data indicating proper performance. The role of organic contaminant removal has shifted from adsorption on activated carbon to degradation in the SBR. With the use of carbon for polishing purposes, a significant cost and energy savings is anticipated. (Rochester-PTT)
W86-04504

INLET DESIGN FOR RECTANGULAR SETTLING TANKS BY PHYSICAL MODELING,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 8B.
W86-04505

TREATMENT OF NUTRIENT DEFICIENT WASTEWATERS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
T. A. Broderick, and J. H. Sherrard.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1178-1182, December 1985. 2 fig, 3 tab, 46 ref.

Descriptors: *Biological wastewater treatment, *Aerobic treatment, *Anaerobic digestion, *Nitrogen, *Phosphorus, *Limiting nutrients, *Industrial wastewaters, Bacterial physiology, Sludge age, Anhydrous ammonia, Calcium dihydrogen phosphate.

The question of the appropriate quantity of nutrients to add to high-rate and low-rate wastewater treatment processes is discussed. Topics include: required nutrient ratios versus sludge age for aerobic and anaerobic treatment, nutrient-deficient industrial wastes, BOD:N:P ratios for wastes, and costs of supplementary N and P (1985 data). Based on past and current practices regarding addition of N and P to nutrient-deficient wastewaters, the following conclusions are drawn: (1) the maximum amount of N and P is being added to most industrial wastewaters with little regard to minimizing their addition; (2) nutrient requirements can be lowered by altering process operating conditions. High sludge ages (low-rate treatment) result in lower waste sludge production than low sludge ages (high-rate treatment), and nutrient requirements are directly proportional to waste sludge production); (3) N and P are being added at concentrations far in excess of the requirements for anaerobic wastewater treatment systems; and (4) to minimize chemical costs, anhydrous ammonia and calcium dihydrogen phosphate should be chosen as sources of N and P, respectively. (Rochester-PTT)
W86-04506

FEASIBILITY FOR PERFORMING A RISK ASSESSMENT ON PATHOGENS,

Environmental Protection Agency, Cincinnati, OH.
L. Fradkin, S. Lutkenhoff, J. Stara, E. Lomnitz, and B. Cornaby.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1183-1188, December 1985. 1 fig, 3 tab, 19 ref.

Descriptors: *Municipal wastewater, *Sludge, *Standard formulation, Pathogenic bacteria, Pathogenic fungi, Pathogenic viruses, Pathogenic protozoa, Pathogenic helminths, Risk assessment.

The practicality of formulating guidelines to assess the risk associated with exposure to pathogens in sludge is evaluated. The feasibility of performing a microbiological risk assessment for pathogens in municipal wastewater sludge by various disposal options was evaluated. Topics include: the mechanism of pathogen transmission, selection of representative pathogens for risk assessment study, the Universal Pathway Model for movement of pathogens, bacteria, viruses, and parasites in wastewater and sludges, uncertainties and major data gaps, and likelihood of exposure to sludge-originated pathogens. Pathogens in sludge, especially pathogenic bacteria, viruses, protozoa, helminths, and fungi, have been studied in various ways, ranging from enumeration of microorganisms before and after various treatments to epidemiological documentation of the role of aerosol pathogens in human infection and disease. Priorities can be set for which exposure situations should be recognized and examined first. Data available for microbiological risk assessment for sludge pathogens varies in quality and quantity for all parts of the process for a limited number of pathogens species. Uncertainties can be identified and rational assumptions justified to augment the evaluation. Risk assessment of pathogens in sludge is a reasonable activity to undertake at this time. Although the models can be improved, sufficient data are available that should approximate reality. (Rochester-PTT)
W86-04507

TREATMENT OF INDUSTRIAL WASTEWATERS,

DHV Consulting Engineers, Amersfoort (Netherlands).
H. Kiestra, and E. Eggers.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 5-16, 1986. 10 fig, 6 tab.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Biological wastewater treatment, *Physicochemical treatment, *Biological oxygen demand, Chemical oxygen demand, Reduction, Aerobic treatment, Denitrification, ANAMET, Tannery wastes, Slaughterhouse wastes, Oil wastes, Anaerobic digestion.

A general analysis is made of the current treatment methods for industrial wastewater. Mechanical, physicochemical and biological treatment processes are discussed and the pros and contras of aerobic versus anaerobic treatment are listed, in terms of biological oxygen demand (BOD) and chemical oxygen demand (COD) reduction, energy demand, operational aspects, land use, sensitivity and sludge production. In general, anaerobic treatment is attractive in cases where wastewater with high BOD concentrations has to be treated while aerobic treatment is less sensitive and allows (de)nitrification in the same reactor. The latest developments in wastewater treatment, such as the ANAMET and the Gist-Brocades systems, are pre-

ment. Three cases of industrial wastewater treatment are elaborated, concerning effluents from a tannery, a slaughterhouse and an oil refinery. (Author's abstract)
W86-04511

TREATMENT OF OIL IN REFINERY WASTEWATER IN SOUTH EAST ASIA,

Burt Consultants Pty Ltd., Singapore.
R. A. Radevsky, and D. A. Burt.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 17-21, 1986. 2 ref.

Descriptors: *Oil refineries, *Oil wastes, *Wastewater treatment, Oil industry, Effluents, Wastewater management, Water treatment facilities, Cost analysis, Design standards.

In response to more severe pollution control regulations and from a desire to reduce pollution levels, oil industry installations are having to re-examine their effluent treatment facilities. Options for upgrading the quality of effluent discharged include: improvements in water management to decrease volumes of effluent produced in processes; modification to existing effluent treatment plant both in performance and operating procedures by the installation of new components or the replacement of individual units; and the installation of completely new effluent treatment facilities using the latest technology. In most existing plants considerable increases in efficiency can be brought about at relatively low cost by the correct application of a range of options. Where new installations are being constructed valuable lessons may be learned by examining the problems that are occurring in plants already in operation. Improvements may thus be made on existing designs. (Author's abstract)
W86-04512

EFFECTS OF WATER REUSE, RECYCLING AND RESOURCE RECOVERY ON FOOD PROCESSING WASTE TREATMENT IN THAILAND,

Seatec International Ltd., Bangkok (Thailand).
R. J. Frankel, and A. Phongphetraratana.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 23-33, 1986. 4 fig, 3 tab, 1 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Thailand, *Recycling, *Waste recovery, *Food processing wastes, Canneries, Cost analysis, Water pollution control, Anaerobic digestion, Wastewater renovation, Air flotation, Byproducts.

Two food processing industries in Thailand, namely pineapple canning and tuna/sardine canning, were studied over a 10 year period to document effects of water reuse, recycling and resource recovery (both energy and product) on waste treatment needs and actual operations. Changes in terms of water consumed, energy required, waste generated, and costs per ton of raw material processed were calculated. Lower overall annual costs resulted from all water conservation and energy recovery schemes even though stricter pollution control laws were the motivating factor behind the changes. Continuous rotary pressure cookers offer the best potential for reducing energy usage in the tuna/sardine processing industry. Potential energy recovery also exists from biogas utilization generated by anaerobic fermentation of the concentrated wastes. Assuming that cooling waters are separated out, screening of segregated wastes is practiced, and air flotation is used for removal of oil/grease from the highly concentrated tuna precook wastes, the overall biological oxygen demand reductions achieved by a well-operated plant will be from the 3000-6000 mg/l range down to 20 mg/l in the effluent. By-product recovery of the screenings for animal feed production, oil/grease skimmings for soap production, together with reuse of can cooling waters, enhance the economics of wastewater treatment and reduce overall water supply/waste treatment costs. (Lantz-PTT)
W86-04513

PALM OIL PROCESSING - NEW DEVELOPMENT IN EFFLUENT TREATMENT,

Palm Oil Research Inst. of Malaysia, Kuala Lumpur.
A. N. Ma, and A. S. H. Ong.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 35-40, 1986. 7 tab, 16 ref.

Descriptors: *Palm oil processing, *Industrial wastes, *Effluents, *Wastewater treatment, Wastewater renovation, Water reuse, Recycling, Fertilizers, Biogas production, Biogas utilization, Animal feed.

Since 1980, the concept of palm oil mill effluent treatment has changed, and there have been several research and development projects to investigate the utilization of the so called waste materials from the palm oil mills. A pollution prevention approach has been increasingly adopted by the industry. Anaerobic liquor is being beneficially recycled to crops and improved crop yield and soil properties have been recorded, and biogas is being harnessed for heat and electricity generation. This paper highlights some of the recent developments through: (1) biogas production and utilization, (2) land application as fertilizer, and (3) utilization of decanter solids as fertiliser or as an animal feed. (Author's abstract)
W86-04514

RUBBER BASED INDUSTRIES: A CASE STUDY ON EFFLUENT TREATMENT,

Rubber Research Inst. of Malaya, Kuala Lumpur (Malaysia).
C. K. John, and P. F. Shea.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 41-46, 1986.

Descriptors: *Rubber, *Industrial wastes, *Wastewater treatment, *Effluents, Aeration, Aerators.

In Malaysia, the bulk of natural rubber produced is exported. Only 4% is currently used by the domestic market in the production of manufactured goods. Whereas much has been written about waste treatment with respect to processing of the raw latex, little has been published on the particular difficulties of treating the waste generated during manufacture of rubber based products. Described are characteristics of the raw waste, such as pH, temperature, chemical oxygen demand, biological oxygen demand, and suspended solids. The treatment works relied to a large extent on manual control for desludging. Other control systems were generally either continuous, such as the aerators although intermittent operation was provided by timers, or automatic, such as for pH correction. Phosphorus addition was by manually adjusted metering pumps. The incoming sewers delivered to a submersible pump pit from which the waste was pumped to the distribution channel of the sedimentation tanks. Discharge was to the lagoons either parallel or in series and then the outfall. (Lantz-PTT)
W86-04515

ANIMAL FARMING EFFLUENT PROBLEMS - AN INTEGRATED APPROACH: RESOURCE RECOVERY IN LARGE SCALE PIG FARMING,

Food and Agriculture Organization of the United Nations, Singapore.
E. P. Taiganides.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 47-55, 1986. 3 fig, 3 tab, 6 ref.

Descriptors: *Farm wastes, *Effluents, *Waste recovery, *Animal wastes, Pig farming, Biodegradation, Anaerobic digestion, Sedimentation, Anaerobic lagoons, Dewatering, Filtration, Water reuse.

A waste treatment plant integrated with treated water recycle, biogas energy recovery, plus solids stabilization and reuse has been constructed in 1985 on a 20,000 standing pig population (SPP) farm. The plant incorporates biotechnologies developed under R&D Projects in the Primary Production Division (PPD) of Singapore with grants from the United Nations Development Programme (UNDP), the Australian Development Assistance Bureau (ADAB), the International Development Research Centre (IDRC) of Canada, the Food Waste Materials Utilization Project of the Association of Southeast Asian Nations (ASEAN) and the Technical assistance of the Food and Agriculture Organization (FAO) of the United Nations. The treatment processes include biogas digestion, chemically aided sedimentation, modified anaerobic lagoon, solids dewatering through sand filters and centrifuge, oxidation ditch aeration basins, etc. The aim of the Project is to determine the technical requirements and costs of producing effluents of 250 mg/l and 50 mg/l BOD integrated with resource recovery and reuse. (Author's abstract)
W86-04516

REUSE, RECYCLING AND RESOURCE RECOVERY IN INDUSTRIAL APPLICATIONS,

Camp Scott Furphy Pty Ltd., Chatswood (Australia).
I. B. Law.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 57-67, 1986. 3 fig, 3 tab, 13 ref.

Descriptors: *Recycling, *Waste reuse, *Resource recovery, *Waste recovery, Industrial wastes, Industrial wastewater, Industrial water, Effluents, Cost analysis, Economic feasibility.

Growing environmental pressures and escalating intake water costs are causing an increasing number of industrialists to reappraise their effluent treatment facilities with a view to effluent recycle and/or resource recovery. In certain instances industrialists have opted for treated sewage effluent as a water source for their process. Industries are, in some instances, practicing not only water reuse but also resource recovery, whereby valuable raw materials and/or by-products are recovered from the wastewater streams - with the value of these recovered resources often off-setting the costs associated with the more advanced degrees of treatment required. This paper covers examples of industrial applications where reuse, recycling and/or resource recovery has found application and attempts to highlight the fact that water can be saved by industry and that treatment facilities can operate profitably if the overall water handling system within the industry is carefully planned. (Lantz-PTT)
W86-04517

REDUCTION OF PULP AND PAPER INDUSTRY EFFLUENT LOADING,

Tampere Univ. of Technology (Finland).
A. Luonsi, P. Vuoriranta, and P. Hynninen.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 109-125, 1986. 12 fig, 9 tab, 20 ref.

Descriptors: *Pulp and paper industry, *Pulp wastes, *Industrial water, *Industrial wastewater, Water conservation, Bleaching wastes, Anaerobic digestion, Activated sludge, Effluent, Wastewater treatment.

The pulp and paper industry consumes large volumes of water i.e. 10-300 cu m/t of product. The most important measure in reducing the pollution charge is a reduction in water consumption. Thereafter, efficient and more easily controllable methods can be used for the treatment of lower volume, more concentrated and warmer wastewaters. Application of medium consistency techniques in production, water recirculation, and more efficient use of wood are pushing development in this direction. The present trend in pulp and paper industry production will result in more efficient use of raw materials, which in practice means increasing production of mechanical pulps. Also, the utilization of wastepaper will increase. Modified cooking and decreasing use of chlorine in final bleaching will reduce the effluent charge of harmful chlorinated organic compounds from chemical pulping. Medium consistency techniques will be increasingly applied in unit processes leading to decreased water and energy consumption. Anaerobic technology will be applied for concentrated wastewaters of (chemi)-mechanical pulp and paper production. Practical applications, of which examples have been presented in this paper, have shown their potential for economical treatment. Also, some fractions of chemical pulp production are

applicable to anaerobic treatment. For dilute mill effluents the activated sludge process is so far the most common. In order to improve the economy of the plants and to reduce eutrophication of sensitive inland waters, the nutrient balance of the process must be increasingly close. The goals of treatment have mainly been set to reduce the loading of oxygen consuming substances. In the future, economy of treatment processes, and the ability to remove specific pollutants, will be the major aspects of concern. Therefore, it is important that the specific compounds which necessarily must be removed in the future should be thoroughly studied and determined in order to guarantee proper selection of treatment methods. If one substance is removed from the wastewater stream, unless completely mineralized, it will go into the air or to the sludge, so systems must be selected which waste materials can be returned most economically to natural circulation. (Lantz-PTT)
W86-04521

TREATMENT OF WASTE WATERS FROM MALTING, BREWING AND DISTILLING,

Taylor (John) and Sons, London (England).
L. J. Smith.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 127-135, 1986. 1 fig, 1 tab, 5 ref.

Descriptors: *Industrial wastewaters, *Wastewater treatment, *Breweries, *Distilleries, Biofiltration, Biological oxygen demand, Filtration, Activated sludge, Anaerobic digestion, Fluidized beds.

The origin and nature of the malting, brewing and distilling wastewaters is briefly described. Possible methods of treatment are reviewed with passing reference to some typical examples. The effect of climate is considered. The second half of the paper is devoted to process selection, design and operation of a high rate plastics media filter treatment plant for Bass Brewing Ltd., at Runcorn U.K. with special reference to measures to avoid nuisance from the readily putrescible wastewaters and an indication of cost. Of the treatment methods of which there is experience, bio-filtration is the most worthy of recommendation. High rate versions of the process using specially designed plastics medium, apart from facilitating partial treatment at high BOD loadings, will also permit up to 95% BOD removal at loadings higher than could be applied to conventional medium filters. While high rate filters are considered preferable to activated sludge on technical grounds, there is not necessarily an energy saving when the cost of pumping to tall towers in two stages is taken into account. On grounds of energy conservation, rotating biological contactors may have the advantage, due to low head requirements, while sharing with high rate filters the merit of a captive biomass. Anaerobic treatment is theoretically attractive on energy economy and sludge yield considerations. It may be particularly appropriate where ambient temperatures approach the required process temperature. Brewery effluent may be too weak for present forms of the process. The advent of fluidized bed and other new technology designs to conserve organisms in the process, may increase the scope and success of anaerobic treatment. In the case of the pretreatment plant described, there is a cost advantage in pretreatment as compared with accepting Water Authority trade effluent charges for the whole untreated discharge, even if this were feasible. The plant provided turned out to be larger than strictly necessary for the BOD load that has in fact been produced. There does however, appear to be a slight cost advantage in treating to the higher standard. (Lantz-PTT)
W86-04522

MECHANISMS OF DYE WASTEWATER COLOUR REMOVAL BY MAGNESIUM CARBONATE-HYDRATED BASIC,

Chulalongkorn Univ., Bangkok (Thailand). Faculty of Engineering.
T. Panswad, and S. Wongchaisuwan.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 139-144, 1986. 3 fig, 1 tab, 14 ref.

Descriptors: *Wastewater treatment, *Color removal, *Dye industry wastes, Alum, Quick lime, Chemical treatment, Magnesium carbonate, Flocculation, Calcium carbonate, Calcium hydroxide, Magnesium hydroxide, Sorption.

Alum and quick lime are the common chemicals used presently as coagulants in color removal from dye wastewaters. However, these chemicals were found to be ineffective in color reduction, especially when the dyestuff was the reactive dye type. Magnesium carbonate was then suggested as a substitute coagulant in the water treatment process with reports indicating good results in color removal from textile dye wastewaters. Since high grade magnesium carbonate is not readily available, pure hydromagnesite or magnesium carbonate-hydrated basic (3MgCO3.Mg(OH)2.H2O), which hereafter shall be referred to as MCHB, was selected and investigated. The capability of alkaline MCHB in terms of color reduction from a reactive red dye wastewater was examined, and its color removal mechanisms analyzed. Other flocculants, such as CaCO3 ppt. and Ca(OH)2 solids formed from other reactions were also investigated for comparison purposes. The raw wastewater was synthetic containing 300 mg/cu dm reactive red dye 519. It has been found that no single flocculant (Mg(OH2), Ca(OH)2 or CaCO3) can satisfactorily effect color removal. The effective color reduction achieved using alkaline magnesium carbonate-hydrated basic has been attributed to the synergistic sorbing capacity of the flocculants Mg(OH)2 and CaCO3. (Lantz-PTT)
W86-04523

OPTIMIZATION OF THE ICP WORKING CONDITIONS FOR THE ANALYSIS OF WASTE WATERS AND INDUSTRIAL SOLUTIONS,

Institute 'Niprorude', Sofia (Bulgaria).
For primary bibliographic entry see Field 5A.
W86-04548

MUNICIPAL PRETREATMENT PROGRAM GOES ON LINE,

Hubbell, Roth and Clark, Inc., Bloomfield Hills, MI.
G. E. Hubbell, R. Zietz, and W. Ewing.
Water Engineering and Management WENMD2, Vol. 133, No. 1, p 22-24, January 1986. 5 tab.

Descriptors: *Industrial waste pretreatment, *Industrial wastewater, *Data storage and retrieval, *User survey, *Monitoring, *Industrial wastewater, Funding, Michigan, Analysis, Sludge, Sludge cake, Metals, Asbestos, Phenols.

The Flint, Michigan, industrial pretreatment program is described in terms of the following aspects: master plan, user survey, discharge limitation development, evaluation of equipment needs, development of funding mechanisms, and data base management system. Information on user classification, results of testing primary sludge, secondary sludge, filter cake, and effluent for metals, asbestos, and phenols, the monitoring schedule employed, equipment requirements, and personnel requirements is presented. The Flint program involves more than 3,700 industrial and commercial businesses. Its goals are: to prevent interference with the operation of publicly owned treatment works (POTW), to prevent the introduction of toxic and incompatible pollutants into POTW that will receive inadequate treatment and will pass through harmful quantities and concentrations, and to prevent the contamination of sewage sludge and thus limit sludge management alternatives and increase operational cost of the POTW. (Rochester-PTT)
W86-04549

TWO OPTIONS FOR TREATMENT OF ACIDIC ORGANIC INDUSTRIAL WASTES,

Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
N. Milliot, N. Dalga, and N. Foussard.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 5-17, 1986. 4 fig, 7 tab, 7 ref.

Descriptors: *Industrial wastes, *Organic wastes, *Acidic wastes, *Waste treatment, *Wet oxidation process, Organic compounds, Waste disposal, Solidification, Sludge.

The treatment of acidic, organic, industrial waste poses many problems. These wastes are characterized by a high organic concentration and pH values approaching zero. The classic treatment processes (incineration, physicochemical treatment, solidification) are plagued by problems with corrosion, by-products formation and ultimate disposal. This paper proposes two new processes for treating these wastes. The first technique is a pressurized oxidation process at high temperature. Wet oxidation requires a major investment of about $2 million, but has the advantage of permitting very high degrees of oxidation whatever the type of organic waste to be treated. The treated effluents have low organic contents, which make it possible to envisage the application of conventional biological or physicochemical treatment before their disposal. Results show total organic carbon (TOC) removal above 96%. The second proposed technique is an improved solidification which incorporates an adsorbent into the solid to immobilize the organic content. A very thick sludge (solids about 60%) is obtained which dries very quickly. Tests on the solids indicate that any leachate formed will be much lower in strength than leachate from the classic solidification process. Landfill disposal of the solidified waste is possible under proper conditions. (Lantz-PTT)
W86-04561

HEAVY METAL REMOVAL IN THE PRESENCE OF COLLOID-STABILIZING ORGANIC MATERIAL AND COMPLEXING AGENTS,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Licsko, and I. Takacs.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 19-29, 1986. 14 fig, 6 ref.

Descriptors: *Heavy metals, *Colloids, *Organic compounds, *Stabilizing agents, Complexing agents, Wastewater treatment, Magnesium, Copper, Zinc, Chromium, Nickel, Cadmium, Ammonium salts, Hydrogen ion concentration, Phase separation.

It has been established in laboratory model experiments that the removal of dissolved heavy metals from wastewaters is rendered more difficult in the presence of colloid-stabilizing agents. This unfavorable effect can be eliminated by the addition of Mg(2+) ions and the adjustment to a fairly high pH. By increasing the concentration of Mg(2+) ions, the pH necessary for destroying the stability of colloidal dispersion can be lowered. These findings also apply to the combined removal of different heavy metals (Cu, Zn, Cr(III), Ni, Cd). In alkaline conditions, in the presence of ammonium salts, some heavy metals (Cu, Zn, Ni) form high stability amine complexes. A higher pH is necessary for the breakdown of these complexes and the satisfactory removal of heavy metals. (Author's abstract)
W86-04562

TREATMENT OF TAR SAND WASTEWATERS WITH ACTIVATED CARBON, OZONE AND REVERSE OSMOSIS,

Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
R. A. Sierka, and P. H. King.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 43-54, 1986. 2 fig, 5 tab, 20 ref.

Descriptors: *Wastewater tretment, *Activated carbon, *Ozonation, *Reverse osmosis, Tar sands, Vernal, Utah, Combustion, Ozone, Stream flooding, Total organic carbon.

Tar sand deposits offer long-term potential for satisfying future energy needs. Two large field-scale extraction experiments near Vernal, Utah, employed either a sequenced reverse-forward combustion technique (TS-2C) or a steam flooding procedure (TS-1S) to recover in-place bitumen. This report documents the evaluation of activated carbon, ozone and reverse osmosis in treating the two types of tar sand wastewaters. Substrates included untreated and pretreated (filtration, foam fractionation, chemical treatment with ferric chlo-

ride) TS-18 and TS-2C wastewaters. Activated carbon, at a dose of 1,000 mg/L, reduced the Total Organic Carbon (TOC) of TS-18 wastewater after treatment by 350 mg/L of ferric chloride to 2.3 mg/L TOC, a reduction of 91.6%. At the same adsorbent dose, activated carbon reduced the TOC in TS-2C wastewater from 678 mg/L to 546 mg/L. A study of the six commercially available adsorbents yielded little difference in adsorption capability for either wastewater. Ozonation of TS-18 wastewater after pretreatment by either foam fractionation or chemical treatment with ferric chloride then activated carbon yielded residual TOC levels of less than 1.2 mg/L. Reverse osmosis (RO) studies included investigation of four membrane types (cellulose acetate, poly-ether amide, poly-ether urea and a noncellulosic on a poly-sulfone base), three applied pressure levels (250, 400 and 550 psig) and two solution pH levels (5.5 and 7.8) with 5.0 micron filtered TS-2C wastewater as the substrate. A two-stage RO process achieved maximum organic and inorganic rejections of 98% and 97%, respectively. (Author's abstract)
W86-04564

WATER TREATMENT BY MEANS OF ACTIVATED CARBON, PREPARED FROM LOCALLY AVAILABLE WASTE MATERIALS (II),

Vrije Univ., Brussels (Belgium). Dept. of Industrial Chemistry.
H. Keirsse, F. van Hoof, J. Janssens, and A. Buekens.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 55-66, 1986. 7 fig, 4 tab, 5 ref.

Descriptors: *Activated carbon, *Wastes, Carbonization, Activation, Local wastes, Fluidized bed reactor, Adsorption, Cacao hulls, Sawdust, Fruit stones, Bark, Industrial wastewater, Thermal properties.

Man's natural water supplies are threatened by a large number of nonbiodegradable and toxic organic compounds. Proper environmental standards often can only be attained using tertiary treatment process, such as adsorption on activated carbon. The latter is an expensive process, owing to the initial cost of activated carbon and the losses occurring during regeneration. Methods are being investigated at the Free University of Brussels for producing and activating carbon, using various types of waste as a raw material. The following materials have already been used: cacao hulls, sawdust, fruit stones, bark, and waste tyres. Both carbonization and activation have been conducted under the carefully controlled conditions of a fluidized bed reactor. The influence of the following process parameters has been investigated: pyrolysis temperature and time, activation temperature and time, and composition of the furnace atmosphere. The resulting activated carbons should exhibit the following qualities: high adsorption capacity and rate, good resistance to attrition, and possibility of regenerating the carbon. The properties of the carbon obtained have been evaluated by means of a number of standard tests (Iodine-index, BET-surface, Tannin-index, Methylene blue-index, and Phenol-index), and adsorption isotherms of phenol, pentachlorophenol, p. toluene sulphonate and dodecyl benzenesulphonate. In general the properties of the carbons obtained were comparable to those of commercial qualities. Some of the activated carbons tested will soon be evaluted using synthetic and real phenolic industrial wastewaters (1.5% of phenol). (Author's abstract)
W86-04565

ELIMINATION OF MICROPOLLUTANTS BY NAALO2 FLOCCULATION DURING PRIMARY TREATMENT OF MIXED WASTEWATER,

Brussels Univ. (Belgium). Lab. de Traitement des Eaux et Pollution.
J. P. Vanderborght, and R. Wollast.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 67-74, 1986. 6 fig, 5 tab, 4 ref.

Descriptors: *Micropollutants, *Sodium aluminate, *Primary wastewater treatment, Wastewater treatment, Flocculation, Suspended solids, Organic matter, Chemical oxygen demand, Heavy metals, Zinc, Cadmium, Copper, Chromium, Nickel, Phosphates.

Sodium aluminate, a well-known flocculating agent occasionally used in the water supply industry, has never veen in serious competition with other chemicals such as aluminum sulfate or ferric chloride for the physicochemical treatment of wastewater. The development of a new method for the treatment of wastewater from aluminum anodization plants, in addition to successful disposal of the spent liquors of this major industrial activity, could lead to a large production of concentrated NaAlO2 solution under attractive economical conditions, and turn sodium aluminate into a valuable alternative to more classical flocculating agents. To evaluate the performance of NaAlO2 flocculation in the primary treatment of domestic wastewater has been purpose of this two-year laboratory and field study. It was demonstrated that, for suspended solids (S.S.) concentrations in the range of 200 - 350 mg/l, flocculation with sodium aluminate at concentrations ranging from 30 to 100 mg AlO2/l could increase the S.S. removal from a typical value of 40% without floccuation to those as high as 70%. For organic matter, a 40% removal of the total COD was reached (75% of the particulate COD), as compared with a 20% removal in the primary treatment without flocculation. Phosphate removal was always greater than 90%, with residual PO4(3-) concentrations below 1 mg P/l. In comparison with the primary sedimentation, aluminate addition results in a lower residual concentration for Zn and Cd. For all metals under investigation (Cu, Cr, Zn, Cd, and Ni), the removal was found to be irreversivle. Biological treatment was uninhibited by an addition of these metals when NaAlO2 - flocculation was provided. (Lantz-PTT)
W86-04566

UPGRADING OF A WASTEWATER TREATMENT PLANT IN A CHEMICAL FACTORY,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
P. Benedek, I. Takacs, and I. Vallai.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 75-82, 1986. 2 fig, 2 tab, 13 ref.

Descriptors: *Wastewater facilities, *Chemical wastewater, *Chemical industry, Industrial wastewater, Micropollutants, Organic compounds, Organic loading, Powdered activated carbon, Biodegradation, Sludge, Foaming.

Full-scale experiments were conducted to study the wastewater treatment plant of a chemical factory. The objective of the study was to upgrade the overloaded biological activated sludge system by powdered activated carbon addition. Improvement of the organic micropollutant removal characteristics was also expected on the basis of previous experiments. Despite the sometimes unfavorable conditions, (e.g. lack of oxygen), 30-40% improvement in performance could be achieved on the powdered activated carbon (PAC), biological treatment plant compared to the control unit. Discharging equal effluent quality, the PAC unit could be overloaded by 20% without any decrease in efficiency. The optimal PAC dose was relatively low, less then 100 g/cu m despite the high organic content of the influent (COD = 3000 g/cu m). Applying PAC dosage would lead to a 20-30% increase in operational costs. Foaming and sludge were no longer a problem, and the sludge volume index decreased to 20 l/kg. An important result of the process is a 20-50% decrease in the concentration of micropollutants compared to that of the control unit. The inclusion of PAC dosage in the treatment line would therefore contribute to the improvement of the receiving waters. (Lantz-PTT)
W86-04567

ALGAE REACTIONS TO MINERAL AND ORGANIC MICROPOLLUTANTS, ECOLOGICAL CONSEQUENCES AND POSSIBILITIES FOR INDUSTRIAL-SCALE APPLICATION: A REVIEW (REVUE DES REACTIONS DES ALGUES AUX MICROPOLLUTANTS MINERAUX ET ORGANIQUES; CONSEQUENCES ECOLOGIQUES ET POSSIBILITIES D'APPLICATIONS INDUSTRIELLES),

Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5C.
W86-04568

DISSOLVED AIR FLOTATION FOR ABATTOIR WASTEWATER,

Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
D. A. Lovett, and S. M. Travers.
Water Research WATRAG, Vol. 20, No. 4, p 421-426, April 1986. 8 fig, 16 ref.

Descriptors: *Industrial wastewater, *Dissolved air flotation, Flotation, Wastewater treatment, Suspended solids, Chemical oxygen demand, Saturator pressure, Fat, Removal efficiency.

The performance of laboratory-scale dissolved air flotation plants treating abattoir wastewater has been measured for saturator pressures from 100 to 550 kPa, wastewater suspended solids concentrations from 170 to 2100 mg/l and air-to-solids ratios from 0 to 0.17. Maximum removal efficiencies for chemical oxygen demand, suspended solids and fat wre 70, 50, and 95% respectively, at high wastewater suspended solids contents and high air-to-solids ratios. Pressure did not greatly influence the size of the bubbles generated in the process, or the removal efficiencies. High air-to-solids ratios were necessary to obtain maximum removal efficiencies and to prevent appreciable settling of the suspended solids. (Author's abstract)
W86-04570

DYNAMIC MODELLING OF ANAEROBIC DIGESTION,

Institut National de la Recherche Agronomique, Massy (France). Station de Technologie Alimentaire.
R. Moletta, D. Verrier, and G. Albagnac.
Water Research WATRAG, Vol. 20, No. 4, p 427-434, April 1986. 9 fig, 3 tab, 15 ref.

Descriptors: *Dynamic modeling, *Anaerobic digestion, *Mathematical models, Model studies, Wastewater treatment, Bacteria, Biomass, Metabolites, Methane bacteria, Acid bacteria, Carbon dioxide.

The anaerobic digestion model presented here considers a two step process. First, acidogenic bacteria convert glucose into acetate then methanogenic bacteria convert this acid into methane and carbon dioxide. The biomass and metabolite production rates are described by distinct mathematical relationships. Therefore, there is not a direct relationship between the growth and the energy production related to metabolite formation. The inhibitory effects of the unionized acid concentration on growth rate of both bacterial populations and the methane production from acetate were considered separately. The model was tested in batch cultures with two types of organic loads, i.e. pea bleaching wastewaters and a synthetic substrate containing sucrose and organic acid. The model simulated satisfactorily the methane production under very different operational conditions. (Author's abstract)
W86-04571

EXTERNAL MASS TRANSFER DURING THE ADSORPTION OF VARIOUS POLLUTANTS ONTO ACTIVATED CARBON,

Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, M. J. Bino, and A. Altememi.
Water Research WATRAG, Vol. 20, No. 4, p 435-442, April 1986. 10 fig, 8 tab, 7 ref.

Descriptors: *Mass transfer, *Activated carbon, *Water treatment, *Water pollution treatment, Phenols, Adsorption, Model studies, Mathematical studies, Sherwood number, Schmidt number, Mercury, Sodium dodecylate.

A wide range of experimental studies are reported for the adsorption of phenol and p-chlorophenol onto activated carbon - Type *Filtrasorb* 400 - in an

agitated batch adsorber. A model has been used to determine the external mass transfer coefficient for the systems and the effect of several experimental variables have been investigated. These include agitation, initial pollutant concentration, carbon mass, carbon particle size and solution temperature. The mass transfer coefficient has been correlated in terms of the dimensionless Sh/Sc(0.33) against each variable. The Sherwood number, Sh=k sub f R/D sub mol, relates the external mass transfer coefficient k sub f to particle radius, R, and molecular diffusivity, D sub mol. The Schmidt number, Sc, is the ratio of kinematic viscosity, v, to molecular diffusivity. Results indicate that overtime, the uptake for the adsorption of SDS (sodium dodecyl sulfate) and p-chlorophenol onto activated carbon, levels off rapidly after about 1-hr of contact. In addition, when the external mass transfer coefficient (k sub f, which depends on the driving force/unit area), increasing the mass of carbon increases the surface area for adsorption, thereby increasing the rate of pollutant removal. (Lantz-PTT)
W86-04572

COMBINED USE OF CALCIUM SALTS AND POLYMERIC ALUMINIUM HYDROXIDE FOR DEFLUORIDATION OF WASTE WATERS,

Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
N. Parthasarathy, J. Buffle, and W. Haerdi.
Water Research WATRAG, Vol. 20, No. 4, p 443-448, April 1986. 4 fig, 7 tab, 19 ref.

Descriptors: *Calcium fluoride, *Calcium, *Polymeric aluminum hydroxide, *Defluoridation, Industrial wastewaters, Fluorides, Kinetics.

The combined use of calcium salt and polymeric aluminum hydroxide (P) for treatment of fluoridated wastewater has been described. In the proposed method of treatment the calcium ions act as the precipitant and polymeric aluminum hydroxide as the coagulant. At low fluoride concentrations (0.002 M) the precipitation reaction of calcium fluoride is a slow process. The residual fluoride concentrations found experimentally approached the theoretically predicted values only at high calcium concentrations (F sub t/ Ca sub t molar ratio=0.24) and for long equilibrium times. The addition of calcium fluoride seeds (approx. 20 mg/l) accelerated the precipitation process and the results obtained for the residual fluoride concentrations were close to the theoretically calculated ones regardless of the calcium ion concentration used. Under these conditions fine CaF2 precipitate with poor settleability was formed. The addition of small amounts of polymeric aluminum hydroxide, P, (F/Al molar ratio=10) greatly facilitates the settleability of the precipitate. The advantage of using P over alum for the removal of fluoride is that less concentration of the former is required and the reproducibility of the results are good. The effect of sulphate on the precipitation of calcium fluoride has been also studied. Tests with fluoride containing wastewater collected from aluminum industry showed that fluoride can be effectively removed. (Author's abstract)
W86-04573

ENHANCEMENT OF MERCURY (II) SORPTION FROM WATER BY COAL THROUGH CHEMICAL PRETREATMENT,

Sri Venkateswara Univ., Tirupati (India). Dept. of Civil Engineering.
J. Karthikeyan, and M. Chaudhuri.
Water Research WATRAG, Vol. 20, No. 4, p 449-452, April 1986. 4 fig, 12 ref.

Descriptors: *Mercury, *Sorption, *Chemical pretreatment, *Coal, *Pretreatment of water, Industrial wastewater, Wastewater treatment, Wastewater purification, Heavy metals, Oxidation, Nitric acid, Hydrogen peroxide, Sulfurization, Manganese oxide, Municipal wastewater.

Utilization and exploitation of mercury and mercury-based technology coupled with inadequate disposal of mercury laden waste pose an increasing threat of environmental contamination. Addition of mercury through waste discharges into natural bodies of water is of serious concern today because of probable entry of mercury into the food chain apart from possible direct ingestion. Consequently, removal of mercury from water and wastewater assumes importance. High capital and regeneration costs of active carbon and ion-exchange resins have resulted in a search for suitable alternative sorbents and to this end bituminous coal was investigated as a sorbent for removing mercury from water. A limited study has indicated the potential of coal surface modification through chemical pretreatment in enhancing mercury sorption. This communication reports the results of a detailed study on enhancement of mercury(II) sorption from water by bituminous coal through chemical pretreatment, explored in the laboratory using batch sorption tests and downflow column studies. Both intensity of sorption and equilibrium sorptive capacity were enhanced significantly following nitric acid and hydrogen peroxide oxidation. Sulfurization and manganese oxide impregnation also showed promise. The chemically pretreated coal sorbents exhibited mercury sorption to a level higher than that accomplished using active carbon. Nitric acid or hydrogen peroxide oxidized or sulfurized coal may well replace active carbon in polishing mercury laden waste following sulfide precipitation or removing mercury during municipal water treatment. This study is of significance in terms of mercury pollution control in the developing countries where imported active carbon or ion-exchange resins are very expensive. (Lantz-PTT)
W86-04574

EFFECTS OF TEMPERATURE SHOCK TREATMENTS ON THE STABILITY OF ANAEROBIC DIGESTERS OPERATED ON SEPARATED CATTLE SLURRY,

Polytechnic of Wales, Pontypridd. Dept. of Science.
M. W. Peck, J. M. Skilton, F. R. Hawkes, and D. L. Hawkes.
Water Research WATRAG, Vol. 20, No. 1, p 453-461, April 1986. 9 fig, 1 tab, 29 ref.

Descriptors: *Temperature effects, *Anaerobic digestion, *Farm wastes, *Cattle, *Slurries, Volatile fatty acids, Digesters, Anaerobic bacteria, Methanogenic bacteria.

Using laboratory scale daily fed digesters operating at steady-state on separated cattle slurry, the temperature was lowered in a similar manner to that which might be expected on a farm due to heating failure; three different recovery methods were then tested. Raising the operating temperature from 3-6 C to 35 C in a single day had only a transient effect on digester stability. Steady-state conditions were reestablished within 8 days of the temperature rise when a 25-day retention time was employed and within 6 days at 10-day retention time. However, slowly raising the operating temperature (over several days) had a more deleterious effect on digester stability. When a 25-day retention time was employed, 10 days were required from the initial temperature rise before steady-state conditions were reestablished, while at a 10-day retention time the period was greater than 12 days. It is therefore proposed that the digester temperature should be raised back up to the normal operating temperature as soon as possible after a heating failure. Digesters which were not fed during the recovery period showed a rapid removal of potentially toxic volatile fatty acids, and this procedure is recommended in the period following temperature shock. The main indicator of digester instability was a dramatic but unequal rise in the concentration of the individual volatile fatty acids. An order of sensitivity to the temperature shock treatment was established: i-butyrate - i-valerate - i-caproate > proprionate > n-valerate - n-caproate > acetate - n-butyrate. Those to the left accumulated most rapidly in the temperature stressed digester, and were removed least quickly during the recovery period. The bacteria responsible for the breakdown of the higher volatile fatty acids (presumably the obligate proton-reducing bacteria) were more sensitive to the shock treatment applied than those catabolizing acetate (presumably the acetate-utilizing methanogenic bacteria). The concentration of the branched volatile fatty acids and propionic acid were the most sensitive to the temperature shock treatment, and therefore represent more sensitive monitors of digester stability than acetic acid or the total volatile fatty acid concentration. (Author's abstract)
W86-04575

BIODEGRADATION PATHWAY OF O-CRESOL BY HETEROGENEOUS CULTURE: PHENOL ACCLIMATED ACTIVATED SLUDGE,

National Research Inst. for Pollution and Resources, Yatabe (Japan).
S. Masunaga, Y. Urushigawa, and Y. Yonezawa.
Water Research WATRAG, Vol. 20, No. 4, p 477-484, April 1986. 10 fig, 1 tab, 21 ref.

Descriptors: *Biodegradation, *Orthocresol, *Heterogeneous cultures, *Phenols, *Activated sludge, Gas chromatography, Mass spectrometry, Dihydroxytoluenes, Pathways, Cresol.

The biodegradation process of 0-cresol by heterogeneous culture is presented in this paper. Metabolic intermediates of o-cresol by phenol acclimated activated sludge were analyzed by GC-MS. o-Cresol was first transformed to three dihydroxytoluenes; 3-methylcatechol, r-methylresorcinol and methylhydroquinone. Three dihydroxytoluene biodegradation experiments with 3-methylcatechol, 4-methylresorcinol and methylhydroquinone revealed that 3-methylcatechol was the main route, and 3-methylcatechol was further degraded through at least two meta cleavage pathways. Various hydroxylated toluenes, namely trihydroxytoluenes and tetrahydroxytoluene were also found among the metabolites from 3-methylcatechol, 4-methylresorcinol and methylhydroquinone. These results indicated that various metabolism with main and side pathways coexisted in the biodegradation process by the heterogeneous culture. (Author's abstract)
W86-04578

INHIBITION OF THE ACTIVITIES OF BETA-GALACTOSIDASE AND DEHYDROGENASES OF ACTIVATED SLUDGE BY HEAVY METALS,

Yamanashi Univ., Kofu (Japan).
K. Katayama-Hirayama.
Water Research WATRAG, Vol. 20, No. 4, p 491-494, April 1986. 6 fig, 2 tab, 15 ref. Ministry of Science, Culture and Education Grant No. 575458.

Descriptors: *Beta-galactosidase, *Dehydrogenases, *Activated sludge, *Heavy metals, *Inhibition, Cadmium, Mercury, Mixed liquor suspended solids, Mercaptides, Kinetics.

Heavy metal inhibitions of the activities of beta-galactosidase and dehydrogenases in activated sludge were studied. The activities of beta-galactosidase and dehydrogenases were strongly inhibited by Cd and Hg. To produce 50% inhibition of beta-galactosidase by Cd and Hg required 1.3 and 0.0004 mmol/g mixed liquor suspended solids (MLSS), respectively. In the case of dehydrogenases, 50% inhibition appeared by Ac 0.16 and Hg 0.04 mmol/g MLSS, respectively. The inhibitions of the activities of beta-galactosidase and dehydrogenases with Cd and Hg were easily recovered with the addition of thiol compounds. Reactivation by thiols suggested that Cd and Hg form reversible mercaptides with SH groups of beta-galactosidase and dehydrogenases. The inhibitions of the activities of beta-galactosidase and dehydrogenases by Cd and Hg gave reversible non-competitive type of kinetics. The inhibitor constant (K sub i) values of beta-galactosidase for Cd and Hg were calculated to be 1.6 mM (1.7 mmol/g MLSS) and 0.005 mM (0.005 mmol/g MLSS), respectively. K sub i values of dehydrogenases for Cd and Hg were 0.06 mM(0.3 mmol/g MLSS) and 0.02 mM (0.01 mmol/g MLSS), respectively. (Author's abstract)
W86-04580

SEPARATION OF THE PROPIONATE DEGRADATION TO IMPROVE THE EFFICIENCY

OF THERMOPHILIC ANAEROBIC TREATMENT OF ACIDIFIED WASTEWATERS,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
W. M. Wiegant, M. Hennink, and G. Lettinga.
Water Research WATRAG, Vol. 20, No. 4, p517-524, April 1986. 8 fig, 3 tab, ref.

Descriptors: *Propionate, *Biological degradation, *Anaerobic digestion, *Acidic water, Thermophilic bacteria, Wastewater treatment, Chemical degradation, Sludge.

In High-rate anaerobic treatment systems propionate usually is the first compound of which the breakdown deteriorates. Apparently the degradation of proprionate is very delicate. In its complete degradation, three bacteria are involved, of which the first converts propionate into acetate, hydrogen and carbonate. The other two are methanogens, converting acetate and carbonate plus hydrogen to methane. Specimens of all three bacterial groups, relevant for mesophilic high rate systems with a high biomass retention, have been isolated and described. In this paper the propionate degradation in thermophilic systems is studied. A two-stage process is developed, in which the propionate degradation is spatially separated from other conversion in which hydrogen is involved. Significantly better results were obtained with the two-stage system as compared with a one-stage system with an equal total volume: loading rates of 20-50 COD/cu m/day showed a 10-13% better treatment efficiency in the two-stage system. It is concluded that the removal of the biogas evolved in the first degradation processes is the cause of the superior performance of the two-stage system. (Lantz-PTT)
W86-04584

ECOLOGY OF SCUM CAUSING ACTINOMYCETES IN SEWAGE TREATMENT PLANTS,

Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
H. Lemmer.
Water Research WATRAG, Vol. 20, No. 4, p 531-535, April 1986. 1 fig, 34 ref. Grant No. PO 231/1-1,2.

Descriptors: *Scum, *Actinomycetes, *Wastewater treatment, Biomass, Activated sludge, Aeration, Microzones, Hydrophobes, Sludge, Flocculation.

Activated sludge scumming, a severe separation problem in sewage treatment plants, is caused in most cases by a high biomass of nocardioform actinomycetes. The aeration tank as a biotope is characterized by low average nutrient concentrations with nutrient-enriched microzones. Possible mechanisms for enrichment are discussed. Actinomycetes need high nutrient concentrations and therefore have to compete for the enriched microzones. The strategies they use encompass the ability to live saprophytically on dead cells, to use refractory organic compounds adsorbed to the sludge floc which are only slowly degraded by other organisms and the adherence to air-water and oil-water interfaces caused by the hydrophobicity of their cell wall. Adherence of air bubbles in the hyphae net causes buoyancy by which the sludge scums. Actinomycetes as former soil inhabitants are better adapted than their competitors to the conditions of dryness and ultraviolet radiation prevailing in this scum fraction. (Author's abstract)
W86-04586

KINETICS OF METHANOGENS IN AN EXPANDED-BED REACTOR,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-04587

FLOCCULANT SETTLING DYNAMICS UNDER CONSTANT LOAD,

Tennessee Eastman Co., Kingsport.
B. F. Severin, and R. A. Poduska.
Journal of Environmental Engineering JOEEDU, Vol. 112, No. 1, p 171-184, February 1986. 9 fig, 3 tab, 12 ref, append.

Descriptors: *Flocculation, *Clarification, Clarifiers, Settleable solids, Sludge, Chemical coagulation, Wastewater treatment, Activated sludge process, Dynamics, Model studies, Load distribution.

A model for predicting the rate of rise or fall of a sludge blanket in an overloaded or underloaded condition is developed from the steady state solids flux theory of clarification. This rate of failure model was verified with substantiating data from a laboratory-scale clarifier with ferric hydroxide floc. The model allows for more rapid assessment of flux balances than previously possible. Once a value of the empirical settling parameter is measured, calculation of the dimensionless loading parameter and underflow parameter is all that is needed to predict blanket stability and blanket dynamics. The model can be used as a functional on-line tool for clarifier control, and may be extended to cover utility for full-scale clarifiers in the activated sludge process. (Geiger-PTT)
W86-04588

LEAST-COST ACTIVATED SLUDGE DESIGN USING A MICROCOMPUTER,

National Univ. of Singapore. Dept. of Civil Engineering.
S. L. Ong.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 245-251, April 1985. 2 tab, 13 ref, 1 append.

Descriptors: *Design criteria, *Activated sludge, *Computer models, *Marginal costs, Activated sludge process, Optimization, Mathematical models, Model studies, Mathematical studies, Wastewater treatment.

This article concerns the application of a microcomputer for the design of a least-cost activated sludge system. The activated sludge system is assumed to consist of an aeration tank and a clarifier connected in series. The activated sludge system is modelled as a mathematical programming problem, containing an objective function and a set of constraint equations. The objective function represents the total cost function of the activated sludge system, and the constraint set describes the biological and clarification processes. The resulting model is solved by a random sampling and search region contraction technique. This optimization technique is simple and can easily be adapted to any microcomputer system. From the results of this study, the least-cost design approach is considered to be very effective. (Author's abstract)
W86-04602

TEMPERATURE EFFECTS ON ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEM,

Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan.
Journal of Environmental Health JEVHAH, Vol. 48, No. 1, p 10-13, July/August 1986. 1 fig, 1 tab, 15 ref.

Descriptors: *Biological wastewater treatment, *Aerobic processes, *Anaerobic processes, *Septic tanks, *Temperature effects, Wastewater treatment, Wastewater disposal, Soil temperature, Performance evaluation, Land disposal, Waste disposal, Ottawa, Ontario.

Briefly reviewed are temperature effects on aerobic and anaerobic biological processes relevant to onsite wastewater disposal systems. The onsite systems considered are septic tank systems with conventional soil absorption and mound disposal options, septic tank-anaerobic filter systems, and aerobic package plants. In addition, temperature and performance data on a septic tank and tile field system near Ottawa are presented. In general, winter operation did not pose any special problems in the case of septic tank systems studied. No specific trend between soil temperatures (depth-dependent) and pollutant removal efficiencies could be identified based on the Ottawa study. The anaerobic filter treatment of septic tank effluent shows great promise especially with respect to its use for low temperature operation. In the case of aerobic package units, low air temperatures were found to be not directly responsible for poor operation, as liquid temperatures in the aeration tank were near 20 degrees. (Geiger-PTT)
W86-04606

DEVELOPMENTS IN SLUDGE DEWATERING.

BioCycle BCYCDK, Vol. 27, No. 3, p 22-23, March 1986. 1 tab.

Descriptors: *Dewatering, *Sludge drying, *Sludge thickening, Sludge conditioning, Sludge disposal, Drying, Wastewater treatment, Waste disposal, Sludge filters, Filtration.

Researchers at Battelle Memorial Institute in Columbus, Ohio are making improvements on an electoacoustic dewater process to augment conventional devices such as vacuum filters. This process has much application in composting facilities to reduce the amount of bulking agent required. At a Phoenix, Arizona wastewater treatment facility, solar drying techniques have been tested for several years. Another approach to solar sludge drying has been developed by the Sandia National Laboratories in New Mexico. This process includes a greenhouse, a crossbar conveyor and 12-inch ports for aeration. Further studies are planned by Sandia to balance drying and heating operations for year round use. The Tough Stuff Filtration system developed by the AFL Industries in Riviera Beach, Florida is basically a gravity dewatering process with the weight of the sludge doing the squeezing. Jacksonville, Florida selected a sludge dewatering and disposal system of three centrifuges, combined with two centrifuges installed in place of the plant's original four vacuum filters. This system not only eliminated the dewatering bottleneck, it also reduced polymer costs, electrical costs, and mechanical support costs, while increasing overall sludge cake dryness and throughput. In the paper industry, the most common dewatering technologies include vacuum filters, belt presses and solid bowl centrifutes. There is a trend toward the use of belt presses which can dewater secondary sludges to 12 to 14% solids, primary sludges 35% solids, and primary/secondary sludge mixtures to 16 to 25% solids. (Geiger-PTT)
W86-04612

INDUSTRIAL WASTE CONTROL PROGRAM: MASS BALANCE OF TOXICS IN A MUNICIPAL POLLUTANTS WASTEWATER SYSTEM,

York City Environmental Services Dept., PA.
C. E. Strehl, J. M. Longstreet, and C. S. Smith.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 2, p 10-14, March-April 1986. 2 tabs.

Descriptors: *Water pollution sources, *Industrial wastes, *Wastewater treatment, *Heavy metals, Toxins, Industrial wastewater, Monitoring, Wastewater analysis, Wastewater composition, Waste management, Wastewater facilities, Ammonia, Municipal wastewater, Influent streams.

As part of a plan to upgrade its industrial waste monitoring program in 1984, the York City Wastewater Treatment Plant began monitoring levels of Cd, Cr, Cu, Fe, Pb, Ni, Ag, Zn, and ammonia in the influent industrial loadings to the plant. Significant non-industrial contributions of toxic metals were found in a well controlled system when industrial and non-industrial sources of the pollutants were compared through a system that involved balancing amounts found in industrial and non-industrial wastewaters and the influent of a regional treatment plant. The sum of the industrial and non-industrial contributions of Zn and Cu, the two toxic pollutants of most concern in the York system, were balanced to within 1% and 5%, respectively, of the influent loadings observed at the treatment plant. The small differences observed for these pollutants suggests that the method of mass balancing shows promise for assessing the success of industrial pretreatment pro-

grams and for determining the sources of toxic pollutants in municipal systems. (Geiger-PTT)
W86-04615

PENNSYLVANIA'S PILOT OUTREACH OPERATOR TRAINING PROGRAM,

Commonwealth Engineering and Technology, Inc., Harrisburg, PA.
R. Myers, and C. Kuder.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 2, p 18-24, March-April 1986. 2 tab.

Descriptors: *Education, *Training, *Wastewater facilities, Personnel, Benefits, Management planning, Operating policies, Water quality standards, Computer models, Personnel management.

The 1972 Federal Water Pollution Control Act provided funding for the Pennsylvania Pilot Outreach Operator Training Program. The primary objective of the program was to demonstrate that treatment plants unable to meet effluent limitations because of inadequate operator skills can achieve compliance with some outside technical assistance and training. The program was carried out in two phases. In the Diagnostic Evaluation Phase, 20 plants were selected as best suited for training and technical assistance by a computer diagnostic operational modeling program. In the Training Program Phase, the training and technical assistance for the ten plants selected based on the diagnostic evaluation process were organized to systematically correct the deficiencies noted at each plant through intensive, on-site, individual assistance. Questionnaires singled out the plants requiring additional personnel training and assessed the effectiveness of training at each plant. Varying degrees of effluent improvements were achieved as a result of the training program. Documented major improvements where permit effluent limit compliance was achieved were realized at forty percent of the ten plants receiving training. In addition, moderate effluent improvements were observed at four other plants. The information gleaned in this training program will be used in developing a self-sufficient continuing training program in the Commonwealth. (Geiger-PTT)
W86-04616

AUTO-OXIDATION EFFECT ON FLUE GAS SLUDGE SYSTEMS,

R. W. Goodwin.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 10-20, September 1985. 10 fig, 3 tab, 15 ref.

Descriptors: *Dewatering, *Sludge thickening, *Flue gas desulfurization, *Sludge disposal, *Sludge conditioning, Sludge drying, Limestone, Oxidation, Fly ash, Wastewater treatment, Sulfates, Sulfur compounds, Waste disposal.

Upsets to flue gas desulfurization (FGD) sludge treatment systems of coal-fired powerplants may occur under auto-oxidation conditions. A 75-79% auto-oxidized FGD sludge exhibits a mean particle diameter of 45 microns - considerably larger than unoxidized particles. The oxidized sludge reaches terminal settling velocity five times faster than unoxidized material, and settles to higher densities and to thicker underflows. Rakearm overload and blanket consolidation can be avoided by proper drive mechanism design and underflow solids/density control, provided an 8 hr underflow surge/storage tank is recommended instead of thickener sludge blanket storage. Vacuum filtration of an 80% $CaSO_4$ sludge yields 25% greater solids in the cake as compared to a 30% oxidized material. To avoid cake-cracking, the degree of vacuum during incidents of auto-oxidation is reduced, and dual filtrate receivers are provided. Using predictive curves, a transportability analysis was performed on a coal of 0.59-0.91% sulfur and of 10.00-21.50% ash. Either filter by-pass or adding less fly ash to the cake resulted in a 75-85% solids transportability blend and enhanced the blend's landfill suitability. (Geiger-PTT)
W86-04634

GAS-LIQUID INTERACTIONS IN OXYGEN ACTIVATED SLUDGE,

Arkansas State Univ., State University. Dept. of Civil Engineering.
R. C. Clifft, and J. F. Andrews.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 61-77, February 1986. 10 fig, 1 tab, 9 ref, 1 append.

Descriptors: *Activated sludge process, *Models, *Aerobic treatment, *Oxygen, Simulation analysis, Biological wastewater treatment, Computer models, Dissolved oxygen, Mathematical models, Mathematical studies, Alkalinity, Hydrogen ion concentration.

A dynamic model was developed for the gas-liquid interactions of a closed-tank oxygen activated sludge system treating carbonaceous wastes. The model describes gas transfer between phases and accounts for equilibrium changes in the carbon dioxide-bicarbonate buffering system. Computer simulations of a four stage reactor were made to show model predictions when using the conventional gas phase controls. In additions, the effects of changing influent bicarbonate alkalinity, respiratory quotient, and gas-liquid volume ratio were studied. The dissolved oxygen concentration in the fourth stage varied widely and resulted in significant oxygen losses for the conventional control method. Influent bicarbonate alkalinity had a significant effect on pH, but changing the respiratory quotient had only a minimal effect on pH for moderate alkalinity wastewater. The gas-liquid volume ratio had a significant effect on the response time for changing the fourth stage gas composition. (Geiger-PTT)
W86-04641

PERFORMANCE OF DEEP BIOFILM REACTORS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 78-93, February 1986. 8 fig, 2 tab, 15 ref, append.

Descriptors: *Biofilm reactors, *Biological membranes, *Biological treatment, *Biological wastewater treatment, *Graphical methods, Mathematical models, Performance evaluation, Wastewater treatment, Mathematical studies, Biofilters, Anaerobic digestion, Aerobic digestion, Anoxic reactors.

The mathematical relationship between a bulk substrate concentration and the corresponding maximum substrate utilization rate was used in developing design nomograms for completely mixed, and plug-flow biofilm reactors. The graphical procedure can be used to estimate the smallest reactor empty-bed detention time that is needed to achieve a certain degree of waste stabilization. Biofilm reactors that are amenable to analysis using this procedure include fluidized-bed and packed-bed anaerobic, aerobic or anoxic reactors. Studies of the role of the attachment medium particle diameter revealed that the deep-biofilm reactor is extremely sensitive to this surface parameter. The empty-bed detention time in a deep-biofilm reactor was found to vary with the diameter of the medium particle, or with the inverse of the specific surface area of the attachment medium. (Geiger-PTT)
W86-04642

EFFECTS OF CD(II) AND CU(II) ON A BIOFILM SYSTEM,

Missouri Univ.-Rolla. Dept. of Civil Engineering.
S.-Y. Chang, J.-C. Huang, and Y.-C. Liu.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 94-104, February 1986. 5 fig, 2 tab, 18 ref.

Descriptors: *Cadmium, *Copper, *Biological wastewater treatment, *Toxicity, *Biological membranes, Heavy metals, Organic carbon, Sugars, Wastewater treatment, Separation techniques, Performance evaluation.

The toxic effect of Cd(II) and Cu(II) on a fixed-film rotating biological contactor (RBC) in treating a sugar waste was evaluated. Different levels of Cd (5 and 20 ml/L) and Cu (1, 5, 10, 25, and 50 mg/L) were doses to a three-stage RBC unit treating an influent of 300 mg/L sugar solution. Results indicated that the treatment efficiency was not adversely affected by the presence of Cu at a concentration of 10 mg/L or less. However, when the Cu concentrations were increased to 25 and 50 mg/L, removal of dissolved organic carbon was reduced by 7 and 10%, respectively. Toxicity was also observed when Cd concentration was either 5 or 20 mg/L. The majority of the doses metal was effectively retained by the biofilm. The efficiency of metal removal in the treatment system varied from 85 to 95% for Cd, and 30 to 90% for Cu, depending on their initial concentrations in the food solution. (Geiger-PTT)
W86-04643

MODEL FOR WINTER HEAT LOSS IN UNCOVERED CLARIFIERS,

Green (Howard R.) Co., Cedar Rapids, IA.
D. J. Wall, and G. Petersen.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 123-138, February 1986. 2 fig, 4 tab, 5 ref, 2 append.

Descriptors: *Mathematical models, *Clarifiers, *Heat flow, *Ice formation, Prediction, Computer models, Wastewater treatment, Clarification, Heat transfer, Mathematical studies, Mathematical equations, Temperature effects.

A heat transfer mathematical model was developed to predict the wintertime equilibrium temperatures and potential freezing in primary and secondary wastewaters clarifiers and other open tank. The model estimates equilibrium temperature in an open tank by balancing heat loss due to radiation, convection, and evaporation against heat input from influent flow to the tank and solar and radiation onto the surface of the tank. Data on wind speed, influent water temperature, influent flow, and ambient air temperature were collected and used to predict the clarifier water equilibrium temperature. The predicted water temperatures were then compared against the actual measured water temperatures of full-scale clarifiers. Heat losses in large open tanks such as clarifiers are actually much less than intuition would dictate. Based on the present model, heat losses in open tanks can be estimated under a variety of flow and weather conditions with and without wind breaks. Use of the model could be extended to holding tanks, aerobic digesters, equalization tanks, chlorination tanks, and other open tanks commonly used at wastewater treatment plants. (Geiger-PTT)
W86-04645

ENTEROVIRUSES IN SLUDGE: MULTIYEAR EXPERIENCE WITH FOUR WASTEWATER TREATMENT PLANTS,

Ohio State Univ., Columbus. Dept. of Medical Microbiology.
V. V. Hamparian, A. C. Ottolenghi, and J. H. Hughes.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 280-286, August 1985. 6 tab, 35 ref. EPA Cooperative Agreement No. CS805189.

Descriptors: *Wastewater treatment facilities, *Sludge, *Enteroviruses, Biological analysis, Cultures, Septic sludge, Cell lines, Isolation.

Described are experiences with the isolation of viruses from four treatment plants located in different geographic areas. Over a period of 3 years, 297 enteroviruses were isolated from 307 sludge samples. The highest frequency of viral isolation (92%), including multiple isolates from single samples, was obtained from a treatment plant serving the smallest population. Excluding the polioviruses, 22 different enterovirus serotypes were isolated. The methods used to isolate the viruses were relatively simple and included an elution procedure in which beef extract was used, and a step disinfection. No concentration procedure was used. Of

three cell culture systems used, the RD line of human rhabdomyosarcoma cells was by far the most useful for the isolation of echoviruses. BFGM and HeLa cells were particularly useful for the isolation of group B coxsackieviruses. A seasonal effect on viral isolation rates from sludge was observed. (Lantz-PTT)
W86-04671

5E. Ultimate Disposal Of Wastes

ISOTOPE TECHNIQUES IN THE HYDROGEOLOGICAL ASSESSMENT OF POTENTIAL SITES FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES,

International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 5B.
W86-03905

ACOUSTICAL METHOD OF BURNING AND COLLECTING OIL SPILLS ON COLD OPEN WATER SURFACES,

Ocean Ecology Ltd., Vancourver (British Columbia).
J. N. Koblanski.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 25-26, 7 fig, 2 ref.

Descriptors: *Oil spills, *Cleanup operations, *Controlled incinerrtion, *Acoustics, *Electrical equipment, *Incineration, Booms, Atomizing.

A completely new method of controlled oil burning with a minimum environmental impact has been developed. Three macrosonic phenomena are combined in one device which is driven into an oil slick. These phenomena are: herding (moving the oil along the surface), levitating and collecting the oil, and atomizing and burning in situ. These functions are so combined as to assist each other. Briefly, two vessels tow a boom through the oil slick. Distributed along the arms of the boom to the central line and also prevent the oil from down draining at the apex in fast current situations. Atomizing and burning transducers as well as a collecting means also are located at the apex. The oil being atomized is ignited easily by a combination of propane torch and high voltage discharge. The unburned but heated oil is sectioned off from the collection area fed by oil levitation transducers. Thus extremely thin and patchy oil may be removed in virtually any environment. The burning may be carried out in populated areas as it is relatively non-polluting. This is due to the combined effect of primary atomization caused by the acoustic energy and secondary atomization caused by the microexplosions of atomized water. Another advantage of this method is the prevention of the sludge formation which results when prevalent standard methods are used. In these in situ methods, the lighter and more volatile materials burn first, leaving a heavy sludge which is difficult or impossible to disperse. The method outlined here burns the volatile and non-volatile portions nonselectively. As a result, no residual sludge is formed. Another advantage of this method is that the prime motivating force applied to the oil is a lightweight transducer having such a low inertia that fast wave situations do not interfere, but serve to increase the burning rate. (Author's abstract)
W86-04004

TESTING OF A PROTOTYPE WASTE OIL FLARING SYSTEM,

Seaward International, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5G.
W86-04005

OIL DEGRADATION AND ENVIRONMENTAL IMPACT OF VARIOUS CO-DISPOSAL METHODS,

Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
G. Halmo.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 269-272, 3 fig, 3 tab, 3 ref.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, *Degradation, Oil pollution, Biodegradation, Oil.

A study on disposal of oily debris from polluted beaches was performed under laboratory conditions in columns simulating a vertical segment of a landfill. Nine different mixtures of oily debris were tested in parallel, including debris pre-mixed with municipal waste, and mixtures with oil absorbents like pine bark and lime. Fertilizers were used to give an optimum C:N ratio. Oil degradation and leachate formation and composition were studied for one year. The results show that if oily debris, i.e., oily sand, gravel, and seaweed, is placed directly in a landfill leachates will have unacceptably high oil content. When oily sand was mixed with pine bark and seaweed was mixed with pine bark and seaweed was mixed with lime, the disposal experiments showed a complete stabilization of the oil. Lime stabilization, however, caused a leachate of unfavorably high alkalinity. Oxygen appears to be the primary limiting parameter for oil degradation in landfills, and small units or different configurations must be used to improve air diffusion into the mass. Mixing the oily debris with municipal waste had a favorable effect on both biodegradation and stability towards leakage. (Author's abstract)
W86-04024

GEOHYDROLOGY SURROUNDING A POTENTIAL HIGH LEVEL NUCLEAR WASTE REPOSITORY IN THE PALO DURO BASIN, TX,

Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
For primary bibliographic entry see Field 2F.
W86-04064

BATCH COAGULATION OF A LAGOON FOR FECAL COLIFORM REDUCTIONS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-04116

ROLE OF COAGULATION IN THE KINETICS OF SEDIMENTATION,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5D.
W86-04229

OCCURRENCE, GROWTH, AND SUPPRESSION OF SALMONELLAE IN COMPOSTED SEWAGE SLUDGE,

Maryland Environmental Service, Annapolis.
D. Hussong, W. D. Burge, and N. K. Enkiri.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 887-893, October 1985. 3 fig, 4 tab, 9 ref. AD-12-F-2a-029.

Descriptors: *Sewage Bacteria, *Sludge, *Salmonella, Sludge Disposal, Composting, Microbiological Studies.

Sewage sludge composts from 30 municipalities were sampled for Salmonellae, and four samples (12%) were positive (two contained <0.3/g, and the other two had 21/g and 17,000/g. All 30 composts were inoculated with salmonellae; the populations decreased at a specific death rate of about 0.15/hr over 24 hr at 36 C. In irradiation-sterilized composts inoculated with salmonellae, the salmonellae grew at a rate of 0.65 doubling per hr for >24 hr. Growth and death rates were moisture and flora associated. The growth or death rates for antibiotic-resistant salmonellae were not different from those of nonresistant strains. It is concluded that the active indigenous flora of compost establish a homeostatic barrier to colonization by salmonellae, and in the absence of competing flora, reinoculated salmonellae may grow to potentially hazardous densities. The active microflora of moist composts eliminated contaminating salmonellae (100,000/g) after 6 wk. (Author's abstract)
W86-04234

MIGRATION OF CHLOROPHENOLIC COMPOUNDS AT THE CHEMICAL WASTE DISPOSAL SITE AT ALKALI LAKE, OREGON - 2. CONTAMINANT DISTRIBUTIONS, TRANSPORT, AND RETARDATION,

Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W86-04242

COMPOSTING REACTION RATE OF SEWAGE SLUDGE IN AN AUTOTHERMAL PACKED BED REACTOR,

Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
P. D. Bach, M. Shoda, and H. Kubota.
Journal of Fermentation Technology, Vol. 63, No. 3, p 271-278, June 1985. 8 fig, 1 tab, 6 ref.

Descriptors: *Composting, *Sludge Cake, *Packed Beds, Bulking Sludge, Lime.

Dewatered sewage sludge cake was composted in an autothermal packed bed reactor (APBR), in which the temperature of composting material was maintained by the heat of reaction and compared with the results in a continuously mixed isothermal reactor (CMIR). The temperature level in the APBR was controlled by regulating the flow rate of air supplied to the reactor. The composting reaction rate was monitored by the CO2 evolution rate. Sludges containing lime and polymer coagulants gave characteristically different CO2 evolution patterns but no significant difference was detected in the gel chromatographic patterns of water extracts from the final products. The optimal temperature for the composting of both sludges was around 60 C, which was the same as that observed previously for the lime sludge in the CMIR. A difference in the reaction rate between the APBR and the CMIR was clear at the initial stage of the reaction but became smaller as the reaction proceeded. The effect of bulking agents on the reaction rate was also investigated. Bulky agents e.g., rice husks or sawdust, providing a large area of contact between compost solid and air were found to promote the reaction. (Peters-PTT)
W86-04248

CHANNEL FLOW SYSTEM FOR WASTEWATER TREATMENT AND FOOD PRODUCTION,

Osaka Univ. (Japan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W86-04249

PHYSICAL AND CHEMICAL CORRELATES OF MICROBIAL ACTIVITY AND BIOMASS IN COMPOSTING MUNICIPAL SEWAGE SLUDGE,

Cincinnati Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W86-04254

INFLUENCE OF DEEP OCEAN SEWAGE OUTFALLS ON THE MICROBIAL ACTIVITY OF THE SURROUNDING SEDIMENT,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
J. A. Novitsky, and D. M. Karl.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1464-1473, December 1985. 6 fig, 5 tab, 22 ref. National Research Council of Canada A-6548 and T-1925.

Descriptors: *Ocean Dumping, *Outfall Sewers, *Marine Sediments, *Sand, *Microbiological studies, Wastewater Disposal, Marine Biology, Slime, Biomass, Oahu, Hawaii.

The microbial activity near two deep ocean sewage outfalls off the coast of the island of Oahu, Hawaii, was characterized. Water samples and sediment samples to a depth of 4.5 cm were analyzed from an area of approximately 45,000 sq m surrounding the outfalls. Although the effluent water at both sites exhibited heterotrophic activity that was 2 orders of magnitude greater than water from a control site, ambient water samples taken within 1 m of the discharge ports exhibited activity only twice that of the control water. The heterotrophic activity of the outfall sediment was only elevated above that of the control site for surface samples collected within 10 m of the outfall. The rates of microbial nucleic acid synthesis and carbon production in the sediment were only elevated immediately adjacent to the outfalls. Total microbial biomass, varied spatially but was generally elevated at the outfall sites. The specific growth rates calculated for the sediment microbial populations were not greater at the outfall sites. At one site the rocks surrounding the diffuser pipe were covered with copious amounts of slime that appeared to be composed entirely of microbial cells and filaments. This microbial mat was extremely active with respect to heterotrophic activity and biomass production. These observations suggest that the impact of the sewage discharge on the ambient seawater microbiota is slight and that the effect on the sediment microbiota is confined to an area immediately adjacent to the diffuser ports. In the sand itself, the effect is limited to the upper 2 cm at most. (Author's abstract)
W86-04257

EFFECT OF TEMPERATURE ON COMPOSTING OF SEWAGE SLUDGE,

Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Nakasaki, M. Shoda, and H. Kubota.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1526-1530, December 1985, 8 fig, 1 tab, 13 ref.

Descriptors: *Composting, *Sludge, *Thermophilic Bacteria, *Temperature Effects, Carbon Dioxide, Bacteria, Respiration.

The effect of temperature on the composting reaction of sewage sludge was investigated at 50, 60, and 70 C. The total amount of CO2 evolved and the final conversion of volatile matter were maximum at 60 C, suggesting that the optimal temperature for composting is around 60 C. The specific CO2 evolution rate (moles of CO2 evolved per hour per viable cell) was maximum at 70 C. The isolated thermophilic bacterium (BH1) which was dominant at 60 C but did not grow at 70 C had a rate of specific 02 consumption (measured on the agar plate) at 70 C four times higher than that at 60 C. This showed that catabolism is dominant at 70 C in the microorganisms indigenous to the compost. Although the specific CO2 evolution rate was higher at 70 C, the optimal temperature for composting is 60 C, the temperature at which there was the maximum CO2 evolution rate. (Peters-PTT)
W86-04259

CHROMIUM MIGRATION THROUGH SLUDGE-TREATED SOILS,

California Univ., Santa Cruz. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04275

MILE-DEEP REACTOR DESTROYS SLUDGE WITH EASE,

Vertech Treatment Systems, Denver, CO.
G. C. Rappe, and W. L. Schwoyer.
Water Engineering and Management, Vol. 132, No. 10, p 27-29, September 1985. 2 fig.

Descriptors: *Sludge disposal, *Wastewater treatment, *Recycling, *Injection wells, *Sludge digestion, Sludge solids, Biological wastewater treatment, Land disposal, Deep wells.

A below-ground system that successfully converts sludge to an inert ash and a highly biodegradable liquid effluent has been adopted by the Longmont, Colorado Wastewater Treatment Plant. Developed by Vertech Treatment Systems, the system has as its core a reaction vessel which is suspended in a conventionally drilled, cement-encased well that is from 10 to 15 in. in diameter and is one mile deep. Verticle concentric tubes form the annular channels through which the liquid wastes flow during treatment. A heat exchanger is suspended within the vessel to maintain temperature. With the combination of high temperatures and pressures in the reaction vessel, the COD of the influent waste is reduced significantly during its residence time in the oxidation zone of the vessel. The ash produced at Longmont can be used as a filler for brick or disposed of in a sanitary landfill. Its treated effluent is clarified and recycled to the plant's biological treatment process. Research is being done to reduce problems of scaling in the reaction vessel and decrease the amount of nitrate found in the effluent. Effluent recycling is expected to reduce nitrate levels. (Geiger-PTT)
W86-04289

SLUDGE MANAGEMENT METHOD GETS UPDATED,

Black and Veatch, Kansas City, MO.
J. H. Robinson, Jr., and R. D. Kuchenrither.
Water Engineering and Management, Vol. 132, No. 13, p 24-27, December 1985. 4 fig.

Descriptors: *Sludge disposal, *Composting, *Mulching, *Sludge drying, *Solid waste disposal, Land disposal, Waste management, Wastewater facilities, Sludge utilization.

In 1972, the Agricultural Research Service of the U.S. Department of Agricultural began investigating municipal sludge composting at Beltsville, Maryland. The findings of this research are embodied in the Beltsville Aerated-Pile Method of composting which, with some slight modifications, has remained unchanged over the past 12 yr. A properly operated composting system can achieve thermophilic temperatures for several consecutive days, and thereby be successful in eliminating most pathogens, and yielding a useful finished compost. Aerobic composting units can be classified into reactor and non-reactor types. Non-reactor methods can be divided into aerated static pile or windrow processes. Moisture control and materials handling processes are the most important considerations in designing a comosting system. In response to bans on ocean dumping of sludge, the city of Philadelphia started composting digested sludge with wood chips at its Southwest and Northeast plants. Pug mill mixing and aeration are employed for composting along with an elaborate drying system and leachate collection system. In Denver, a windrow composting system was carried out on a pilot scale. As a result of findings on the small scale trials, the 100-dry-ton-per-day operation for Denver incorporates a paved and covered 23-acre composting area, translucent solar roof panels to enhance drying, a fixed aeration system and provisions for odor scrubbing. Combined curing/composting in the windrow method was found to further reduce costs. (Geiger-PTT)
W86-04298

PILOT STUDIES INDICATE COMPOSTING CHOICES,

Camp, Dresser and McKee, Inc., Boston, MA.
J. Donovan.
Water Engineering and Management, Vol. 132, No. 13, p 28-31, December 1985. 2 fig, 2 tab.

Descriptors: *Composting, *Mulching, *Sludge disposal, *Pilot plants, *Land disposal, Landfills, Mulches, Wastewater treatment, Wastewater facilities, Solid waste disposal, Waste disposal.

Pilot plant studies of wastewater sludge composting can be an effective method of tailoring the Department of Agriculture design used at the Beltsville, Maryland location to the requiremetns of other specific locations. A properly designed pilot program can help to obtain information for process design, select equipment, refine cost estimates, produce an end product to determine market and demand, demonstrate the process to plant staff and local officials, and perform chemical and bacteriological analyses on the product. In 1981, the Barrington, Rhode Island plant undertook the task of upgrading its composting facility due to complaints of odor. Two devices were tested, a shredder and an agricultural mixer, to mix the sludge with wood chips. Since the sludge clogged the shredder, its use was discontinued, and local funding was sought to improve the composting facility. At the new advanced wastewater treatment facility in Mansfield, Massachusetts, pilot composting studies were conducted to find effective ways to break up sludge cake. A rotary-hopper grinder was selected which broke up the cake into pieces .5 to 1 inch pieces. The Amherst, Massachusetts facility conducted a demand study to find potential users of its sludge. Following the use of questionnaires and meetings, the facility found that demand for its municipal sludge which was classified Type I was twice the yearly production. The Haverhill Massachusetts facility composted its sludge with wood chips. Average temperatures did not reach the 55 degree standards, but pathogen kill was reported as good. (Geiger-PTT)
W86-04299

TRANSIENT MOVEMENT AND TRANSFORMATION OF CARBON SPECIES IN SOIL DURING WASTEWATER APPLICATION,

California Univ., Davis. Dept. of Land, Air and Water Resources.
A. N. Angelakis, and D. E. Rolston.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1141-1148, August 1985. 7 fig, 1 tab, 24 ref.

Descriptors: *Wastewater disposal, *Land disposal, *Carbon, *Soil, *Solute transport, *Mathematical models, Kinetics, Numerical analysis, Mathematical equations, Mathematical studies, Carbon dioxide, Organic carbon, Path of pollutants, Fate of pollutants.

The transport of three C species (insoluble, soluble, and gaseous) in soil were mathematically described as functions of depth and time, subject to intervals of 0<t<or = tl and tl<t<or = t(max), where tl refers to time of application of insoluble and/or soluble C. Convective and convective-dispersive transport for the first and second C species, respectively, gas diffusion for the third species, and first-order kinetics as a transformational mechanism were assumed. Linear adsorption isotherms for the first two species and a constant gas solubility were also assumed. Combined analytical and numerical solutions of three coupled partial differential equations were developed. The numerical model was used to study the microbial mineralization of organic C transformed under a biophasic scheme by applying a primary wastewater effluent to top-soil columns. Distribution of insoluble C concentrations were accurately predicted, particularly at large times. On the other hand, soluble C profiles were more accurately predicted at early times and shallow depths than for t<tl and large depths. Fitted gaseous diffusion coefficients were required to describe the measured CO2 profiles instead of those measured in the top of the soil columns. Gaseous C profiles were accurately predicted, especially at early times and shallow depths. (Author's abstract)
W86-04311

INDUSTRIAL WASTES AND PUBLIC HEALTH: SOME HISTORICAL NOTES, PART I, 1876-1932,

Carnegie-Mellon Univ., Pittsburgh, PA.
J. A. Tarr.
American Journal of Public Health, Vol. 75, No. 9, p 1059-1067, September 1985. 4 fig, 64 ref.

Descriptors: *Industrial wastes, *Policy making, Water pollution control, History, Priorities, Public policy.

The positions of public health professionals on the disposal of industrial wastes in waterways are ex-

plored for the period from 1876 through 1932. Major themes discussed include the rationale for setting priorities about human and industrial pollution; the relationship between industrial wastes and water supplies; and the development of indicators for the presence and measurement of industrial wastes. Industrial wastes were accorded a relatively low priority by the public health community compared to human wastes because of the potential for acute health effects from human wastes compared with the belief that industrial wastes had only indirect effects. A relatively small group of professionals argued for attention to the indirect health effects of industrial wastes and their impacts on the total stream environment. The final significant development regarding industrial pollution and public health was the formulation by Streeter and Phelps of the Public Health Service of a theory of stream purification with a set of general quantitative indicators. The Streeter-Phelps model enhanced the possibility of successful control by circumventing the problem of the heterogeneous nature of organic industrial effluents. (Rochester-PTT)
W86-04327

PERCENTILE ESTIMATION PROCEDURES FOR WATER QUALITY MANAGEMENT,

Water Research Centre, Swindon (England). Swindon Engineering Centre.
For primary bibliographic entry see Field 7C.
W86-04340

OPTIMAL DISCHARGE PROFILES FOR SUDDEN CONTAMINANT RELEASES IN STEADY UNIFORM OPEN-CHANNEL FLOW,

N. C. Daish.
Journal of Fluid Mechanics, Vol.159, p 303-321, October 1985. 7 fig, 12 ref.

Descriptors: *Discharge profiles, *Pollutant releases, *Open-channel flow, *Variance maximization, Topography, Slopes, E-folding.

The effect of varying the initial concentration distribution is investigated for sudden contaminant release in a uniform straight channel. Taking the optimal choice to be that which maximizes the variance of the contaminant cloud far downstream, it is found that, unless the topography is very unusual, the largest variance can be generated by splitting the contaminant into two parts, placing the larger part at the bank where the channel bed slopes most greatly, and the remainder near to where the channel is deepest. This procedure significantly reduces peak concentrations far downstream when compared with making the entire release at any single point across the flow. Even at distances as large as six times the e-folding distance for cross-sectional for cross-sectional mixing, the splitting of the discharge is shown to reduce the peak concentrations by a third. (Author's Abstract)
W86-04344

HEALTH RISK COMPARISON BETWEEN GROUNDWATER TRANSPORT MODELS AND FIELD DATA,

Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5B.
W86-04397

METAL MOVEMENT IN SLUDGE-TREATED SOILS AFTER SIX YEARS OF SLUDGE ADDITION: 2. NICKEL, COBALT, IRON, MANGANESE, CHROMIUM, AND MERCURY,

California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W86-04408

FATE OF DI-2-(ETHYLHEXYL)PHTHALATE IN THREE SLUDGE-AMENDED NEW MEXICO SOILS,

For primary bibliographic entry see Field 5B.
W86-04413

RESIDUAL CADMIUM FORMS IN ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,

Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-04414

PLANT UPTAKE OF CADMIUM FROM ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,

Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-04415

DISTRIBUTION OF PLUTONIUM AND AMERICIUM BENEATH A 33-YR-OLD LIQUID WASTE DISPOSAL SITE,

Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.
W86-04416

EFFECT OF NITRILOTRIACETIC ACID ON THE SOLUBILITIES OF METALS IN SOIL-SLUDGE MIXTURES,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
K. Garnett, P. W. W. Kirk, J. N. Lester, and R. Perry.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 549-553, October-December 1985. 10 fig, 2 tab, 26 ref.

Descriptors: *Chelating agents, *Metal complexes, *Sludge disposal, *Nitriloacetic acid, Copper, Manganese, Nickel, Lead, Zinc, Hydrogen ion concentration, Solubility, Soil.

The effect of nitrilotriacetic acid (NTA) on the solubilities of Cu, Mn, Ni,Pb, and Zn in soil/sludge mixtures was investigated in batch equipments. Soil samples from Wye Coombe series (silt-loam, Rendolic Eutrochrepts) and Essex Windsor series (clay-loam, Haplaquepts) were each mixed with anaerobically digested sewage sludge and teh influence of extraction time, NTA concentration, and pH on the solubility of NTA and metals was assessed. Removal of NTA from the liquid phase by soil/sludge colloids became constant after 8 h and was attributed to adsorption. The concentration of soluble Ni, Pb, and Zn increased in both soil/sludge mixtures with increases in NTA concentration from 0 to 0.212 mmol/L. Manganese was the least affected by the addition of NTA, and pH was shown to be the overriding influence on its solubility. In the Essex soil/sludge mixture, increasing the NTA concentration from 0 to 0.005 mmol/L caused a sharp decrease in Cu solubility, with higher NTA concentrations having no further effect on soluble Cu levels. Addition of NTA did not significantly change Cu solubility in the Wye soil/sludge mixture. These results provide a basis to design further experiments to determine if increased heavy metal solubility could result if sludge containing NTA was applied to agricultural land. (Author's abstract)
W86-04420

BIOLOGICAL TREATMENT OF HAZARDOUS WASTE IN SEQUENCING BATCH REACTORS,

CECOS International, Niagara Falls, NY.
For primary bibliographic entry see Field 5D.
W86-04504

TREATMENT OF OIL IN REFINERY WASTEWATER IN SOUTH EAST ASIA,

Burt Consultants Pty Ltd., Singapore.
For primary bibliographic entry see Field 5D.
W86-04512

TWO OPTIONS FOR TREATMENT OF ACIDIC ORGANIC INDUSTRIAL WASTES,

Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
For primary bibliographic entry see Field 5D.
W86-04561

WATER TREATMENT BY MEANS OF ACTIVATED CARBON, PREPARED FROM LOCALLY AVAILABLE WASTE MATERIALS (II),

Vrije Univ., Brussels (Belgium). Dept. of Industrial Chemistry.
For primary bibliographic entry see Field 5D.
W86-04565

WASTE MANAGEMENT PLANNING,

Durham Univ. (England). Faculty of Law.
For primary bibliographic entry see Field 5G.
W86-04590

TEMPERATURE EFFECTS ON ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEM,

Regina Univ. (Saskatchewan). Faculty of Engineering.
For primary bibliographic entry see Field 5D.
W86-04606

USE OF IRON RODS TO DETERMINE THE DEPTH OF SEASONAL WATER TABLES FOR ABSORPTION FIELDS IN SEWAGE DISPOSAL SYSTEMS,

South Carolina State Dept. of Health and Environmental Control, Charleston.
F. G. Spinale, and W. H. McKee, Jr.
Journal of Environmental Health JEVHAH, Vol. 48, No. 1, p 26-27, July/August 1985. 1 fig, 1 tab, 2 ref.

Descriptors: *Measuring instruments, *Water level, *Waste disposal, Piezometers, Septic tanks, Seasonal variation, Wastewater disposal, Water table, Monitoring.

Comparisons of rust formation on iron rods with results obtained by using conventional piezometers indicate that iron rods will accurately measure the average depth to seasonal water tables for evaluation of sites for septic tank absorption fields. The use of iron rods was found to be less expensive in terms of material and manpower and is recommended as a supplement to the use of conventional piezometers for determining seasonal water table measurement on imperfectly drained soils. (Author's abstract)
W86-04608

DEVELOPMENTS IN SLUDGE DEWATERING.

For primary bibliographic entry see Field 5D.
W86-04612

USING ORGANIC WASTES IN TENNESSEE,

Tennessee Univ., Knoxville. Inst. of Agriculture.
J. D. Wolt.
BioCycle BCYCDK, Vol. 27, No. 3, p 24-25, March 1986.

Descriptors: *Manure, *Animal wastes, *Sludge disposal, *Waste disposal, *Farm wastes, Organic wastes, Land disposal, Fertilizers, Nitrogen, Wastewater disposal, Industrial wastes, Municipal wastes, Fertilization, Feedlot wastes.

The University of Tennessee Agricultural Experiment Station in Knoxville is conducting studies to investigate the effects of applying manure and industrial and municipal sludge on forage crops. At the Dairy Experiment Station in Lewisburg, liquid dairy manure was either injected or broadcast in fall and spring and was compared to conventional inorganic nitrogen fertilization on pastures planted with corn. Results showed that neither time nor method of application influenced crop yield or nutrient content to a significant degree where manure was applied to a site which had continuously received broadcast application of dairy manure for several years. At the Ames Plantation at Grand Junction, liquid swine waste was injected into Loring silt loam at a rate of 1 dry ton/acre from September to May. Corn silage yields varied with the month of application in all three years. Spring applications consistently produced yields comparable to those resulting from conventional nitrogen fertilization. Dewatered industrial sludge

from E. I. DuPont was applied to bermuda grass grown on Statler sandy loam and on wheat and rye grown on Sequatchie silt loam. A variety of trace elements were found that could pose an environmental hazard if improperly managed on cropland. Municipal sludge from the Maryville Regional Wastewater Treatment Plant was applied to limed and unlimed plots. Although nitrogen yields were comparable to conventional nitrogen fertilization, Zn levels were a limiting factors. (Geiger-PTT)
W86-04613

STRAW-BASED TECHNIQUES FOR COMPOSTING,

Birmingham Univ. (England). Wolfson Compost Studies Group.
A. J. Biddlestone, K. R. Gray, and D. J. Cooper.
BioCycle BCYCDK, Vol. 27, No. 3, p 40-44, March 1986. 2 tab, 4 ref.

Descriptors: *Composting, *Farm wastes, *Animal wastes, *Straw, *Feedlot wastes, Waste disposal, Manure, Sludge disposal, Slurries.

This paper describes the joint work done by the University of Birmingham in England and industry to mitigate the problems arising from farm effluent disposal. A reliable method for blending slurries and straw on a large scale is available using the Armix Processor. The processor uses straw which itself presents a disposal problem in the United Kingdom, and blends it with organic animal waste slurries or vegetable wastes of high moisture content for composting in Arcub cubicles. The straw-slurry mixture can be composted with reasonably low air pressure drops and this method shows much potential in the future treatment of sewage sludges. Since the straw can absorb considerable quantities of liquor, the technique can overcome silage liquor problems and may be applied to the recycling of certain food industry wastes for animal feedstuffs. It also has potential for the deep filtration of organic slurries, through which is removed a much higher proportion of the suspended solids than can be achieved with mechanical, screen-type slurry separators. The active compost heaps are useful in removing many offensive odors. (Geiger-PTT)
W86-04614

AUTO-OXIDATION EFFECT ON FLUE GAS SLUDGE SYSTEMS,

For primary bibliographic entry see Field 5D.
W86-04634

SOLID WASTE MANAGEMENT FOR UTILITY RECONVERSIONS,

Stone and Webster Management Consultants, Inc., New York.
For primary bibliographic entry see Field 5G.
W86-04635

FIELD AGING OF FIXED SULFUR DIOXIDE SCRUBBER WASTE,

Maryland Univ., College Park. Dept. of Civil Engineering.
M. S. Aggour, W. D. Stanbro, and J. J. Lentz.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 62-73, September 1985. 13 fig, 4 tab, 7 ref.

Descriptors: *Landfills, *Fly ash, *Waste disposal, *Sludge disposal, *Design criteria, Pilot plants, Land disposal, Weathering, Degradation, Linings, Waste dumps, Sulfur compounds, Aging.

A fixed-material test pad was constructed to evaluate the long-term effects of the fixation with lime of blended fly ash and scrubber sludge. The test pad was used as a scale model disposal site and the fixed material was tested at the time of pad construction in 1979 and again in 1983. The study included field and laboratory evaluation of the physical and chemical properties of the four-year-old fixed scrubber sludge. Results indicated that the undeteriorated fixed fly ash-scrubber mixture is a very acceptable material for disposal by landfilling or storage in piles where foundation conditions are unlikely to produce fracturing of the material. Since the material undergoes considerable weathering, for deposition of the material in a pile, the manner of placement is of utmost importance. The influx of oxygen-rich-rainwater induces oxidation to a more soluble material. An overdrain system is desirable to prevent infiltration of water into the material, and a nonfrost-susceptible soil cover can help reduce the chemical transformations as well as the mechanical weathering. When an embankment is constructed in stages with long periods of time intervening between the successive stages, weathering and chemical changes could cause substantially degraded structural properties. (Geiger-PTT)
W86-04636

CLAY LINER CONSTRUCTION AND QUALITY CONTROL,

Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W86-04638

PRACTICAL APPLICATION OF THEORETICAL MODELS TO MAGNETOMETER SURVEYS ON HAZARDOUS WASTE DISPOSAL SITES - A CASE HISTORY,

Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, P. C. Heigold, and D. E. Layman.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 54-61, Winter 1986. 12 fig, 12 ref. EPA Cooperative Agreement No. R810442-01-7.

Descriptors: *Magnetic studies, *Hazardous materials, *Land disposal, *Theoretical analysis, Model studies, Case studies, Trenches, Field tests, Mathematical models, Wilsonville, Illinois.

Wastes were to be exhumed and removed from a hazardous and chemical waste disposal site that was situated near the town of Wilsonville, Illinois. This landfill operation was a trench and fill procedure that relied on natural attenuation of contaminants by the native geological materials. The site was 130 acres, with individual trenches 10-20 feet deep, 150-300 feet long and 50-100 feet wide. Theoretical two-dimensional models were used to evaluate the application of magnetic methods to define trench boundaries on the disposal site. The models predicted that both the total field and the vertical component anomalies were diagnostic; however, the vertical component anomaly was more focused on the trench boundaries. A survey with a vertical component fluxgate magnetometer was successful in defining trench boundaries. Observations made along traverses that trended perpendicular to the long axis of the parallel trenches indicated vertical magnetic intensity values with a cyclical pattern of large positive values over trenches and large negative values over intertrench corridors. Vertical magnetic intensity values determined with theoretical two-dimensional models compared favorably to the observed vertical magnetic values. The models were used to constrain the interpretation of the field observations to define trench boundaries; the magnetic survey defined trench boundaries with an accuracy within + 2 feet. (Lantz-PTT)
W86-04654

5F. Water Treatment and Quality Alteration

PREDICTING THE REMOVAL OF SOLUBLE ORGANIC CONTAMINANTS BY LIME SOFTENING,

National Chunghsing Univ., Taichung (Taiwan). Dept. of Environmental Engineering.
M. Y. Liao, and S. J. Randtke.
Water Research WATRAG, Vol. 20, No. 1, p 27-35, January 1986. 1 fig, 5 tab, 43 ref.

Descriptors: *Water treatment, *Organic compounds, *Lime softening, Adsorption, Polymers, Phenols, Industrial wastes, Organophosphorus compounds.

The removal of organic contaminants by lime softening and molecular characteristics influencing removal were experimentally and theoretically examined. Coprecipitation appeared to be the major removal mechanism for organic substances in low concentrations, and only those substances able to adsorb onto CaCO3 were able to be removed by lime softening. All of the removable anionic compounds were able to coordinate with Ca(2+) to form relatively insoluble complexes. Fatty acids, which form relatively soluble complexes with Ca(2+) and hydrophobic chemicals unable to coordinate with Ca(2+) were not removed. Molecular characteristics influencing removal included molecular charge, functionality, degree of polymerization, molecular geometry and affinity for water. In general, softening is effective in removing polymeric electrolytes possessing acidic oxygen-containing residues, such as carboxyl, phenol, enol, phosphoryl, phosphonyl,sulfuryl and sulfonyl groups. Simple monomeric molecules are not expected to be effectively removed unless they polymerized or possess phosphorus-containing functional groups such as phosphoryl and phosphonyl. (Author's abstract)
W86-04105

LOW TECHNOLOGY WATER PURIFICATION BY BENTONITE CLAY FLOCCULATION AS PERFORMED IN SUDANESE VILLAGES: VIROLOGICAL EXAMINATIONS,

Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Dept. of Veterinary Virology and Immunology.
E. Lund, and B. Nissen.
Water Research WATRAG, 20, No. 1, p 37-43, January 1986. 9 tab, 23 ref.

Descriptors: *Water treatment, *Flocculation, *Bentonite, *Sudan, Nile River, Drinking water, Viruses, Suspended solids, Water renovation, Water reuse.

During the flood season (June-September), the Nile River in Sudan, is highly turbid. Suspended solids may be as high as 8000 mg/l. In the villages, water purification by flocculation has been employed for over 100 years, using 'rauwaq' clarifier (a local clay) and bentonite. A suspension of rauwaq is prepared and added to turbid water. If the proper rauwaq concentration is used, flocs will form and settle, after at least 1 hr of purification. Noting that villages employing this method of water purification suffer from fewer gastrointestinal disturbances, the authors report here on a study to determine the effectiveness of the technique for virus removal. Results indicate that with proper flocculation, 3 to 4 log units of virus could be removed. Conditions for floc formation are discussed. (Lantz-PTT)
W86-04106

EFFECT OF OPERATION CONDITIONS ON BIOLOGICAL FE(2+) OXIDATION WITH ROTATING BIOLOGICAL CONTACTORS,

Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
K. Nakamura, T. Noike, and J. Matsumoto.
Water Research WATRAG, Vol. 20, No. 1, p 73-77, January 1986. 7 fig, 1 tab, 7 ref.

Descriptors: *Rotating biological contactors, *Iron oxides, *Acid mine drainage, *Biological oxidation, Hydrogen ion concentration, Oxidation rate, Iron, Oxidation, Ferrobacillus, Japan, Mine drainage.

Oxidation of ferrous iron (Fe(2+)) by acidophilic iron-oxidizing bacteria was conducted with a laboratory-scale rotating biological contactor (RBC) in order to investigate the effects of Fe(2+) concentration, pH, temperature and rotation rate. Fe(2+) oxidation rate on RBC was expressed as a first-order reaction with respect to Fe(2+) concentration when it was below 150 mg/l. Fe(2+) oxidation rate was not affected by pH from 1.0 to 2.6 nor by temperatures from 10 to 40 C, but was accelerated by increasing peripheral disk velocity from 4.7 to 28.2 m/min. (Author's abstract)
W86-04111

VOLATILE OZONIZATION PRODUCTS OF AQUEOUS HUMIC MATERIAL,

Bristol Univ. (England). Organic Geochemistry Unit.
S. D. Killops.
Water Research WATRAG, Vol. 20, No. 2, p 153-165, February 1986. 6 fig, 4 tab, 45 ref.

Descriptors: *Humic acids, *Fulvic acids, *Ozonation, *Water treatment, *Volatile solids, Natural waters, XAD-2 resin, Carbonyl group formation, Gas liquid chromatography, Nuclear magnetic resonance.

Humic and fulvic acid samples, extracted from river water, and two upland waters with high humic content were studied. Aqueous solutions were effectively decolorized by ozonation (< or = to 3 mg ozone/mg humic substance), although significant alteration of the bulk humic material was not detected. The greater proportion of the material remained as polymeric structures, and typically <10% comprised relatively volatile material, which was isolated by XAD-2 resin and subjected to GC-MS analysis. GC-MS analysis. GC-MS analysis provided some evidence for the formatioon of carbonyl groups (chiefly COOH) among the volatiles from the humic and fulvic acids. Apart from the fulvic acid, ozonation failed to increase the amount of volatile components extracted by XAD-2 resin. The volatiles chiefly appeared to be species trapped in the macromolecular structure of the humic material. Some changes were noted among the volatiles of fulvic and humic acids following ozonation (e.g., increase in n-alkanes and disappearance of alkylnaphthalenes), but volatiles from the upland waters appeared more resistant towards oxidation. (Author's abstract)
W86-04122

ACTION OF OZONE ON METHYL OCTADEC-9-ENOATE IN POLAR SOLVENTS: A MODEL FOR AQUEOUS OZONIZATION OF ORGANIC COMPOUNDS,

Bristol Univ. (England). Organic Geochemistry Unit.
S. D. Killops.
Water Research WATRAG, Vol. 20, No. 2, p 167-171, February 1986. 4 fig, 2 tab, 7 ref.

Descriptors: *Methyl octadec-9-enoate, *Polar solvents, *Water treatment, Aldehydes, Carboxylic acids, Acetals, Hydroxyl radicals, Methoxy radicals, Gas liquid chromatography, Organic compounds.

Aqueous ozonization of methyl octadec-9-enoate resulted in aldehyde and carboxylic acid group formation at the fragmented C=C bond. High ozone doses lead to increased oxidation of aldehyde to carboxylic acid groups. Methanolic ozonization produced dimethyl acetal groups in preference to aldehyde groups, and methylation of carboxylic acid groups was noted. Analysis of reaction products was performed by capillary GLC and GC-MS. Results were consistent with radical attack (*OH or *OMe) for ozonization in polar solvents. (Author's abstract)
W86-04123

REMOVAL OF NITRATE IN DRINKING WATER BY ION EXCHANGE - IMPACT ON THE CHEMICAL QUALITY OF TREATED WATER,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. Dore, Ph. Simon, A. Deguin, and J. Victot.
Water Research WATRAG, Vol. 20, No. 2, p 221-232, February 1986. 14 fig, 7 tab, 22 ref.

Descriptors: *Drinking water, *Denitrification, *Ion exchanged, *Water quality, *Adsorption, Styrene, Divinylbenzene, Trimethylamine, Nitrates, Aromatic compounds, Chlorinated hydrocarbons, Herbicides, Nitrosamines.

The increase in nitrate concentration in public water supplies is becoming an important problem in certain countries. Among the treatment processes available, the removal of nitrates by ion exchange has been thoroughly studied in recent years with regard to problems of capacity and selectivity. The use of anionic resins in drinking water treatment imply that these compounds do not induce secondary degradation in the quality of the treated water. The purpose of this paper is to examine the chemical quality of water treated by a strong base ion exchange resin (IRA 400) regenerated by sodium chloride. Two sources of organic compounds can be found in water treated with a filter of ion exchange resin: The constitution monomers leached from IRA 400 (styrene, divinylbenzene, trimethylamine and their derivatives). The micropollutants are liable to be absorbed, desorbed or produced during the exhaustion cycles of denitratation. The evolution of the concentration synthesis monomers in treated water was studied during the conditioning and the exhaustion cycles of the resin. Moreover the adsorption isotherms of the IRA400 for different kinds of micropollutants (aromatic compounds, chlorinated solvents, herbicides, nitrosamines) were determined and the concentration of an added micropollutant (phenol) was measured during an exhaustion cycle. As for the formation of organic compounds during the treatment, we have limited our study to the analysis of N-dimethylnitrosamine during the exhaustion cycle, since this compound has been detected in water demineralized by an ion exchange resin. (Lantz-PTT)
W86-04128

DEVELOPMENTS OF TOTAL KIELDAHL NITROGEN AND BACTERIAL BIOMERS ALONG A POTABITIZATION LINE.

Montpellier-2 Univ. (France).
Water Research WATRAG, Vol. 20, No. 2, p 237-245, February 1986. 4 fig, 4 tab, 17 ref.

Descriptors: *Potable water, *Kjeldahl nitrogen, *Biomass, *Bacteria, Drinking water, Nitrogen compounds, Ammonia, Oise River, France, Chlorination, Ozonation, Disinfection, Escherichia coli, Epifluorescence.

Quality standards relative to water distributed for human consumption are increasingly stringent; the authorized rate of total Kjedahl nitrogen (TKN) in particular has been fixed at 1 mg N/l by EEC standards (Guideline of 15 July 1980). The behavior of this parameter has been monitored throughout the treatment line at the Mery-sur-Oise potable waterworks of the Suburban Paris Water Authority (Val d'Oise, France), this also includes the physiochemical and biological stages. Total Kjeldahl nitrogen which corresponds to organic Nitrogen (N sub org.) and ammonia nitrogen (N-NH4(+)) is measured by Kjeldahl method. Ammonia nitrogen is measured by the indophenol modified blue method as described in AFNOR. In order to study the possible influence of total bacteria on the evolution of TKN, a bacteria count is conducted by epifluorescent microscopy and by spreading on solid culture media. The first of these techniques makes it possible to count separately the 'active' bacteria (red fluorescence) and the 'inactive' bacteria (green fluorescence). The second detects only the bacteria capable of forming colonies on non-selective media (Agar nutrient). Water sampled from the river Oise upstream from the waterworks shows a remarkably constant low TKN content whatever the season. Following clarification and filtration, this water is disinfected by ozonation and chlorination. The effect of these two oxidizing agents on organic nitrogen compounds seems complex since two opposite trends can occur, i.e., the nitrogenous concentration can either increase or decrease compared with the previous stage of treatment. Since we know that the Kjeldahl method does not enable all the organic nitrogen compounds to be measured it is logical to suppose that these trends are only an appearance due to the transformation of the chemical structure, can become measurable by the Kjeldahl method while others become refractory. Several mechanisms have been suggested in connection with the action of ozone, e.g., lysis of the bacteria, effect on the enzymatic system and effect on nuclear structure. In the latter case, it is possible that ozone denatures the DNA so that it loses its double-strand structure, each single strand reacting towards the fluorochrome like an RNA. The bacteria would then appear to be active. Ozone might also affect the RNA in such a way that it stops reacting with the fluorochrome and then only the green color produced by the acridine orange DNA compound is perceptible. The hypothesis according to which there is only a temporary loss of the ability to form colonies, hence to reproduce, immediately after ozonation remains to be proved. (Lantz-PTT)
W86-04130

PREDICTION OF MULTICOMPONENT ADSORPTION EQUILIBRIA USING IDEAL ADSORBED SOLUTION THEORY,

For primary bibliographic entry see Field 5D.
W86-04136

SUCCESSFUL ABATEMENT OF LEAD EXPOSURE FROM WATER SUPPLIES IN THE WEST OF SCOTLAND,

Glasgow Univ. (Scotland). Dept. of Medicine.
For primary bibliographic entry see Field 5C.
W86-04146

PREFORMED MONOCHLORAMINE USED AS A POST-DISINFECTANT IN DRINKING WATER TREATMENT AT SJAELSO WATER WORKS,

Gentofte Municipal Water Supply (Denmark).
J. Beck, J. B. Dyhm, and P. K. Jensen.
Aqua AQUAAA, No. 1, p 25-33, 1986. 17 fig, 4 tab, 15 ref.

Descriptors: *Monochloramine, *Water treatment, *Chlorination, *Disinfection, *Drinking water, *Sjaelso Water Works, Denmark, Groundwater, Surface water, Chemical treatment, Bacterial analysis, Escherichia coli, Pseudomonas, Preformed monochloramine.

A new advanced technological method for post-disinfection has been developed at Sjaelso Water Works, Denmark, using a concentrate of well-defined and stable monochloramine. The method is in practical use for the post-disinfection of water from three plants, treating two types of ground water and a surface water where ozone is used as the main disinfectant. the conditions for the production of the preformed monochloramine concentrate were established by pilot scale experiments. The practical details and design features for the full-scale operation together with the safety and control measures to be incorporated into the design of the monochloramine production and dosage unit are presented in detail. The efficiency of preformed monochloramine as a disinfectant was examined by laboratory experiments with E. coli and Ps. fluorescens as tests organisms. Routine bacteriological examinations at sampling points throughout the distribution system have furthermore shown that a satisfactory post-disinfection was achieved. The chemical stability of monochloramine was investigated by sampling and in situ analysis for chloramines of a water plug passing through the mains under conditions of constant flow. Preformed monochloramine proved to be a relatively stable disinfectant compared with the less well-defined combined chlorine/chloramination. The use of preformed monochloramine has the advantage that the presence of dichloramine and trichloramine, which are responsible for taste and odor problems, is avoided, and there is no formation of trihalomethanes. (Author's abstract)
W86-04152

WATER SUPPLY BY OPTIMAL MIXING OF WATERS OF VARIABLE QUANTITY AND QUALITY,

University of Petroleum and Minerals, Dhahran (Saudi Arabia).
A. B. Shahalam, A. H. Al-Ahamed, and A. R. Mansour.
Aqua AQUAAA, No. 1, p 45-49, 1986. 3 fig, 5 tab, 3 ref.

Descriptors: *Water supply development, *Mixing, *Water quality management, Impaired water use, Drinking water, Optimization models, Water demand, Jordan.

Presented is a methodology for optimal mixing of waters from multiple sources. The mixing is performed in such a way so that the quality of aftermix water satisfies the prescribed standards of drinking water while the amount of total supply is maximized. In the process, the cost of water treatment and transportation is minimized. The problem has been formulated as a linear optimization model. The output of the model includes optimal water procurement cost and optimal amounts of water desired to be extracted from various sources. The model can be used to determine the minimal treatment required in order to satisfy the area demand provided the combined safe yield of all sources remains equal or more than the demand. In case of demand exceeding the combined safe yield of all available sources, the model can be used to determine the minimal volume and quality of shortage. Such informations can be subsequently utilized for exploration of new sources. The use of the model has been demonstrated in a special case of water supply in a northern district of Jordan. (Lantz-PTT)
W86-04154

EFFECTS OF EXPOSURE TO SALTY DRINKING WATER IN AN ARIZONA COMMUNITY: CARDIOVASCULAR MORTALITY, HYPERTENSION PREVALENCE, AND RELATIONSHIPS BETWEEN BLOOD PRESSURE AND SODIUM INTAKE,

Centers for Disease Control, Atlanta, GA. Div. of Chronic Disease Control.
For primary bibliographic entry see Field 5C.
W86-04223

HOLDING EFFECTS ON COLIFORM ENUMERATION IN DRINKING WATER SAMPLES,

Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
A. E. McDaniels, R. H. Bordner, P. S. Gartside, J. R. Haines, and K. P. Brenner.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 755-762, October 1985. 7 fig, 2 tab, 13 ref.

Descriptors: *Coliforms, *Drinking Water, *Bacterial Analysis, Water Analysis, Microbiological Studies, Heterotrophic Bacteria.

Standard procedures for analyzing drinking water stress the need to adhere to the time and temperature conditions recommended for holding samples collected for microbiological testing. Research was conducted by standard analytical methods to determine if changes occurred when samples were held at 5 and 22 C and analyzed at 0, 24, 30, and 48 hr. Samples were analyzed for coliforms by the membrane filter and fermentation tube procedures and for heterotrophs by the pour plate method. A total of 17 treated water samples were collected from a large municipal distribution system from August to December 1981, and 12 samples were collected from January to May 1983. The samples were dosed with coliforms previously isolated from the water system, Enterobacter cloacae in 1981 and Citrobacter freudii in 1983. The coliform counts declined linearly over time, and the rates of decline were significant at both 5 and 22 C. Within 24 hr at 22 C, levels of E. cloacae and C. freundii decreased by 47 and 26%, respectively, and at 5 C, E. cloacae numbers declined by 23%. Some samples with initially unacceptable counts (>4/100 ml) met the safe drinking water limits after storage for 24 hr at 5 and 22 C and would have been classified as satisfactory. In contrast to the coliform losses, heterotrophic plate counts of samples held at 22 C for 30 and 48 hr increased by 0.5 to 2.5 orders of magnitude and often interfered with coliform counts on the membrane filter. Heterotrophic counts of the same samples held at 5 C for 30 and 48 hr declined slightly. It is recommended that drinking water samples be iced and that they be analyzed as soon as possible on the day of collection to minimize changes in bacterial densities. (Author's abstract)
W86-04233

SELECTIVE MEDIUM FOR THE ISOLATION OF OPPORTUNISTIC FLAVOBACTERIA FROM POTABLE WATER,

National Hansen's Disease Center, Carville, LA.
S. G. Franzblau, D. R. Jimenez, and N. A. Sinclair.
Journal of Environmental Science and Health JESEDU, Vol. A20, No. 5, p 583-591, July 1985. 4 tab, 11 ref.

Descriptors: *Flavobacterium, *Culture Media, *Potable Water, Drinking Water, Well Water.

A selective medium was developed for the primary isolation of opportunistic flavobacteria from potable water. A minimal-salts maltose yeast extract agar medium (MSMY) supplemented with either kanamycin (MSMY-K) or tobramycin (MSMY-T) was effective in suppressing the background microflora from most sources while allowing for the growth of Flavobacterium meningosepticum and Flavobacterium IIb. For routine sampling of well and distribution system water, 100 ml samples were filtered and filters placed on MSMY-K. F. meningosepticum and F. IIb were differentiated by the yellow pigment produced by the latter when incubated at 35 C on trypticase soy agar. Opportunistic flavobacteria were isolated from 11/37 potable well and 5/50 potable distribution water samples tested using MSMY-K. MSMY-K may be of value in a membrane filtration procedure for testing large volumes of water for the presence of these infectious agents. (Peters-PTT)
W86-04239

EFFECTS OF METALS ON LEGIONELLA PNEUMOPHILA GROWTH IN DRINKING WATER PLUMBING SYSTEMS,

Pittsburgh Dept. of Water, PA.
S. J. States, L. F. Conley, M. Ceraso, T. E. Stephenson, and R. S. Wolford.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1149-1154, Nov. 1985. 2 fig, 3 tab, 42 ref. EPA CR 80681-01-2.

Descriptors: *Drinking Water, *Legionella Bacteria, *Plumbing, Bacterial Analysis, Chemical Analysis, Metals, Corrosion, Iron, Zinc, Potassium, Hospitals, Storage Tanks, Water Tanks.

The chemical environment and growth of Legionella pneumophila in plumbing systems was investigated to gain a better understanding of its ecology in this habitat. Water samples were collected from hospital and institutional hot-water tanks known to have supported L. pneumophila and were analyzed for 23 chemical parameters. The chemical environment of these tanks varied extensively, with the concentrations of certain metals reaching relatively high levels due to corrosion. The effect of various chemical conditions on L. pneumophila growth was examined by observing its multiplication in a series of tap water samples artificially supplemented with various concentrations of metals. Additionally, growth of L. pneumophila was examined in a more natural setting by monitoring its multiplication in the chemically analyzed hot-water tank samples after sterilization and reinoculation with L. pneumophila obtained from a hot-water tank. These strains were maintained in tap water and had never been passaged in agar. The results of the growth studies indicate that although elevated concentrations of a number of metals are toxic, lower levels of certain metals such as iron, zinc, and potassium enhance growth of naturally occurring L. pneumophila. Parallel observations on accompanying non-Legionellaceae bacteria failed to show the same relationship. These findings suggest that metal plumbing components and associated corrosion products are important factors in the survival and growth of L. pneumophila in plumbing systems and may also be important in related habitats such as cooling towers and air-conditioning systems. (Author's abstract)
W86-04251

USE OF IMMUNOFLUORESCENCE AND PHASE-CONTRAST MICROSCOPY FOR DETECTION AND IDENTIFICATION OF GIARDIA CYSTS IN WATER SAMPLES,

Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W86-04255

EVALUATION OF METHODS FOR CONCENTRATING HEPATITIS A VIRUS FROM DRINKING WATER,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W86-04256

POTENTIAL HEALTH IMPLICATIONS FOR ACID PRECIPITATION, CORROSION, AND METALS CONTAMINATION OF DRINKING WATER,

Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5C.
W86-04264

COOPERATIVE SERVICE ARRANGEMENTS,

Department of Commerce, Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04283

ON-LINE PARTICLE COUNTING IMPROVES FILTER EFFICIENCY,

Johnson Controls, Inc., Carrollton, TX. Systems Engineering and Construction Div.
C. W. Hutchinson.
Water Engineering and Management, Vol. 132, No. 7, p 20, 22, 24-25, July 1985. 4 fig, 5 ref.

Descriptors: *Filtration, *Suspended solids, *Water treatment, *Particulate matter, *Process control, *Computers, Optimization, Coagulants, Chemical treatment, Automation, Filters, Cost analysis.

During the recent expansion of the Southern Nevada Water System, a distributed process control system was added to provide full automated control and process optimization. An innovative feature of this system is the use of on-line particle counting for monitoring and control of filtration. The particle counter was adopted after its use was demonstrated in laboratory tests to reduce chemical costs by 30%. In addition to providing optimum coagulant dosage determinations, the approach also contributes to savings in the form of reduced backwash frequency and associated load reductions on the sludge handling system. The particle counter is based on light blockage. Each particle in the water to be treated interrupts a beam of light directed onto a photosensitive detector. Particle size is determined by the amount of light blockage that occurs as each particle passes through the calibrated sensor. Since the orifice of the counter is susceptible to clogging, pre-filtering and an automatic backflush function are provided. A parallel computer interface provides a means for communicating data from the particle counter to the remote transmitting unit. Data from the counter can help plant operators detect filter breakthrough up to several hours in advance of actual occurrence. (Geiger-PTT)
W86-04285

TEXAS BOOMTOWN GETS NEW GUSHER,

R. C. Burrows, S. A. Webb, and D. Storm.
Water Engineering and Management, Vol. 32, No. 7, p 26-28, July 1985.

Descriptors: *Water treatment facilities, *Clarification, *Clarifiers, Automation, Chemical treatment, Turbidity, Color, Process control, Water treatment, Flocculation, Filtration.

To accommodate an increasing population, the Beaumont, Texas water treatment plant was expanded to meet water needs to the year 2000. A system was adopted which could use existing equipment and plant configuration, but not without a complete clarification system overhaul. The Pulsator clarifier manufactured by Infilco Degremont, Inc. was selected which is based on a hydraulic pulsation sludge blanket and could combine solids

contact mixing, flocculation, and solids/water separation, and continuous removal of sludge in a single process. After startup of the plant with the new clarifier, it was found that the unit could easily handle flow rate variations and raw water quality changes, while requiring little operator assistance. The Pulsator installation was complemented with improved filtration, chemical feed, and instrument systems. A liquid chemical feed system consisting of bulk liquid storage tanks, day tanks, and metering pumps was recommended and installed. Liquid alum replaced dry alum, lime which was being used for pH adjustment was replaced with liquid caustic soda, and liquid hydrofluosilicic acid replaced dry sodium silicofluoride. An advanced electronically controlled filter was installed, and hydraulic valves and mechanical flow rate valves were replaced by electrically motorized valves and electronic filter control tables. An evaluation of the chemical feed systwem is currently underway. These improvements at the North facility which allow the plant to achieve a capacity of 30 mgd will eliminate the South plant and free the land for future expansion needs. (Geiger-PTT)
W86-04286

ADVANCED TECHNOLOGY MAKES MOUNTAIN RUN-OFF PALATABLE,

W. Powell.
Water Engineering and Management, Vol. 132, No. 7, p 30-31, July 1985.

Descriptors: *Water treatment facilities, *Water treatment, *Clarifiers, *Filtration, *Turbidity, Filters, Clarification, Coagulation, Cost Analysis, Disinfection.

At Eagle, Colorado, a package water treatment system was recently installed that can efficiently handle the high turbidity levels that occur during the spring and summer due to mountain runoff. The new Culligan MT-108 Multi-Tech water treatment system consists of three trains of two tanks each. Each two-tank train comprises a depth clarifier and a depth filter connected in series so that water flows first through the clarifier and then the filter. The depth clarifiers make the system compact and efficient. Each contains a 40-in.-deep bed of contact clarifier mineral. The process uses alum and polymer as flocculants and coagulants, both stored in holding tanks and fed automatically. The depth filter contains three layers of filtering media, an arrangement that elimiates clogging. As water leaves the depth filter, it is gas chlorinated for basic disinfection and piped to an underground clearwell. From the clearwells it is distributed to three storage tanks. An efficient backwash sequence was provided in the design and installation of the facility. The new plant has proved to be substantially more economical to operate than the old one. (Geiger-PTT)
W86-04287

STABILIZING WATER WITH CHEMICAL DOSES,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, J. M. Morgan, and M. W. Corey.
Water Engineering and Management, Vol. 132, No. 11, p 36-37, October 1985. 2 fig, 4 ref.

Descriptors: *Hydrogen ion concentration, *Water treatment, *Chemical treatment, *Computers, *Mathematical studies, *Lime, Alkalinity, Water treatment, Drinking water, Calcium carbonate, Stability analysis, Corrosion control, Water distribution.

Producing the best possible water for customers requires not only disinfection, but also a product with a pH that will not corrode distribution equipment. Trial-and-error methods of calculating the proper lime dosage to raise the pH of water are often very time consuming. A set of nomograms were developed for calculating chemical doses of calcium carbonate for all types of naturally occurring drinking waters. The nomograms were combined with a microcomputer to calculate the optimum chemical dose needed to stabilize water. The programs not only can calculate the chemical dose in terms of pure chemical, but given data on chemical purity and actual plant flow rate, they calculate feed rate in terms of pounds per hour of chemical. The combined microcomputer-nomogram system will be useful in correcting chemical dosing in response to pH changes due to temperature, variable water sources, and weather conditions. (Geiger-PTT)
W86-04295

MOTOR CONTROL ELIMINATES ERRATIC DISTRIBUTION PRESSURE,

El Reno City Public Works, OK.
G. Watts.
Water Engineering and Management, Vol. 132, No. 11, p 38, 40, October 1985.

Descriptors: *Pumps, *Water pressure, *Water distribution, Electrical equipment, Hydraulic equipment, Hydraulic machinery, Cost analysis.

A variable-speed motor drive was installed on a booster pump already in place on a water distribution pump of an Oklahoma town due to complaints of erratic water pressure. The drive was supplied by Parametric of Barry Wright. An isolated signal interface controller and existing pressure transducer located on the pump line is used to sense pressure. The transducer generates a feedback signal depending on line pressure. When low pressure is sensed, a signal instructs the motor drive to speed up the pump motor to increase the line pressure. As pressure increases, the motor slows to maintain an optimum value. A magnetic bypass system allows the pump to run at full speed in case of a motor drive failure. The new system has corrected the water pressure problems and is expected to increase the motor and pump life up to five times. Also in the flat pressure system, leaks and other problems are more easily detected, a factor which should also help reduce maintenance costs. (Geiger-PTT)
W86-04296

CHEMICAL BID PACKAGE CUTS COSTS, IMPROVES CONTROL,

Manatee County Water Treatment Plant, Brandenton, FL.
For primary bibliographic entry see Field 5D.
W86-04301

PREDOMINANT BACTERIAL GENERA IN GRANULAR ACTIVATED CARBON WATER TREATMENT SYSTEMS,

Philadelphia Water Dept., PA.
G. A. Burlingame, I. H. Suffet, and W. O. Pipes.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 3, p 226-230, March 1986. 4 tab, 21 ref. EPA Grant 806256-02.

Descriptors: *Granular activated carbon, *Bacterial analysis, *Drinking water, *Sand filters, *Chlorination, *Ozonation, Water treatment, Heterotrophic plate count techniques, Philadelphia, Pennsylvania, Pilot plants.

Granular activated carbon (GAC) beds may be used for removal of dissolved organic matter during the treatment of drinking water. However, they also might change the microbiological quality of the water entering the distribution system, either by changing the predominant bacteria or the bacterial density of the treated water. A 3-yr pilot plant study of water treatment using GAC beds was conducted at the Baxter Water Treatment Plant in Philadelphia. During the study, bacteria were isolated from raw water and from the effluents of the GAC treatment units. Bacteria genera in the GAC effluents and in the GAC units themselves were similar to those found in the raw water and in the sand beds. Prechlorination and (or) preozonation of the water before GAC treatment had no noticeable effect on the bacterial genera found as compared with a GAC unit having no predisinfection. The bacterial genera found in this study were similar to those found in seven other studies of GAC water treatment that used a variety of treatment schemes and a variety of heterotrophic plate count techniques to evaluate bacterial populations. From these several studies it appears that GAC treatment does not change the nature of the bacterial populations associated with drinking water. (Author's Abstract)
W86-04339

CHLOROFORM IN TAP WATER AND HUMAN BLOOD,

Turku Univ. (Finland). Dept. of Public Health.
R. Kroneld.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 477-483, April 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Drinking water, *Blood, *Chloroform, *Volatile halocarbons, Turku, Finland, Tap water, Well water.

Volatile halocarbons were sought in blood samples from the following three groups: patients in Turku, Finland, hospital and healthy subjects, both of which drank chlorinated water, and control subjects from the southwestern Finnish archipelago, who drank unchlorinated water from wells. Of the volatile halocarbons, only chloroform was found in blood samples from healthy individuals (about 4% of 200 samples) and patients(about 3% of 210 samples). Neither the blood of control subjects nor the water from the wells contained detectable amounts of chloroform. The fact that chloroform was not found in blood sugar samples in autumn, at the time when chloroform concentrations were highest in the water samples, suggests that blood chloroform may have come from sources other than water. When volatile hydrocarbons were added to blood samples, they were taken up significantly more by the cell fraction. (Rochester-PTT)
W86-04361

AQUATIC TOXICITY EVALUATED USING HUMAN AND MONKEY CELL CULTURE ASSAYS,

Shimane Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
For primary bibliographic entry see Field 5C.
W86-04362

FLAVOR PROFILE ANALYSIS: TASTE AND ODOR CONTROL OF THE FUTURE,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. H. M. Bartels, G. A. Burlingame, and I. H. Suffet.
American Water Works Association JAWWA5, Vol. 78, No. 3, p 50-55, March 1986. 2 tab, 51 ref.

Descriptors: *Taste, *Odors, *Organoleptic properties, *Drinking water, *Flavor profile analysis, *Taste panels, Water treatment, Sensory analysis, Water quality standards.

A standard method is needed in the drinking water industry to describe the actual flavor and aroma of a water sample in a qualitative and reproducible way, and to provide a quantitative estimate of the intensities of organoleptic (taste and odor) sensations. Organoleptic problems in drinking water and characteristics of sensory analysis are reviewed, and the employment of flavor profile analysis (FPA) as the method of choice for taste and odor description of water is described. Selecting and training FPA panelists, FPA methodology for the evaluation of drinking water, and goals for standardizing the FPA method are discussed. The FPA method used so far by water utilities has allowed panelists to use a large number of descriptives for characterizing water samples, but several descriptives seem to be used for the same sensation, making comparison among panel results difficult. The number of descriptives could be reduced by using standards for certain aromas and flavors. New panelists could be trained to recognize the aroma of a standard compound and to use a predesignated descriptive, even if their own sensation differs slightly. This approach might lead to a more universal vocabulary for description of water samples. (Rochester-PTT)
W86-04370

CASE STUDY OF GEOSMIN IN PHILADELPHIA'S WATER,

Philadelphia Water Dept., PA.
G. A. Burlingame, R. M. Dann, and G. L. Brock.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 56-61, March 1986. 4 fig, 2 tab, 20 ref.

Descriptors: *Algae, *Odor control, *Geosmin, *Philadelphia, *Hydraulic strategies, Activated carbon, Taste, Odor, *Water treatment, Schuylkill River, Pennsylvania.

Two episodes of unacceptable tastes and odors, which corresponded with levels of geosmin in the water that were much higher than the background level of 20 nanogram/liter or less, occurred in Philadelphia during 1985. The source of one episode was found to be a localized bed of algae in the Schuylkill River. An existing taste- and odor-control program, which utilizes instrumental and sensory analyses, was largely responsible for the effective management of the episodes. Hydraulic strategies were used to reduce the treatment plant's intake of geosmin, and powdered activated carbon in the treatment train further reduced the geosmin level. Dilution of this treated water with other finished waters in the distribution system also diminished the impact of geosmin on the taste and odor of Philadelphia's water. (Author's abstract)
W86-04371

OXIDATION OF FIVE EARTHY-MUSTY TASTE AND ODOR COMPOUNDS,

University of Southern California, Los Angeles. Dept. of Civil Engineering.
S. Lalezary, M. Pirbazari, and M. J. McGuire.
American Water Works Association JAWWA5, Vol. 78, No. 3, p62-69, March 1986. 7 fig, 3 tab, 60 ref.

Descriptors: *Geosmin, *Odor, *Chlorine, *Chlorine dioxide, *Ozone, *Permanganate adsorption, *Water treatment, Oxidation, Taste.

Four commonly used techniques (chlorination with C12, Chlorination with C102, and potassium permanganate adsorption) were tested for their effectiveness in removing five different organic taste and odor compounds from water. The compounds treated were geosmin, 2,3,6-trichloroanisole (TCA), 2-isopropyl-3-methoxy pyrazine (IPMP), 2-isobutyl-3-methoxy pyrazine (IBMP), and 2-methyl-isoborneol (MIB). Although testing was originally intended to simulate water treatment conditions, it was necessary to choose conditions that were often extreme, such as wide ranges of dosages and contact times, so that more conclusive evidence of the efficiencies of these techniques could be obtained. A comparison at equivalent dosages showed that chlorine dioxide was the most effective oxidant for removing the five selected compounds. (Rochester-PTT)
W86-04372

CHEMISTRY AND PHYSIOLOGY OF ODOR SENSITIVITY,

Agricultural Research Service, Albany, CA. Western Regional Research Center
J. E. Amoore.
American Water Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 70-76, March 1986. 6 fig, 3 tab, 12 ref.

Descriptors: *Olifactory sensitivity, *Specific anosmia, *Odor classification, Odors, *Drinking water, Geosmin, 2-Methylisoborneol, Organic compounds.

The chemistry and physiology of odor sensitivity are discussed, including individual human odor thresholds, the concept of primary odors, classification of odors, descriptives of odor problems in water, and tastes and odors of organics in water. The normal small sensitivities of healthy people, olfactometric properties of primary odorants, general odor classifications, specific anosmia ('smell-blindness') analyses, structural formulas of primary odorants, and structural formulas and olfactory properties of earth-musty odorants are considered. Odor threshold testing has demonstrated the wide variation in normal olfactory sensitivities of a population and the common occurrence of the specific anosmia. Continuing research on specific anosmia is leading to a fundamental classification of primary odors. Many objectionable primary odorants are composed of unsaturated or nucleophilic molecules and are susceptible to destruction, or conversion to odorless derivatives, by oxidizing agents added to the water. Odorants that resist oxidation, such as geosmin and 2-methylisoborneol, are a problem. (Rochester-PTT)
W86-04373

EARLY WARNING SYSTEM FOR TASTE AND ODOR CONTROL,

Southern California Metropolitan Water District, La Verne.
E. G. Means, III, and M. J. McGuire.
American Water Works Association JAWWA5, Vol. 78, No. 3, p 77-83, March 1986. 8 fig, 1 tab, 19 ref.

Descriptors: *Taste, *Odor, *Reservoirs, *Copper sulfate, Oscillatoria species, 2-Methylisoborneol, Geosmin, Algae, California, Lake Mathews.

An early warning system was set up that would detect impending taste and odor problems in Lake Mathews, a Southern California storage reservoir, and control was effected by identifying the sources of the earthy-musty odors, identifying the agents responsible, studying agents' habitat and distribution in the reservoir, and exploring various control methods. Advance notice has been provided effectively by sampling the reservoir at seven locations, with detection of 2-methylisoborneol and geosmin in the water. With this system, the severity and extent of annual taste and odor episodes has been minimized. Application of chunk copper sulfate has proven to be the most economical method of controlling the algae (Oscillatoria curviceps, O. splendida) responsible for the taste and odor problems. Long-term control options include addition of activated carbon (which is under investigation), biological controls, e.g., introduction of fish species that feed on blue-green algae, and construction of a bypass pipeline. (Rochester-PTT)
W86-04374

CHLORINE DIOXIDE FOR TASTE AND ODOR CONTROL,

Edmonton Water and Sanitation (Alberta). Water Treatment Section.
G. S. Walker, E. P. Lee, and E. M. Aieta.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 84-93, March 1986. 6 fig, 5 tab, 20 ref.

Descriptors: *Taste, *Odor, *Hydrocarbons, *Urban runoff, Activated Carbon, Water treatment, Canada.

A Canadian utility's experience with chlorine dioxide treatment for the prevention of tastes and odors is outlined. After 3 yr experience with high-yield C102 treatment for the control of taste and odor at Edmonton treatment plants, nearly all types of taste and odor complaints have been eliminated, the exception being those resulting from incomplete removal of street-runoff hydrocarbons that enter the river between the two treatment plant sites. Application of particulate activated carbon (PAC) is effective in removing hydrocarbons, but judging from the inability of these processes to eliminate complaints entirely, it is concluded that (1) the hydrocarbon molecule is refractory to C102 oxidation under water treatment conditions and (2) PAC, applied as a slurry at the headworks, is not efficient enough to complete the removal of offensive contaminants. (Rochester-PTT)
W86-04375

RETURNING RECENTLY COVERED RESERVOIRS TO SERVICE: HEALTH AND AESTHETIC CONSIDERATIONS,

Southern California Metropolitan Water District, La Verne.
S. W. Krasner, and E. G. Means, III.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 94-100, March 1986. 8 fig, 3 tab, 18 ref.

Descriptors: *Reservoirs, *Xylenes, *Bacterial analysis, *Chlorine residual, Trace organics, Odors, Flavor, Covers, California, Monitoring.

Garvey and Orange County reservoirs in Southern California are described, and the process of covering these two reservoirs and subsequently returning them to service is discussed. Elastomer covers were installed with xylene as a solvent during fabrication. When the reservoirs were refilled, monitoring of chlorine residual, bacteria, trace organics, and odor and taste was conducted to ensure suitability of the water for use. These two finished-water reservoirs were filled and monitored in such a way that xylenes leaching from their covers were diluted to a negligible concentration in the effluents. The bacteriological quality of the water remained high throughout the filling and returning to service of the reservoirs. The floating covers have dramatically improved the overall microbiological quality of the two reservoirs — a major objective of the installing the covers. While the reservoirs were being restored to service, no complaints about the aesthetic quality of the water were received, and health requirements were satisfied. (Rochester-PTT)
W86-04376

OIL POLLUTION OF A GROUNDWATER SOURCE,

Eastbourne Waterworks Co. (England).
For primary bibliographic entry see Field 5B.
W86-04377

DESTRATIFICATION AT BEWL BRIDGE RESERVOIR, KENT,

Mid Kent Water Co., Canterbury (England).
For primary bibliographic entry see Field 5G.
W86-04378

DESIGN AND CONSTRUCTION OF NEW SPILLWAYS AND OTHER REMEDIAL WORKS TO THE LITTON RESERVOIRS, NEAR BRISTOL,

Watson Hawksley, London (England).
For primary bibliographic entry see Field 8A.
W86-04379

DIGITAL DISTRIBUTION SYSTEM RECORDS: A JOINT VENTURE,

North Surrey Water Co., Staines (England).
For primary bibliographic entry see Field 7C.
W86-04380

GRANULAR ACTIVATED CARBON AS SAND REPLACEMENT IN RAPID GRAVITY FILTERS,

Water Research Centre, Stevenage (England).
R. A. Hyde, D. G. Hill, and T. F. Zabel.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 40, No. 1, p 70-80, February 1986. 5 fig, 8 tab, 6 ref.

Descriptors: *Activated carbon, *Sand, *Sand filters, *Chlorination, *Bacteria, *Turbidity.

Work carried out at the Church Wilne water treatment works of the lower Trent division, Severn Trent Water (England), has shown that the few alterations are required to convert a sand filter to a granular activated carbon (GAC) filter. Exposed metal surfaces must be painted to prevent corrosion, provisions must be made for the removal of GAC, and backwash rates must be reduces by approximately 50% to avoid GAC losses. GAC of similar size to sand was as effective as the sand as a filter medium in terms of turbidity and residual coagulant removal. As expected, the GAC filter produced a water of lower organic content than the sand filter. However, the GAC dechlorinated the water and there were indications that the microbiological quality of the water from the GAC filter was worse than the water from the sand filter in which a free chlorine residual of 0.8 mg/l was maintained. The run lengths of the GAC filter

were, on average, 60 percent longer than those of the sand filter. At the same time effective carbon, sand replacement was less expensive than post-filter adsorbers as a means of applying GAC treatment. (Author's Abstract)
W86-04381

STUDY OF THE TRACE ORGANICS PROFILES OF RAW AND POTABLE WATER SYSTEMS,

Anglian Water Authority, Cambridge (England).
M. J. Pinchin.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 40, No. 1, p 81-99, February 1986. 13 fig, 7 tab, 6 ref.

Descriptors: *Gas liquid chromatography, *Trace organics, *Trihalomethanes, *Total organic carbon, *Raw water, *Potable water, Water treatment, England, Monitoring, Activated carbon, Carbon filters, Computers, Relative retention time, Great Ouse River.

Three water treatment works on the River Great Ouse, England, (Grafham, Bedford, Foxcote) and their distribution systems are described in terms of analyses of total organic carbon (TOC), trihalomethanes, and general organic quality determined by 'water profile analysis' based on gas-liquid chromatography (GLC) studies. The analytical technique used was designed to obtain information about a large number of GLC-amenable organics in a single run. This required the acceptance of unknown percentage recoveries during the solvent extraction, only relative quantification against a single internal standard, and limitation of the chromatographic conditions to give a reasonable overall performance within an acceptable time. Despite these restrictions, the system proved useful in the description of waters and treatment processes. When used on a comparative basis it has confirmed conclusions suggested by TOC measurements and has been readily interpretable in terms of storage and treatment. It is well suited to follow the performance of processes such as granular activated carbon filtration and to monitor sources that might be vulnerable to non-specific contamination, and for general survey work. Data analysis need not be restricted to broad relative retention time bands. The computer-based system can examine narrow sections of the profiles if required. (Rochester-PTT)
W86-04382

DESORPTION KINETICS OF PHENOL ON ACTIVATED CARBON,

California Univ., Davis. Dept. of Chemical Engineering.
C. Krebs, and J. M. Smith.
Chemical Engineering Science CESEAC, Vol. 40, No. 1, p 1041-1050, July 1985. 13 fig, 2 tab, 14 ref. NSF Grant 8026101.

Descriptors: *Kinetics, *Phenols, *Activated carbon, *Water treatment, Thermodynamics, Desorption, Activation energy, Mathematical studies.

Phenol absorbed on activated carbon from aqueous solutions is a complex system. When samples are thermally regenerated, the rate of desorption and the chemical species desorbed depend on the treatment prior to heating. It was found that only phenol is desorbed at temperatures in the range 110-200 C from samples prepared at 25 C and maintained in a desiccator at that temperature. Kinetics of desorption of such samples was studied by measuring weight and rate of weight change in runs at constant temperature (110-200 C) and at a constant heating rate (6 C/min). The data did not agree with first order kinetics using a constant energy, but could be explained by employing an exponential distribution of sites over a range of activation energies. Desorption was not complete even when samples were heated to 800 C. Our results and that of others indicate that the residue is most likely formed by reaction of phenol during the adsorption stage and during storage of the samples. (Author's abstract)
W86-04402

DECOMPOSITION OF OZONE IN WATER IN THE PRESENCE OF ORGANIC SOLUTES ACTING AS PROMOTERS AND INHIBITORS OF RADICAL CHAIN REACTIONS,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W86-04428

TRANSFORMATION OF TRACE ORGANIC COMPOUNDS IN DRINKING WATER BY ENZYMATIC OXIDATIVE COUPLING,

Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
S. W. Maloney, J. Manem, J. Mallevialle, and F. Fiessinger.
Environmental Science and Technology, Vol. 20, No. 3, p 249-253, March 1986. 4 fig, 2 tab, 21 ref.

Descriptors: *Organic compounds, *Trace levels, *Drinking water, *Enzymatic oxidative coupling, Enzymes, Water treatment, Horseradish peroxidase, Chlorinated phenols, Hydrogen peroxide.

A new method has been suggested for removal of aromatic compounds from water. The procedure involves enzymatic coupling of aromatic compounds and precipitation of the less soluble, high molecular weight end products. Horseradish peroxidase (HRP) catalyzes the oxidative coupling in the presence of hydrogen peroxide. This new method has been demonstrated on a laboratory scale with synthetic mixtures at concentrations (e.g., 100 mg/L) found in industrial wastewaters. These concentrations are quite high compared to drinking water, where the levels of specific organics lie in the nanograms per liter-micrograms per liter range. This paper examines HRP oxidative coupling of several chlorinated phenols. These compounds were chosen because they arise from a variety of anthropogenic sources, are often toxic, and present taste and odor problems in finished drinking water. Feasibility at low substrate concentration, interferences from natural background organics, and the nature of final products were investigated. The results indicate that enzymatic oxidative coupling using horseradish peroxidase and hydrogen peroxide may be useful in eliminating some aromatics that are not well-removed in biological or physical water treatment, but the nature of the byproducts must be determined to assure that the products are not more undesirable than the initial compounds. (Lantz-PTT)
W86-04439

DOES FLUORIDATION OF DRINKING-WATER PREVENT BONE FRAGILITY AND OSTEOPOROSIS,

National Board of Health, Helsinki (Finland).
O. Simonen, and O. Laitinen.
The Lancet LANCAO, Vol. II, No. 8462, p 432-433, August 24, 1985. 3 tab, 16 ref.

Descriptors: *Fluoridation, *Drinking water, *Osteoporosis, Bone fragility, Water treatment, Physiological effects, Kuopio, Jyvaskyla, Finland, Fluoride.

Bone fragility in elderly people is a serious public health problem, and the pressure on health services will increase as the proportion of elderly people rises. The effect of fluorides on bone tissue has been shown in several studies, and the use of fluorides for the treatment of osteoporosis and osteoporotic hip fractures has been recommended. The fluoridation of drinking water since 1945 has been successful in the prevention of dental caries in the general population and may possibly prevent bone fragility and osteoporosis. The aim of this study was to examine the association between incidence of femoral neck fractures in the population aged 50 and over, and fluoride content of 1 mg/l in drinking water. The incidence was compared in 2 Finnish towns of similar economic structure, Kuopio and Jvyaskyla. Kuopio has fluoridated its drinking water since 1959, while Jyvaskyla has only trace amounts of fluoride in its drinking water. The incidence of bone fragility (measured as femoral neck fractures) was found to be significantly less in Kuopio than in Jyvaskyla. This finding seems to be associated with a fluoride content of 1 mg/l in the drinking water of Kuopio. (Lantz-PTT)
W86-04453

DEVELOPMENT OF AN ON-LINE ZERO CHLORINE RESIDUAL MEASUREMENT AND CONTROL SYSTEM,

Metro Renton Treatment Plant, WA.
For primary bibliographic entry see Field 5D.
W86-04492

OPERATION AND MAINTENANCE OF THE UOSA WATER RECLAMATION PLANT,

CH2M/Hill, Reston, VA.
For primary bibliographic entry see Field 5D.
W86-04499

EFFECTS OF WATER REUSE, RECYCLING AND RESOURCE RECOVERY ON FOOD PROCESSING WASTE TREATMENT IN THAILAND,

Siamotec International Ltd., Bangkok (Thailand).
For primary bibliographic entry see Field 5D.
W86-04513

ULTRAPURE WATER IN THE ELECTRONICS INDUSTRY,

Famil International B.V., Amsterdam (Netherlands).
H. M. Bunnik.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 69-79, 1986. 4 fig.

Descriptors: *Ultrafiltration, *Electronic industry, *Industrial water, *Ultrapure water, Reverse osmosis, Cartridge filters, Pumps, Sand filters.

The production of integrated circuits needs an ultra pure water to prepare the acid cleaning and etching baths, to clean the matrices in order to stop the acidic action and to fill the cascade or overflow rinse tanks to remove the last traces of processing solutions. Etch, clean, flush and rinse steps are repeated many times for each matrix until the integrated circuit chip is ready. Impurities in the water can cause failures in the integrated circuit. The objective of this paper is to give an idea about the requirements for the ultra pure water used for the above mentioned applications and to describe an installation designed to meet these requirements - break tanks, sodium hypochlorite dosing, transfer pumps, sand filters, chemical dosing, cartridge filters, high pressure pumps, reverse osmosis units, etc. (Lantz-PTT)
W86-04518

USE OF OZONE IN THE TREATMENT OF WATER FOR POTABLE PURPOSES,

Singapore Public Utilities Board. Dept. of Water.
W. K. Wei.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 95-108, 1986. 5 fig, 4 tab, 5 ref.

Descriptors: *Ozonation, *Water treatment, *Potable water, *Water supply development, Rivers, Reservoirs, Estuaries, Storage reservoirs, Water supply, Water use, Cost analysis.

Singapore water supply comes from rivers, upland reservoirs and estuarial reservoirs. There are seven estuarial reservoirs, all located in the western part of Singapore. The estuarial reservoirs were developed in the seventies and early eighties. They were formed by constructing dams or dykes across the river mouths or low lying coastal areas. Six out of the seven estuarial reservoirs collect the catchment runoff directly. The remaining one was built as an off-stream reservoir at the side of a canal with a top water level about 4 meters higher than the normal canal level. Hence water collected in the canal has to be pumped into this reservoir. It was necessary to develop the estuarial reservoirs in the seventies as all upland sources have been exploited. In taking this decision, it was necessary to commit a program to clean up the water catchments and strictly control the type of human activities and

degree of urbanization in the 'new' water catchments. Discussed here are the charcteristics of the various sources of raw water, various water treatment processes, characteristics of ozone and its usage in water treatment, types of ozonizers (plate-type and tub-type), the Chao Chu Kang ozone generation and treatment plant, problems experienced, and the costs of treatment. (Lantz-PTT)
W86-04520

CHANGES IN PARTICLE SIZE DISTRIBUTIONS ON A FIXED BED OF GRANULAR ACTIVATED CARBON,

New York State Dept. of Health, Albany. Div. of Labs. and Research.
E. A. Shpirt, and K. T. Alben.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 31-42, 1986. 5 fig, 3 tab, 22 ref.

Descriptors: *Granular activated carbon, *Particle size, *Fixed bed, Water treatment facilities, Water treatment, Waterford, New York, Backwash, Calgon F400, Stratification, Domestic water.

The particle size distribution at different bed depths of a fixed bed of granular activated carbon (GAC) has been monitored during 50 weeks of a pilot column run at the Waterford, New York potable water treatment plant. Initial backwashing resulted in significant stratification of GAC in the column: larger particles (average diameter 1.18 mm) settled in the bottom of the colum (105 cm), and smaller particles (average diameter 0.97 mm) were concentrated near the top (24 cm), compared to samples of unstratified virgin Calgon F400 (average diameter 1.09 mm). During column loading and initial backwashing, more fines were created than were present in the virgin GAC (average 6.5% of GAC fines in the > 40 mesh fraction, compared to only 0.3% in the > 40 mesh fraction for virgin Calgon F400). After 50 weeks of service there was an overall trend toward a smaller average particle size (0.9 mm) with development of a more regular pattern of bed stratification (1.08 mm at the bottom and 0.75 mm at the top). These changes are attributed to breaking of large particles (12-20 mesh) and creation of intermediate size particles (20-30 and 30-40 mesh). (Author's abstract)
W86-04563

EXTERNAL MASS TRANSFER DURING THE ADSORPTION OF VARIOUS POLLUTANTS ONTO ACTIVATED CARBON,

Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W86-04572

ENHANCEMENT OF MERCURY (II) SORPTION FROM WATER BY COAL THROUGH CHEMICAL PRETREATMENT,

Sri Venkateswara Univ., Tirupati (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-04574

PHOSPHATE ADSORPTION ONTO HYDROUS MANGANESE (IV) OXIDE IN THE PRESENCE OF DIVALENT CATIONS,

Shiga Univ., Otsu (Japan). Dept. of Chemistry.
M. Kawashima, Y. Tainaka, T. Hori, M. Koyama, and T. Takamatsu.
Water Research WATRAG, Vol. 20, No. 4, p 471-475, April 1986. 4 fig, 14 ref.

Descriptors: *Phosphates, *Adsorption, *Manganese oxide, *Cations, *Water treatment, Inorganic compounds, Barium, Calcium, Strontium, Magnesium, Natural waters.

Phosphate which exists as H2PO4(-) and HPO4(2-) in most freshwaters can be rapidly removed from solutions by adsorption onto inorganic substances. Hydrous Fe(III) oxide, hydrous Al oxide and clay minerals are thought to be important adsorbents for phosphate since all these substances have positive surface charges at slightly acid to neutral pH and therefore high affinities for anions. Alkaline earth cations, Ba(2+), Sr(2+), Ca(2+), Mg(2+) and transition metal ions, Mn(2+), Co(2+), Ni(2+), cause hydrous manganese (IV) oxide (HMO) to strongly adsorb phosphate between pH 6 and 9 depending on the cation. The effectiveness of the alkaline earth cations to cause P adsorption was Ba(2+) > Sr(2+) > Ca(2+) > Mg(2+), which is the same order as their affinities for the oxide. Changes with time were found in the abilities of the transition metals to cause P adsorption onto HMO and this may be due to conversion of the adsorbed cation to its oxide. A new potential role for HMO as an adsorbent of phosphate in natural waters was indicated. (Lantz-PTT)
W86-04577

SURVEY OF LEGIONELLA PNEUMOPHILA IN WATER IN 12 CANADIAN CITIES,

Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5A.
W86-04581

KINETICS OF METHANOGENS IN AN EXPANDED-BED REACTOR,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y.-T. Wang, M. T. Suidan, and B. E. Rittman.
Journal of Environmental Engineering JOEEDU, Vol. 112, No. 1, p 155-170, February 1986. 5 fig, 3 tab, 31 ref, append. EPA Contract No. EPA-809750-01.

Descriptors: *Mathematical models, *Biological treatment, *Biological membranes, *Kinetics, Anaerobic bacteria, Methane bacteria, Biomass, Mathematical studies, Model studies, Biological wastewater treatment, Substrates, Activated carbon, Anaerobic digestion, Monod kinetics.

A biofilm mathematical model for single-stage substrate utilization was developed for an expanded-bed, activated-carbon anaerobic reactor. The concepts of liquid-layer mass transport, biofilm molecular diffusion, and Monod kinetics were incorporated into the model. During 849 days of continuous operation, four steady state operating conditions were obtained, covering a wide range of feed acetate concentration. Steady state data collected when the feed acetate concentrations were 1,600 ml/L and 3,200 mg/L and weekly data obtained when the feed acetate concentration was 6,400 mg/L were used to estimate biokinetic parameters. The model input for each data set consisted of the acetate flux and the log-mean bulk acetate concentration within the reactor. The model was solved for attached biomass using each data set and various trial values of the two Monod constants (one for the half-velocity coefficient, the other for the maximum utilization rate of acetate), and a microbial biofilm density of methanogens. Best estimates of the two Monod constants and the biofilm cell density were obtained by observing the lowest value of the minimum sum of squared deviations between the model-predicted biomass and measured biomass. The biofilm kinetics were characterized as fully penetrated, with no significant external mass transport resistance. (Author's abstract)
W86-04587

TRY TACKLING A CORROSION INVESTIGATION,

Los Angeles City Dept. of Water and Power, CA.
For primary bibliographic entry see Field 8G.
W86-04619

PRECURSOR SIZE AND ORGANIC HALIDE FORMATION RATES IN RAW AND COAGULATED SURFACE WATERS,

Clarkson Univ., Potsdam, NY. Dept. of Biology.
R. L. Sinsabaugh, III, R. C. Hoehn, W. R. Knocke, and A. E. Linkins.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 139-153, February 1986. 4 fig, 8 tab, 46 ref.

Descriptors: *Organic carbon, *Halides, *Coagulation, *Sulfates, *Fulvic acids, Separation techniques, Surface water, Halogens, Particle size, Water treatment, Virginia, Trihalomethane.

The size distribution of organic carbon and organic halide precursors was determined for raw and coagulated waters from two Virginia reservoirs. Organic carbon removal by ferric sulfate coagulation was size dependent, with larger molecules (>5,000 daltons) removed more effectively than smaller ones (<1,000 daltons). In coagulated waters, the specific yields of organic halide and reaction rates of precursors with chlorine were low compared to the corresponding raw waters. These trends were explained by the selective removal of fulvic acids by coagulation. The dominant organic halide precursors in treated waters were small hydrophobic neutral molecules. Compared to fulvic acids, they had lower specific yields of organic halide and slower reaction rates with chlorine. Because this type of molecule was not removed by coagulation, their concentration ultimately determined whether coagulation alone was sufficient for trihalomethane control. (Author's abstract)
W86-04646

INACTIVATION OF NORWALK VIRUS IN DRINKING WATER BY CHLORINE,

Texas Univ. at San Antonio. Medical School.
B. H. Keswick, T. K. Satterwhite, P. C. Johnson, H. L. DuPont, and S. L. Secor.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 261-264, August 1985. 3 tab, 22 ref. EPA CR 810778-01-0, and PHS Grant RR00350.

Descriptors: *Norwalk virus, *Drinking water, *Chlorination, *Water Treatment, Viruses, Bacteriophage, Waterborne pathogens.

Norwalk virus in water was found to be more resistant to chlorine inactivation than poliovirus type 1 (LSc2Ab), human rotavirus (Wa), simian rotavirus (SA11), or f2 bacteriophage. A 3.75 mg/l dose of chlorine was found to be effective against other viruses but failed to inactivate Norwalk virus innoculum remained infectious for five of eight volunteers, despite the initial presence of free residual chlorine. Infectivity in volunteers was demonstrated by seroconversion to Norwalk virus. Fourteen of 16 subjects receiving untreated inoculum seroconverted to Norwalk virus. Illness was produced in four of the eight volunteers and in 11 of 16 control subjects. A similar Norwalk virus inoculum treated with a 10 mg/l dose of chlorine produced illness in only one and failed to induce seroconversion in any of eight volunteers. Free chlorine (5 to 6 mg/l) was measured in the reaction vessel after 30-minute contact period. Norwalk virus appears to be very resistant to chlorine which may explain its importance in outbreaks of waterborne disease. (Author's abstract)
W86-04670

CHANGES IN VIRULENCE OF WATERBORNE ENTEROPATHOGENS WITH CHLORINE INJURY,

Montana State Univ., Bozeman. Dept. of Microbiology.
M. W. LeChevallier, A. Singh, D. A. Schiemann, and G. A. McFeters.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 412-419, August 1985. 7 fig, 1 tab, 35 ref. PHS Grant AI19089 and AM33510-01.

Descriptors: *Waterborne pathogens, *Chlorination, *Enteric pathogens, Yersinia enterocolitica, Salmonella typhimurium, Shigella, Eschericia coli, Coliforms, Water treatment.

Experiments to assess the effect of chlorine injury on the virulence of waterborne enteropathogens, were designed. Higher chlorine doses (0.9 to 1.5 mg/l) were necessary to produce injured Yersinia enterocolitica, Salmonella typhimurium, and Shigella spp. than to produce injured enterotoxigenic Eschericia coli or coliform bacteria (0.25 to 0.5 mg/l) in the test system used. 50% lethal dose experiments, in which mice were used, showed that injured Y. enterocolitica cells were 20 times less virulent than uninjured control cells (3,300 and 160 CFU, respectively). This decrease in virulence was not related to reduced attachment to Henle

407 intestinal epithelial cells, but could be related to a loss of HeLa cell invasiveness. In contrast, injured S. typhimurium and enterotoxigenic E. coli cells lost their ability to attach to Henle cells. These data show that some enteropathogens and coliform bacteria differ in their sensitivities to chlorine injury and that the virulence determinants affected by chlorine may vary from one pathogen to another. (Lantz-PTT)
W86-04673

5G. Water Quality Control

SAN JOSE DEL CABO, BAJA CALIFORNIA, NARROW VALLEY AQUIFER,

Universidad Nacional Autonoma de Mexico, Mexico City.
For primary bibliographic entry see Field 2F.
W86-03979

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).

American Petroleum Inst., Washington, DC.
February 28-March 3, 1983, San Antonio, Texas. 586 p.

Descriptors: *Oil spills, *Cleanup operations, *Conferences, *Dispersants, Environmental effects, Cold regions, Model studies, Case histories, Oil recovery, Brackish water, Natural waters, Oil, Oily water, Legal aspects, Oil pollution.

The biennial Oil Spill Conference Proceedings have been recognized worldwide as the authority for state-of-the-art information on oil spill equipment, regulation, and cleanup techniques, as well as the impacts resulting from social and legal forces. This 1981 Oil Spill Conference Proceedings presents a distinguished, international exchange of information with session sections covering topics such as: dispersants, laboratory and effluent water studies, training, modeling, cold water studies, case histories, petroleum in fresh and brackish waters, nearshore sediment studies, socioeconomic and legal aspects, offshore platform studies, and contingency planning. (Lantz - PTT)
W86-04001

DISPERSANT USE GUIDELINES FOR FEDERAL REGIONS IX AND X,

Fish and Wildlife Service, Sacramento, CA.
R. W. Smith, and R. Pavia.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 3-7, 12 ref.

Descriptors: *Dispersants, *Guidelines, *Oil spills, *Cleanup operations, Cleanup, Environmental contamination, Oil spill impact, Recommendations, Surfactants.

The Regional Response Teams in California, Oregon, and Washington have attempted to deal with the problem of providing rapid approval or denial of dispersant use requests during a major spill event. Realizing that the On-Scene Coordinator must act quickly in order for the dispersants to be effective, the RRT undertook a program to develop a system that would allow for approval or denial within four hours. The Regional Response Teams in Standard Federal Regions IX and X developed and implemented Dispersant Use Guidelines, from 1978 to the present, to enhance the regions' capability to respond rapidly to requests for approval of dispersant use. The physical, chemical, and biological parameters associated with spilled oil and dispersants are evaluated in this procedure. A decision to use dispersants is based on balancing the possible contamination of the environment with other factors. Damages expected from spills not treated with dispersants are compared to damages which would be expected if the oil were successfully treated. The objective is to minimize the impact of spilled oil on natural resources. This paper summarizes the progress of two Regional Response teams in responding to the questions of dispersant use, reviewing dispersant guidelines, and recommending minimum standards for documentation. The procedure involves the interaction and cooperation of the several agencies, and promotes the timely use of knowledge and information. (Author's abstract)
W86-04002

DISPERSION OF CHEMICALLY TREATED CRUDE OIL IN NORWEGIAN OFFSHORE WATERS,

Sentralinstitutt for Industriell Forskning, Oslo (Norway).
R. G. Lichtenthaler, and P. S. Daling.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 7-14, 6 fig, 11 tab, 9 ref.

Descriptors: *Dispersants, *Oil spills, *Cleanup operations, *Oil slicks, *Water analysis, Cleanup, Oil, Chemical analysis, Gas chromatography, Surfactants.

In May and July 1982, two series of dispersant research oil spills were carried out off the Norwegian coast. The May series comprised three discharges of 2,000 liters of Statfjord topped crude oil (initial boiling point 150 C). Two of the slicks were treated with dispersants (A and B) from a boat while the third untreated slick served as control. The July series comprised four discharges of 2,000 liters of Statfjord crude oil, with the application of three dispersants (A, B, and C), and one untreated slick as control. Water samples were collected from under the slicks and analyzed for total petroleum using a gas chromatographic technique. Chemical analyses showed six percent dispersion of the oil for dispersant A, and 17 percent for dispersant B in the May series. Effectiveness of dispersants in the July series was found to be 19 percent for dispersant A and 22 percent and 2 percent for dispersants B and C, respectively. Gas chromatographic analyses showed in several cases the presence of dispersants (up to two ppm) in water samples without the presence of petroleum at all. The highest oil contents found in water samples were 10 ppm at a one meter depth. The variations in the effectiveness of the three dispersants tested in the field were later confirmed in laboratory tests. (Author's abstract)
W86-04003

TESTING OF A PROTOTYPE WASTE OIL FLARING SYSTEM,

Seaward International, Inc., Falls Church, VA.
R. L. Beach, and W. T. Lewis.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 29-32, 5 fig, 2 ref.

Descriptors: *Oil, *Oil wastes, *Incineration, *Flaring, Prototype tests, Prototypes, Flare incineration, Weather conditions, Hazardous environment.

This paper describes a prototype flaring burner system developed for the U.S. Coast Guard. The system is capable of flaring 180 gallons per minute (gpm) of light oil or 90 gpm of oil with a viscosity of up to 1,600 centistokes (cs). Smokeless burning can be achieved in certain cases. The system is designed to be portable. The entire system can be broken down into modules and transported in a C-130 aircraft, and each module is light enough to be carried to a remote spill site by a Coast Guard helicopter. The system is self-erecting and capable of operating safely in hazardous environments and in cold weather conditions. The performance test program conducted on the completed prototype system also is described. These tests were successful, with the conclusion that the prototype could be used for operational flaring at this time. (Author's abstract)
W86-04005

EFFECTIVE LOW COST FIREPROOF BOOM,

Environmental Protection Service, Montreal (Quebec).
K. M. Meikle.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 39-42, 5 fig, 2 tab, 4 ref.

Descriptors: *Booms, *Fireproof booms, *Oil spill, *Design objectives, *Prototype testing, *Incineration, Costs, Effectiveness.

The design objectives for a fireproof floating oil containment barrier were developed, and a boom was designed, produced, and tested. At a cost comparable to that of conventional equipment of similar size, the boom is equally effective at retaining oil in a current, withstands exposure to burning oil, and can easily be restored for reuse if damaged by severe wave action or rough handling. (Author's abstract)
W86-04006

DEVELOPMENT AND TESTING OF A FIREPROOF BOOM,

Dome Petroleum Ltd., Calgary (Alberta).
I. A. Buist, W. M. Pistruzak, S. G. Potter, N. Vanderkooy, and I. R. McAllister.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 43-51, 14 fig, 1 tab, 13 ref.

Descriptors: *Fireproof booms, *Oil spills, *Prototype testing, *Incineration, Booms, Oil, Cleanup operations, Confinement.

In situ burning of crude oil on water can be an extremely effective oil spill countermeasure, particularly in remote offshore areas and on cold water where conventional countermeasures are limited. In order for in situ burning to be an efficient mitigative technique, the oil must be contained and thickened. A novel fireproof boom has been researched, developed, and tested that can: (1) survive, without damage, long term exposure to the heat generated by burning crude oil in situ; (2) contain burning crude oil in at least sea states up to three and at current speeds up to 0.4 m/s without loss of combustion intensity; (3) survive without damage for long periods at sea; and (4) withstand contact with small ice features. (Author's abstract)
W86-04007

OPERATIONAL CONSIDERATIONS FOR OPTIMUM DEPOSITION EFFICIENCY IN AERIAL APPLICATION OF DISPERSANTS,

Exxon Chemical Co., Houston, TX. Technology Div.
G. P. Lindbloom, and B. S. Cashion.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 53-60, 10 fig, 4 tab, 8 ref.

Descriptors: *Dispersants, *Oil spills, *Cleanup operations, *Aircraft, *Deposition, *Distribution, Cleanup, Oil, Surfactants, Particle size, Viscosity, Velocity.

The growing worldwide recognition of the value of aircraft for application of dispersants to marine oil spills has resulted in a number of tests and field trials, but they have developed new concerns regarding control of depositional efficiency. These are similar to those extensively studied by the agricultural aviation industry, and involve anything influencing placement of a calculated dosage on a given area with minimum variation or loss due to aircraft turbulence, drift, or other factors. Aerial application of dispersants differs from agricultural practice in the physical properties of the fluids sprayed, the dosage generally required, and operational factors such as altitude, speed, swath, and total area to be covered. Consideration of these may result in need for special mechanical designs or alterations in the spray system. The major requirement for depositional efficiency is the droplet size distribution, which is affected by at

least five factors. The most critical are nozzle diameter, viscosity of the fluid sprayed, and its exit velocity relative to the aircraft speed. These, together with pressure and pump rates, result in two shear regimes which are the ultimate controllers of droplet size. This report presents evidence for the above from mathematical model studies, laboratory windstream tests, and flight tests of both piston and turbo powdered aircraft. The data are used to propose a framework of requirements for optimal aerial dispersant application operations. (Author's abstract)
W86-04008

PERFORMANCE EVALUATION OF A NEW VERSATILE OIL SPILL DISPERSANT,

Exxon Chemical Co., Houston, TX. Technology Div.
K. W. Becker, and G. P. Lindbloom.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p. 61-64, 6 fig, 5 tab, 2 ref.

Descriptors: *Oil spills, *Dispersants, *Surfactants, *Evaluation, *Saline waters, *Aircraft, Oil, Salinity, Viscosity, Oil-water interfaces, Organic solvents.

Several oil spill dispersants available since 1975 have successfully dispersed spills of light to medium oils. However, they generally have performed poorly on heavily weathered oil, low gravity viscous oils, waxy crudes, 'chocolate mousse' emulsions, and any oil spilled in cold environments. Some also were not formulated for use on waters of low salinity. In many cases involving spills of low viscosity oils, the decision to use chemical treatment has been delayed until the oil is in a weathered state. Chemical treatment under any of these conditions requires that the active surfactants reach the oil/water interface with the aid of a penetrating hydrocarbon solvent. Such formulations lose effectiveness when diluted with water (as in boat spraying) and usually must be used undiluted at a high dosage. They also often are too low in viscosity and density to be sprayed efficiently by aircraft. This paper discusses the properties and performance of formulations which avoid the above oil viscosity and water salinity problems and offer, for the first time, opportunity for widespread chemical treatment of such spills by aerial spray from large aircraft. (Author's abstract)
W86-04009

EFFECTIVENESS, BEHAVIOR, AND TOXICITY OF DISPERSANTS,

Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W86-04010

SELF-CONTAINED OIL RECOVERY SYSTEM FOR USE IN PROTECTED WATERS,

Coast Guard, Washington, DC. Office of the Commandant.
S. Cohen, and S. Dalton.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 73-79, 9 fig.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Storage, *Skimming, Oil, Booms, Containment boom, Barriers.

The U.S. Coast Guard's success with the high seas skimming barrier prompted the development of a smaller, half-scale version for use in protected bays and harbors. The smaller version (SCOOP) enables more rapid deployment with significantly fewer people. Individual components of the system include a 65-foot section of skimming barrier with redesigned skimming struts, 200 feet of containment boom, two 30-foot work boats for storage, transport, and operation of the system, trailers to carry the boats to the scene, and an oil recovery system including double-acting diaphragm pump, gravity-type oil-water separator, and 750 gallon collapsible storage bags. In tests at the Environmental Protection Agency's Oil and Hazardous Materials Simulated Test Tank (OHMSETT) facility, the SCOOP exhibited recovery efficiencies between 30 percent and 60 percent over a speed range of 0.5 to 1.75 knots. The oil recovery rate was between 30 and 70 gallons per minute over the same speed range. At speeds below 0.9 knots there were no losses of oil from the boom. The system has been delivered to the Coast Guard Gulf Strike Team in Bay St. Louis, Mississippi, where it is being evaluated through use in routine spill response operations and exercises. (Author's abstract)
W86-04011

OHMSETT TEST OF TRUCK-MOUNTED VACUUM SYSTEMS FOR OIL SPILL RECOVERY,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
D. C. Gates, K. M. Carradino, and W. R. Sanftner.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 81-85, 1 fig, 4 tab, 6 ref.

Descriptors: *Oil recovery, *Vacuum skimming, *Oil skimmers, Skimming, *Oil spills, Cleanup operations.

Two recent test programs at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) examined two different vacuum systems. The first program, performed in September 1980, tested a vacuum truck fabricated by Coleman Environmental and Pollution Control Equipment Co., Inc. and a Vactor 2045 air conveyor system made by the Peabody Myers Company. The vacuum truck produced an average and an oil recovery efficiency of 18 percent. Results confirmed the prevalent belief that this type of equipment is well suited for use in thick slicks (i.e., above 60 millimeters). The addition of skimmer attachments to the hose end increased recovery efficiency without affecting oil recovery rate. The air conveyor tests resulted in an average oil recovery rate of 4.4 cu m/hour (19.4 gpm) and a recovery efficiency of 61 percent. The air conveyor worked well, particularly with thinner slicks. The independent variables incorporated into the first test program included slick thickness, test oil viscosity, blower speed, length of the recovery hose, the height of the suction hose end above the slick, and use of skimmer attachments. The second test program, performed in August 1982, extended the investigations of the initial program, adding a more viscous test oil, debris, and a different skimming attachment for the hose end. Also included were tests to confirm results of the first program. The truck used in the second program was another vacuum truck made by Coleman Environmental and Pollution Control Equipment Co., Inc. The standard vacuum truck yielded an average oil recovery rate of 5.0 cu m/hour (22 gpm) with an average oil recovery efficiency of 51 percent. This was over nine different phases, each phase studying the effect of a different combination of variables. Skimming a higher viscosity test oil in the range of 11.2 centipoise (cp) to 318 cp caused an increase in oil recovery rate and recovery efficiency. The addition of a skimming attachment increased recovery efficiency and decreased oil recovery rate. Tests with debris confirmed the necessity of keeping debris away from the hose end. (Author's abstract)
W86-04012

OHMSETT PUMP TESTS,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. Borst, R. J. Cocherell, and H. W. Lichte.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 87-94, 5 fig, 1 tab, 11 ref.

Descriptors: *Oil recovery, *Pumps, *Pump testing, *Oil spills, Cleanup operations.

Pumps are an integral part of all oil spill recovery operations. Skimmers and booms are of little or no practical use if the recovered spill cannot be transferred to permanent installations for further treatment, storage, or disposal. The recovered oil may be weathered, emulsified, debris-filled, or simply highly viscous. The U.S. Environmental Protection Agency has recognized the importance of this often over-simplified operation and performed tests at its Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) to document the performance of a variety of pumps commonly used at spills and pumps less commonly used for this specific purpose. The tests were designed to provide performance curves for each pump and to document the abilities of the pumps in four specific situations. While the same tests were applied to each pump to produce these performance curves, because of the different designs and inherent characteristics of each of the pumps (as internal and external gear, progressive cavity, centrifugal, and diaphragm type), comparisons were not intended and would be counterproductive. The results of the tests on each pump stand on their own merits. The first tests run with each pump were conducted to measure the suction-head and discharge-head abilities of each unit using clean oils. Four oils were chosen to cover a range of viscosities from less than 10 centipoise to several thousand centipoise depending on ambient conditions. The next set of tests documented the pumping characteristics when oil and water were introduced to the pump as non-mixed fluids for concurrent pumping and, more importantly, measured the tendency of the pump to emulsify the oil and water. The third set of tests measured the same relationship as the oil tests using pre-emulsified oil of a high apparent viscosity as a non-Newtonian test fluid. The fourth set of tests simply measured debris-handling abilities of the pump. This paper presents the initial results for the types of pumps chosen from the OHMSETT inventory. (Author's abstract)
W86-04013

RESEARCH AND DEVELOPMENT IN THE INSTITUTE OF OCEAN ENVIRONMENTAL TECHNOLOGY,

Japan Foundation for Shipbuilding Advancement, Tokyo. Inst. of Ocean Environmental Technology.
A. Yazaki.
In: Proceedings of the 1983 Oil Spill Conference (Prevention Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 95-103, 9 tab, 26 ref.

Descriptors: *Oil spills, *Booms, *Skimmers, *Chemical dispersants, Cleanup operations, Design objectives.

This paper presents a summary of research and development projects at the Institute of Ocean Environmental Technology. First, projects in the field of oil boom and skimmer development are described. Oil containment performance for each of four new oil booms, and the oil recovery rate for each of seven new oil recovery devices and a new oil recovery ship are explained. Next, as typical examples of research projects concerning ocean and marine environmental problems, summaries of the following themes are presented: (a) oil spreading on the water surface, (b) the mechanism of oil leakage from a flat plate barrier, (c) oil slick behavior around a moving catamaran skimmer, (d) a law of similarity for the performance of oil recovery equipment, (e) evaporation of gasoline under various conditions, (f) the relationship of spilled oil and dissolved oxygen in sea water, (g) the effectiveness of chemical dispersants for spilled gasoline, (h) the generation of transient waves in a circulating water channel, and (i) experiments with a wave energy absorber. (Author's abstract)
W86-04014

ENHANCED OIL BIODEGRADATION: A NEW OPERATIONAL TOOL TO CONTROL OIL SPILLS,

Elf Aquitaine, Pau (France).
B. Tramier, and C. Sirvins.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), Ameri-

can Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 115-119, 4 fig, 5 tab, 11 ref.

Descriptors: *Oil spills, *Biodegradation, *Cleanup operations, Oil pollution, Oil.

Biodegradation of oil is a natural and universal process. Unfortunately, it is a slow one, and most attempts to enhance it have failed. A new approach has been devised to try to render this enhancement process operational. A nutrient including nitrogen, phosphorus and carbon has been developed and formulated as an oleophilic microemulsion. It is, therefore, not dispersed in seawater. The nutrient has been tested in laboratory and field situations in temperate and cold climates. Biodegradation rates have ranged from 60 percent to 85 percent depending on conditions. Combined with natural evaporation, enhanced oil biodegradation can lead to a reduction in oil content of at least 65 percent in less than one week. (Author's abstract)
W86-04016

METHOD FOR RANKING BIOLOGICAL RESOURCES IN OIL SPILL RESPONSE PLANNING,

National Coastal Ecosystems Team, Slidell, LA.
For primary bibliographic entry see Field 6B.
W86-04017

ECOLOGICAL MAPPING AND CLEANUP OF OIL SPILLS ONSHORE,

Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W86-04018

MIRG ENVIRONMENTAL ELEMENT: AN OIL SPILL RESPONSE PLANNING TOOL FOR THE GULF OF MEXICO,

ARCO Oil and Gas Co., Bakersfield, CA.
J. Lindstedt-Siva, B. J. Baca, and C. D. Getter.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas, p 175-181, 7 fig, 18 ref.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, Ecological effects, Mapping, Oil pollution, Oil, Gulf of Mexico.

Several companies involved in the marine transportation of petroleum in the Gulf of Mexico have established the Marine Industry Group (MIRG). MIRG has funded two oil spill contingency planning information projects for the Gulf of Mexico. The Resources and Logistics Element identifies the location and accessibility of cleanup equipment in the area of interest. The Environmental Element describes Gulf of Mexico environments, identifies biologically and socioeconomically sensitive areas, and includes countermeasure considerations. This paper examines the environmental element of the MIRG project. The purpose of this element is to provide environmental information on the Gulf of Mexico coastline in a form that can easily be used during an oil spill emergency. The information covers both U.S. and Mexican nearshore waters and coastal areas and is specific enough to provide meaningful guidance to spill response personnel. The environmental element is divided into two volumes. Volume I is an environmental overview of the Gulf of Mexico environments, an analysis of possible spill impacts, and spill cleanup considerations for each type of environment. Volume II is divided into regional sections. Each section includes overview maps of the area covered, detailed maps of identified sensitive areas, and accompanying data sheets which include reasons for sensitivity, access and possible launch points for equipment, and countermeasure considerations. These volumes are designed to function as field manuals during spills as well as reference documents for spill response planning. (Author's abstract)
W86-04019

OIL SPILL PROTECTION PLANNING FOR NATURAL RESOURCES IN OREGON,

Oregon State Dept. of Environmental Quality, Corvallis.
For primary bibliographic entry see Field 6A.
W86-04020

OIL SPILL PREPAREDNESS IN A TROPICAL OFFSHORE AREA,

Smith Associates Consulting System Engineers Ltd., Surrey (England).
For primary bibliographic entry see Field 6A.
W86-04021

OIL SPILL ON NORTHERN SHORELINES: AN EVALUATION OF SOME OPTIONS DEALING WITH THIS PROBLEM,

Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
E. Sendstad, and P. Sveum.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 255-260, 10 fig, 6 tab, 16 ref.

Descriptors: *Oil spills, *Cleanup operations, *Oily water, *Shores, Coasts, Composting, Oil pollution, Oil.

Three options for dealing with oily debris from oil contaminated shorelines are studied. It is shown that bunker oil does not affect plant life but does kill the invertebrates in the contaminated supralittoral zone. A non-sticky soil surface can be established if treated with a sorbent. Oily debris picked up by hand, composted with sorbents, and conditioned with fertilizers showed a decrease in total oil content of approximately 60 percent after 400 days. The addition of sorbents gave approximately the same rate of biodegradation, whereas the addition of fertilizer alone had a less beneficial effect on oil biodegradation. The use of sorbents did not affect the generation of leachate water from the compost piles. The oil content in the leachate was between 20 and 40 milligrams per liter. Seaweed in the oily debris decomposed rapidly. The volume of piles was reduced by about 50 percent. Total oil content was approximately constant in the compost piles. The rapidly decomposing seaweed made it difficult to keep the compost piles in an aerobic state. Oily debris mixed with lime (CaO) produced a dry material. The lime volume required was approximately equal to the oil volume in the debris. Even after this treatment, some oil and other organic components were released with the leachate. The process of mixing lime into the oily debris was very unpleasant for the workers and posed a severe working environment problem. (Author's abstract)
W86-04022

SHORELINER EXPERIMENTS AND THE PERSISTENCE OF OIL ON ARCTIC BEACHES,

Woodward-Clyde Consultants, Victoria (British Columbia).
For primary bibliographic entry see Field 5B.
W86-04023

FIRST EXPERIENCES WITH THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY OIL SPILL MODEL,

Massachusetts Inst. of Tech., Cambridge.
H. N. Psaraftis, J. D. Nyhart, and D. A. Betts.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 301-305, 4 fig, 2 tab, 10 ref.

Descriptors: *Oil spills, *Modelling, *Cleanup operations, Planning, Dispersants, Environmental effects, Cost Analysis, Oil.

A research group at the Massachusetts Institute of Technology has completed the first phase of development of a computer-assisted model for analyzing complex decisions and policies regarding oil spill cleanup. The model is the product of an ongoing MIT Sea Grant project sponsored by a consortium of government and industry organizations. The model can be used, among other things, in 'strategic' planning for the long-term oil spill response needs of a region, in assisting on-scene coordinators in responding to a specific spill ('tactical operational' setting), in evaluating the environmental and economic damages of a spill versus the cost of cleanup, in simulation and training, and in the analysis of various policy and regulatory issues such as delays, use of dispersants, and liability and compensation. The model is described in detail, with a focus on its potential uses. Some illustrative applications in the New England region are presented and applications of the model for the solution of Petro-Canada's dispersant logistics problem are discussed briefly. (Author's abstract)
W86-04025

REVIEW OF THE STATE-OF-THE-ART OF OIL SPILL FATE/BEHAVIOR MODELS,

Raytheon Co., Portsmouth, RI. Submarine Signal Div.
J. C. Huang.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 313-322, 5 tab, 58 ref.

Descriptors: *Oil spills, *Fate of pollutants, *Modelling, *Cleanup operations, *Reviews, Environmental effects, Advection, Evaporation, Dispersants, Distribution patterns, Biodegradation.

The fate and behavior of spilled oil can be affected by nine physical, chemical, and biological processes: advection, spreading, evaporation, dissolution, emulsification, dispersion, auto-oxidation, bio-degradation, and sinking/sedimentation. Currently, oil fate predictions and/or the assessment of environmental impact or risk of a spill are based mostly on oil spill models which simulate only the advective processes and some which include also the spreading processes. These models do not account for the weathering or the loss of the spilled oil that may occur immediately or soon after the spill, and thus may lead to unrealistic assessments or inaccurate predictions. Models with varying degrees of sophistication and with different approaches for the various weathering processes are being developed, some of them implemented in composite oil fate/behavior models that are constructed to provide more realistic or accurate predictions. To provide some understanding of the current state-of-the-art of these modeling technologies, this paper presents an overview and discussion of the available models for each of the nine oil fate/behavior governing processes. (Author's abstract)
W86-04026

TEXACO CONNECTICUT'S OIL SPILL INCIDENT IN THE PANAMA CANAL,

Panama Canal Commission, APO Miami 34011.
C. V. Chong, J. C. Jordon, and R. Gutierrez.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 369-370.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, Oil recovery, Case studies, Panama canal, Texaco Connecticut.

The second largest recorded oil spill to occur in the waters of the Panama Canal happened on June 7, 1980. The 39,366 deadweight ton (dwt) United States tanker Texaco Connecticut, while on a northbound transit and laden with Alaskan crude, struck the east bank of Gaillard Cut, ripping its number 1 and 2 cargo tanks. In a period of approximately six hours, from the time the tanker struck the bank of the canal until it was anchored for repairs at Limon Bay, the Atlantic entrance to the Panama Canal, an estimated 4,000 barrels (bbl) or crude were spilled in a distance of approximately 35 miles. A multi-agency effort was deployed immediately. The Panama Canal Commission's own pollution control forces, in close working coordination with other units of the commission, the United States Army and the Government of the Republic of Panama were able to recover a

total of 1,361 bbl of crude. Manual and mechanical methods of oil recovery were used during 27 days in which an estimated total of 29,396 man hours were used at a total cost of approximately $800,000. The environmental impact of the spill was observed by Panama Canal Commission biologists as well as by the Smithsonian Tropical Research Institute (STRI). Although no baseline data exists for comparison, it is apparent that no far reaching negative effects were imposed on the fauna and flora of Gatun Lake. (Author's abstract)
W86-04028

HASBAH 6: OIL COMPANIES RESPONSE TO OIL POLLUTION IN THE ARABIAN GULF,

Gulf Area Oil Companies Mutual Aid Organization, Manama (Bahrain).
For primary bibliographic entry see Field 6B.
W86-04029

HASBAH 6 (SAUDI ARABIA) BLOWOUT: THE EFFECTS OF AN INTERNATIONAL OIL SPILL AS EXPERIENCED IN QATAR,

Shell International Petroleum Mij., The Hague (Netherlands).
For primary bibliographic entry see Field 5C.
W86-04031

UNDERGOUND OIL SPILL INVESTIGATION AND CLEANUP,

Environmental Protection Agency, Boston, MA. Region I.
D. McIntyre.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 393-396, 7 fig, 3 ref.

Descriptors: *Oil spills, *Cleanup operations, *Underground waste disposal, *Leaching, Oil pollution, Oil recovery, Case studies, Oil.

In April 1978, the U.S. Environmental Protection Agency (EPA) Region I office received an oil spill report which involved a sheen leaching from an industrial park into a river in Connecticut. Initial investigation revealed only two 10,000-gallon and one 11,000-gallon buried storage tanks as possible sources. All were located relatively close together about 200 feet from the river. The maintenance man reported that one of the 10,000-gallon tanks had spilled an estimated 500 gallons into the ground the previous year. EPA responded and initially worked with the property owner and the Connecticut Department of Environmental Protection in addressing the problem. Although the leaching seemed to be relatively minor at first, it gradually increased after July 1978. The property owner was unable to finance cleanup actions after the first few months. EPA assumed cleanup responsibility, using federal funds, and eventually took over all investigation and recovery efforts in 1980. The incident has involved many phases, including locating and estimating the volume of the underground contamination, attempted source identification through sample analysis, installing recovery systems, excavating the oil storage tanks, winter operations of the recovery systems, disposal of product, and river cleanup. Analyses of test boring data in 1979 indicated the maximum volume of spilled product on the groundwater to be between 50,000 and 150,000 gallons. Since 1980, the recovery system alone have yielded more than 90,000 gallons of oil, making this innocuous incident one of the largest inland oil spills ever in Region I. It also has been the most expensive federally-funded inland spill in the region. Recovery from the groundwater is expected to continue through 1982, albeit at a decreasing rate. The total observed volume of oil involved in the spill will probably exceed 110,000 gallons. (Author's abstract)
W86-04032

GEOMORPHOLOGICAL IMPACT OF CLEAN-UP OF AN OILED SALT MARSH (ILE GRANDE, FRANCE),

Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 5C.
W86-04039

GROUND WATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,

Robert S. Kerr Environmental Research Lab., Ada, OK.
C. W. Hall.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 3-5, 12 ref.

Descriptors: *Groundwater, *Water quality protection, *Water quality control, Environmental protection, Legislation, Public participation, Groundwater pollution.

The importance of protecting ground-water resources cannot be overstated, and many people throughout the world seem anxious to physically and financially support a rational program to this end. The complacency of the public regarding the quality of ground-water was destroyed with headline-grabbing incidents of pollution such as Love Canal, Valley of the Drums, and Times Beach. Contrary to earlier popular belief, the soil mantle has been shown to be ineffective in the cleansing of certain pollutants from the water flowing through it. The legislative basis for developing and implementing broad ground-water quality protection programs exists, although it is dispersed in a variety of pieces of legislation. Such programs presuppose the existence of the scientific knowledge necessary to produce viable and effective results from its implementation. This article addresses the research needed for accumulation of this scientific knowledge. (Author's abstract)
W86-04043

APPLICATION OF BIOLOGICAL TRANSFORMATIONS IN GROUND WATER,

Stanford Univ., CA. Dept. of Civil Engineering.
P. L. McCarty.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 6-11, 2 fig, 3 tab, 24 ref.

Descriptors: *Biotransformation, *Groundwater, *Groundwater pollution, Microorganisms, Biodegradation, Microbial degradation, Organic compounds, Substrates, Path of pollutants, Fate of pollutants.

Microorganisms can bring about the transformation of many common trace organic ground-water contaminants which serve as secondary substrates. Half-lives of such compounds are generally long because of low active microbial concentrations, inappropriate environmental conditions, or inability of indigenous bacteria to acclimate to the compounds. Some hazardous compounds such as chlorinated benzenes appear biodegradable only under aerobic conditions, while others such as many halogenated aliphatic compounds appear biodegradable only under anaerobic conditions. Biotransformation of some compounds, such as tetrachloroethylene, 1,1,1-trichloroethane, and ethylene dibromide, result in the transient formation of intermediates such as vinyl chloride. The impact of environmental conditions and intermediate formation needs to be better understood. Biotransformation rates might be increased through the stimulation of indigenous bacteria by injection of a suitable primary substrate and required nutrients, and by maintenance of a suitable environment. This might also result from the introduction of acclimated bacteria. However, much more needs to be known about the native microorganisms, their biochemical capabilities, and the effect of environmental conditions on biodegradation. (Author's abstract)
W86-04044

MICROBIAL ECOLOGY OF A HAZARDOUS WASTE DISPOSAL SITE: ENHANCEMENT OF BIODEGRADATION,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5D.
W86-04048

SORPTION OF ORGANIC SOLUTES: COMPARISON BETWEEN LABORATORY-ESTIMATED RETARDATION FACTORS AND FIELD OBSERVATIONS,

Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04051

REMOVAL OF IRON AND MANGANESE FROM GROUND WATER WITH THE VYREDOX METHOD,

Ground Water Associates, Inc., Arlington, MA.
A. W. Zienkiewicz.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 74-77, 5 fig, 3 tab, 4 ref.

Descriptors: *Iron, *Manganese, *Vyredox, Water quality control, Oxidation-reduction potential, Groundwater.

Water systems with wells drawing ground water containing soluble iron and manganese can have production capacity losses, transmission capacity losses and consumer complaints about odor, staining and taste. Vyredox is a method for removing iron and manganese from ground water at the source, in the ground, before the water is drawn to a well. It works by raising the redox potential in the ground around a well with periodic recharges of aerated water using specially engineered conditioning equipment and recharge wells. The oxygen in the recharge water acts as a catalyst to begin a biochemical reaction that transforms iron and manganese from their soluble form to insoluble compounds that are kept in the ground away from the well. Vyredox plants have been in operation world wide since 1955. Since 1979, in the U.S., pilot studies have been conducted at 20 sites. Full scale plants have been completed at three sites and are under construction at three more. Vyredox has proved applicable and economical in varied settings for a wide range of raw water quality. (Author's abstract)
W86-04061

APPLICATION OF MULTI-PHASE FLOW THEORY AT A CHEMICAL WASTE LANDFILL, NIAGARA FALLS, NEW YORK,

Little (Arthur D.), Inc., Cambridge, MA.
J. H. Guswa.
In: Second International Conference on Groundwater Quality Research: Processings, National Center for Groundwater Research, Houston, TX. (1985). p 108-111, 7 fig, 1 tab, 8 ref.

Descriptors: *Chemical wastes, *Multiphase flow, *Path of pollutants, *Landfills, *Waste pollution protection, *New York, Waste dumps, Simulation, Flow simulators, Fluid flow, Hydrogeology, Niagara Falls.

A one-dimensional two-phase fluid flow simulator was developed for Occidental Chemical Corporation to aid design of a remedial action plan for a chemical waste landfill in the Niagara Falls area, New York. A two-phase flow model was necessary because field observations have indicated that immiscible dense organic chemicals exist as a separate fluid phase in the landfill. Under these conditions the effects of capillary pressure forces as well as hydrodynamic and gravitational forces must be considered in order to predict fluid movement and to simulate the effects of various remedial actions. The two-phase fluid flow simulator was used to identify various hydrogeologic conditions which could be an effective barrier to the downward migration of a heavier-than-water non-aqueous phase liquid (NAPL) from unconsolidated glacial deposits to the underlying bedrock. Analysis of model results indicated that even under a downward hydraulic gradient natural differences in capillary pressure relationships for different lithologies could prevent downward migration of NAPL. It was also determined that in the absence of natural

lithologic barriers an upward hydraulic gradient created by an overburden dewatering system could also prevent downward migration of NAPL. (Author's abstract)
W86-04069

MODEL TO EVALUATE SALT WATER INTRUSION DUE TO DIFFERENT CONJUNCTIVE USE STRATEGIES IN COASTAL AQUIFERS IN SAUDI ARABIA,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
T. H. Illangasekare, and H. J. Morel-Seytoux.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 119-121, 1 fig, 7 ref.

Descriptors: *Saline water intrusion, *Modeling, *Coastal aquifers, Groundwater, Surface-groundwater relations, Numerical analysis, Surface water, Groundwater quality.

A study was conducted to evaluate different strategies of conjunctive use management of surface and groundwater in the coastal aquifers of the Red Sea coast in Saudi Arabia. A physically based distributed parameter model was developed to simulate both the physical behavior and the operational behavior of the surface-groundwater system. The numerical model developed was based on the 'Discrete Kernel Approach' of groundwater modeling (a response matrix model). The development strategies tested were designed to use the groundwater as a supplementary source to the traditionally used surface supplies. The excessive extraction of groundwater may result in the mining of the aquifer and degradation of groundwater quality by the intrusion of sea water. A component of the model simulates the salinity transport at the coastal boundary of the aquifer. This paper presents the design of this model component and the procedures used in the coupling of the salinity transport model to the quantity flow model. A simple technique where the solute transport by hydrodynamic dispersion and convection were treated separately was used. The study results showed that the test strategies will not drastically effect the groundwater quality by seawater intrusion. (Author's abstract)
W86-04072

NITRATE CONCENTRATIONS IN MUNICIPAL WELLS LOCATED WITHIN A RIVER BED,

Nebraska Univ. at Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-04078

CONCENTRATION OF ROTAVIRUS BY ULTRAFILTRATION,

Queen Elizabeth II Medical Center, Nedlands (Australia). Combined Clinical Microbiology Service.
J. Jansons, and M. R. Bucens.
Water Research WATRAG, Vol. 20, No. 1, p 79-83, January 1986. 3fig, 1 tab, 20 ref.

Descriptors: *Rotaviruses, *Ultrafiltration, *Wastewater treatment, *Water pollution treatment, Groundwater recharge, Aquifers, Enteric viruses, Adsorption, Elution, Filtration, Protein wash, Enzyme-Linked Immunosorbent Assay, ELISA.

The use of wastewater for the recharge of groundwater aquifers offers a practical and economic method for its disposal. In order to overcome the problem of contamination of the aquifer with human pathogens which include enteric viruses, careful studies of the survival and movement of these agents must be performed. The currently accepted procedure for concentrating viruses from large volumes of water is the Viradel method, which utilizes the filter adsorption-elution principle, with secondary concentration carried out by membrane filtration, aluminum hydroxide precipitation or organic flocculation. However, this method is known to be tedious and time consuming, exposing viruses to high and low pH during adsorption and elution, often with virus survival. These factors have created a need for the development of concentration techniques that would enable more reliable detection of a broad range of enteric viruses. In this study a number of parameters were varied in an attempt to optimize recoveries via hollow fibre ultrafiltration evaluated for its capacity to concentrate human rotavirus from experimentally contaminated groundwater. The results of these experiments suggest that virus recovery is greatly improved by utilizing either a protein wash with beef extract or by backflushing the hollow fibres with phosphate buffered saline. An enzyme-linked immunosorbent assay (ELISA) was used to determine rotavirus recoveries after concentration. (Lantz-PTT)
W86-04112

REMOVAL OF NITRATE IN DRINKING WATER BY ION EXCHANGE - IMPACT ON THE CHEMICAL QUALITY OF TREATED WATER,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W86-04128

MONITORING OF ENTEROVIRUSES IN THE WATER SUPPLY OF BARCELONA FROM SURFACE WATER OF THE RIVER LLOBREGAT (CONTROLE D'ENTEROVIRUS DAS L'APPROVISIONNEMENT A BARCELONE PAR L'EAU DE SURFACE DU FLEUVE LLOBREGAT),

Sociedad General de Aguas de Barcelona (Spain).
F. Ribas, J. M. Hugueut, and J. Perramon.
Aqua AQUAAA, No. 1, p 34-44, 1986. 3 fig, 12 tab, 2 ref.

Descriptors: *Enteroviruses, *Water supply, *Barcelona, *Surface water, *Llobregat River, Adsorption, Elution, Water analysis, Physiochemical properties, Bacterial analysis, Potable water, Drinking water, Spain.

Described is enterovirus control in the water supply to Barcelona by superficial water from the river Llobregat during a period of two years. First, the implementation of a unit to concentrate enterovirus starting from large volumes of water by adsorption/elution on glass dust is studied. Second, a study of 15 Samplings of 10 points of the Llobregat basin analyzing the enterovirus as well as several physicochemical and bacteriological parameters is conducted. Finally, the evolution of the different parameters in the successive phases of potabilization of the superficial water, is being studied. (Author's abstract)
W86-04153

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 1. ESTIMATION TECHNIQUES,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04168

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 2. VERIFICATION AND APPLICATIONS,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04169

TREATMENT OPTIMIZATION OF MUNICIPAL WASTEWATER AND REUSE FOR REGIONAL IRRIGATION,

Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 3C.
W86-04196

WASTE TREATMENT/DISPOSAL SITE EVALUATION PROCESS FOR AREAS UNDERLAIN BY CARBONATE AQUIFERS,

Minnesota Pollution Control Agency, Roseville.
J. A. Magner, P. R. Book, and E. C. Alexander.
Ground Water Monitoring Review, Vol. 6, No. 2, p 117-121, Spring 1986. 1 tab, 14 ref.

Descriptors: *Waste treatment, *Waste disposal, *Aquifers, *Groundwater pollution, Karsts, Carbonates, Water pollution treatment, Soil texture, Drilling, Erosion, Groundwater movement, Case studies, Minnesota.

Fractured carbonate or karst aquifers are highly susceptible to contamination. In Minnesota, the areas underlain by karst aquifers are often characterised by thin soil cover, poorly cased wells and/or collapse features. When coupled with improper land use decision these aquifers have become extensively contaminated. Evaluation of existing or potentially contaminated sites has required the development of unique site evaluation techniques or combinations of techniques. Shallow geophysics have been used successfully to determine subsurface karst features, pinpoint locations for additional investigations and evaluate pump-test data. Soil texture, density and relative moisture content have been closely examined and criteria have been established, to evaluate subsurface erosion susceptibility. Percent rock core recovery, mechanical response of drilling and drilling fluid loss have been used to characterize the secondary porosity and potential contamination susceptibility of the carbonate roc nonuniform lateral inflow, since at least parts of the solution are known analytically. (Geiger-PTT)
W86-04219

ANALYSIS OF A CONTAMINATED BEDROCK AQUIFER BY MEANS OF A PACKER AND ATTEMPTS AT REMEDIATION USING A PACKER,

Olin Chemical Group, Charleston, TN.
For primary bibliographic entry see Field 5B.
W86-04220

RIPARIAN LOSSES OF NITRATE FROM AGRICULTURAL DRAINAGE WATERS,

North Carolina Agricultural Research Service, Raleigh.
For primary bibliographic entry see Field 5B.
W86-04260

NUTRIENT REMOVAL POTENTIAL OF SELECTED AQUATIC MACROPHYTES,

Central Florida Research and Education Center, Sanford, FL.
K. R. Reddy, and W. F. DeBusk.
Journal of Environmental Quality, Vol. 14, No. 4, p 459-462, October-December 1985. 2 fig, 3 tab, 22 ref.

Descriptors: *Aquatic Plants, *Nitrogen Removal, *Phosphorus Removal, *Wastewater Renovation, Water Hyacinth, Water Lettuce, Pennywort, Duckweed, Azolla, Salvinia, Egeria, Denitrification.

The role of eight aquatic macrophytes in removing N and P from nutrient enriched waters was evaluated using microcosm retention ponds. The aquatic macrophytes included water hyacinth (Eichhornia crassipes), water lettuce (Pistia stratiotes), pennywort (Hydrocotyle umbellata), duckweeds (Lemna minor Spirodela polyrhiza), azolla (Azolla caroliniana), salvinia (Salvinia rotundifolia), and a submersed macrophyte, egeria (Egeria densa). Nitrogen removal by aquatic macrophyte systems was in the order of water hyacinth > water lettuce > pennywort > Lemna > Salvinia > Spirodela > egeria during the summer season, while pennywort ranked first during the winter followed by water hyacinth, Lemna, water lettuce, Spirodela, Salvinia, and egeria systems, while pennywort and Lemna showed high P removal rates during the winter compared to other plants. Nitrogen and P removal were generally higher in summer than winter. Plant uptake accounted for 16 to 75% of total N removal, and 12 to 73% of total P removal, indicating the possibility of N and P

removal by the mechanisms other than assimilation by plants. (Author's abstract)
W86-04262

COOPERATIVE SERVICE ARRANGEMENTS,

Department of Commerce, Washington, DC.
R. K. Hedge, Jr., and D. J. Eaton.
Southwest and Texas Water Works Journal STWJDC, Vol. 67, No. 4, p 5, 6, 8, 10, July 1985.

Descriptors: *Drinking water, *Water treatment, Water treatment facilities, *Water supply, *Water law, Water policy, Legal aspects, Public policy.

Texas water law establishes the community's prerogative to decide the manner in which it will supply water to local residents. Many communities have chosen to maintain independent water supply and distribution systems. However, economic and technical considerations may prompt a re-evaluation of traditional institutional arrangements. Cooperative water supply arrangements may provide a means for checking the rising cost of water service and minimizing any added expenses associated with achieving federal drinking water quality standards. A cooperative water supply arrangement may follow two alternative patterns. In the first, called procedural adaptation, each participating water system maintains an independent identity, but all cooperate in acquiring and/or treating water. The second approach involves the combining of water systems to form a new entity, which is a structural adaptation. The state and local laws establish the parameters for organizational change and system financing, although final community decisions will likely be shaped by legal, economic, and political influences. (Geiger-PTT)
W86-04283

COMPUTERS JOIN THE MAINTENANCE TEAM,

Saint Petersburg City Public Works, FL.
For primary bibliographic entry see Field 6A.
W86-04302

MUDDY WATER AND AMERICAN AGRICULTURE: HOW TO BEST CONTROL SEDIMENTATION FROM AGRICULTURAL LAND,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W86-04303

MIXING OF A STRATIFIED RIVER BY BARGE TOWS,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
H. G. Stefan, and M. J. Riley.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1085-1094 August 1985. p 1085-1094, 14 fig, 3 tab, 11 ref.

Descriptors: *Navigation, *Stratification, *Destratification, *Barges, *Mixing, Rivers, Effluents, River flow, Flow rates, Flow velocity, Surges, Turbulent flow, Water quality, Path of pollutants.

The effect of commercial navigation on the mixing and reestablishment of stratification was studied in the upper Mississippi River downstream from a major wastewater effluent site and in a laboratory flume. Mixing effectiveness increases from single towboats to unloaded barges to loaded barge tows. Energy expenditure by barge tows per foot of river length traveled is much larger than work done by gravity forces of the free-flowing river to overcome bottom shear. The displacement of water by loaded barge tows appears to be more significant than the jet effect of the towboat propellers. One passage usually causes complete vertical mixing in the path of the tow. Surface waves and internal waves generated by a towboat passage cause surging of the effluent for up to 30 min after passage. Reestablishment of stratification is controlled by mean river velocity and the frontal velocity of the density current resulting from the discharge. Calculated and observed reestablishment times depend on distance from the outlet and strength of the stratification. Order of magnitude comparisons of calculated and observed reestablishment times were in good agreement. Reestablishment of stratification may take from 15 to 45 min at a distance of only 1000 ft from an outfall. Water quality models and field studies in impounded rivers with high navigation frequency should take into account the mixing and transport effects of towboats, especially under low flow conditions. (Geiger-PTT)
W86-04306

CLOSTRIDIUM PERFRINGENS, A RELIABLE INDICATOR OF STREAM WATER QUALITY,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, and L. K. Shizumura.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 986-992, October, 1985. 2 fig, 5 tab, 18 ref. Dept. of Int. Grant No. 14-34-0001-1113.

Descriptors: *Water quality, *Stream pollution, *Water quality standards, Water analysis, Bacteria, Coliforms, Clostridium, Enteric bacteria, Streptococcus, Recreation, Water pollution sources.

The use of C. Perfringens in place of fecal streptococci as an indicator of water quality in recreational streams in Hawaii was investigated. Densities of indicator bacteria were measured in water from the Kipapa Stream and South Ahuimanu Stream, both of which receive wastewater effluent from treatment plants operated by the City and County of Honolulu. Results showed that in streams not receiving wastewater, the concentrations of C. perfringens are consistently low, while the concentrations of fecal coliforms and fecal streptococci vary considerably and are often very high. On the other hand, stream samples below effluent discharge sites consistently contain increased concentrations of C. perfringens which reflects the dilution of effluent by the stream. In addition, it was concluded that the assumption that waste water is the primary source of fecal coliforms in streams is not valid, and that the common practice of analyzing stream samples obtained downstream from an effluent discharge site for fecal coliforms and fecal streptococci as a means of assessing the effects of discharge is not conclusive. Based on these findings, a standard of 50 C. perfringens/100 mL instead of 200 fecal coliforms/100 mL is recommended as the recreational standard for streams in Hawaii. (Geiger-PTT)
W86-04328

CURRENT STATUS IN USE OF FLEXIBLE EFFLUENT STANDARDS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. C. Lamb,III, and D. B. Hull.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 993-998, October, 1985. 10 tab, 6 ref.

Descriptors: *Water quality standards, *Surveys, *Effluent limitations, Cost analysis, Capital costs, Operating costs, Seasonal variation, Permits, Water Law, Administrative agencies, Administrative regulations, Monitoring.

A questionnaire that included 24 inquiries about policies, practices, and agency experiences concerning flexible effluent standards and discharge monitoring from municipalities and industries was sent to key personnel in all state agencies. From the 48 replies received, the following conclusions were drawn about the use of flexible standards in the U.S. Of the 48 states that responded, 45 use flexible effluent standards to some degree in their pollution control programs. The uses of flexible standards among the states vary substantially with respect to the number of permits that include them, the types of dischargers to which they are offered, the types of water quality parameters for which they are issued, and how they are implemented in the state programs. The principal perceived disadvantages of flexible standards include increased complexity of the approach, difficulty and higher cost of implementation, and additional personnel requirements. The principal perceived advantages in using flexible standards include reductions in capitol costs, operating costs, and energy consumption. Few states had solid information on the savings that result from the use of flexible effluent standards. Most of the states expect to increase use of flexible standards in the future. The three states that reported that they do not use the flexible standards anticipate initiating their use in the future. (Gieger-PTT)
W86-04329

PERCENTILE ESTIMATION PROCEDURES FOR WATER QUALITY MANAGEMENT,

Water Research Centre, Swindon (England). Swindon Engineering Centre.
For primary bibliographic entry see Field 7C.
W86-04340

CMA: AN ALTERNATIVE TO ROAD SALT,

Defense Environmental Leadership Project, Washington, DC.
L. P. Boice.
Environment ENVTAR, Vol. 28, No. 1, p 5 and 45, January-February 1986. 2 ref.

Descriptors: *Calcium magnesium acetate, *Road salt, *Sodium, *Deicer, *Highways, *Nonpoint pollution sources, *Surface runoff, Cost, Acid rain, Water supply, Contamination, Highway icing, Acidic soils.

The characteristics of calcium magnesium acetate (CMA) as a substitute for salt as a highway deicer are discussed. Road salt is responsible for costly rusting of vehicles, bridges, and road surface retaining rods, as well as water supply contamination in the northeastern United States. CMA is the most promising among several alternative deicers that have been studied. Its main drawback remains the lack of an economical and reliable means of production. Although it is nearly 20 times as expensive as road salt, it does not harm the environment and may actually yield some benefits, including neutralizing acidified solids and waters. (Rochester-PTT)
W86-04359

GROUNDWATER: SAVING THE UNSEEN RESOURCE,

D. E. Burmaster.
Environment ENVTAR, Vol. 28, No. 1, p 25-28, January-February 1986. 11 ref.

Descriptors: *Groundwater, *Aquifers, Reviews, Recommendations, Monitoring, Classification, Data Collection, Analysis, Enforcement, Regulations, Surface-water Management, Contamination.

The report of the National Groundwater Policy Forum is reviewed. The history of the report and of the Environmental Protection Agency's groundwater protection strategy are discussed. The Forum urges every state that has not already done so to enact legislation to affirm the public interest in groundwater protection and adopt the comprehensive programs necessary to manage groundwater effectively. It further recommends that Congress embody the intent of groundwater management in federal law by declaring that the goal of the United States is to protect the physical, chemical, and biological integrity of the nation's groundwater resources and ensure that they are not degraded. Specific recommendations for each state's program cover the following: comprehensive aquifer mapping, anticipatory classification of aquifers, ambient groundwater standards, contamination control, monitoring, data collection, and data analysis programs, effective enforcement provisions, surface-use restrictions to protect groundwater, control of withdrawals, coordination of groundwater and surface-water management, and coordination of groundwater programs with other relevant natural-resource protection programs. (Rochester-PTT)
W86-04360

VARIANCE ANALYSES AND CRITERIA FOR TREATMENT REGULATIONS,

Montana State Univ., Bozeman. Dept. of Civil

Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5D.
W86-04369

RETURNING RECENTLY COVERED RESERVOIRS TO SERVICE: HEALTH AND AESTHETIC CONSIDERATIONS,

Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W86-04376

DESTRATIFICATION AT BEWL BRIDGE RESERVOIR, KENT,

Mid Kent Water Co., Canterbury (England).
M. J. Bailey.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 40, No. 1, p 29-36, February 1986. 3 fig.

Descriptors: *Reservoir operation, *Compressed air, Water treatment, England, Raw water, Capital costs, Operating costs

The original, temporary, and permanent destratification systems installed at Bewl Bridge reservoir (River Medway Scheme, England) are described, including details of the installation, operation, capital costs and running costs, and resultant water quality. The permanent destratification system consisted of a compressor delivering 94 liter/sec of air at a pressure of 7 bar to a 200 meter load, 50mm diameter perforated pipe with 1 mm diameter holes at 3 mm centers. A 100 m length of plain pipe was used to connect the perforated pipe to the air source. The system cost 14,360 British pounds. The system has been both effective and reliable since installation. Minor modifications included addition of an ammeter to monitor the performance and a time switch to accomodate intermittent operation to take advantage of lower electric rates. (Rochester-PTT)
W86-04378

INTERFERENCE IN THE BACTERICIDAL PROPERTIES OF INORGANIC CHLORAMINES BY ORGANIC NITROGEN COMPOUNDS,

California Univ., Irvine. Program in Social Ecology.
For primary bibliographic entry see Field 5B.
W86-04427

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,

Kennedy/Jenks Engineers, San Francisco, CA.
J. A. Campbell, and W. R. Mabey.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 58-62, Fall 1985. 2 tab, 5 ref.

Descriptors: *Groundwater quality, *Monitoring, *Data acquisition, *Data interpretation, Mathematical analysis, Statistical analysis, Boreholes.

The recognition and assurance of the quality of groundwater monitoring data are crucial to the correct assessment of the magnitude and extent of a groundwater contamination problem. The article addresses an approach being developed to systematically evaluate the quality of a given set of groundwater monitoring data collected during site investigation/remedial action efforts. The system consists of a checklist of criteria, grouped into four major categories, which can be applied to laboratory or field measurements. The first category, basis of measurement, considers whether the appropriate sampling, boring and/or analytical methods were chosen to obtain the measurement and the limitations of each method. Second, the application of the method is assessed. This includes examination of the extent to which procedures were correctly performed, the use of quality control measures and calibration, and possible sources of error in the measurements. Third, evaluation of applied statistical methods is made, with consideration given to which statistics are meaningful in a given context and whether measurements are reproducible. The final category, corroborative information, considers whether independent data or other information are available that add credibility to the values measured. This system has been found to be useful in the multidisciplinary efforts that require measurement and use of groundwater monitoring data. It is suggested that a system such as the one presented here be applied in the design of a site investigation or groundwater monitoring program, and that sufficient information be documented in field notes and reports to allow the quality of resulting data to be fully evaluated. The more that quality criteria are considered prior to data collection, the more certain it is that high quality data will be produced. (Lantz-PTT)
W86-04472

COASTAL ECOLOGY AND THE ARCTIC OIL INDUSTRY: SOME ELEMENTS FOR FUTURE OIL-SPILL CONTINGENCY PLANNING,

Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
E. Sendstad.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 87-96, 1986. 3 fig, 21 ref.

Descriptors: *Coastal ecology, *Arctic, *Oil industry, *Cleanup operations, *Future planning, Oil spills, Oil recovery, Environmental protection, Enhanced oil recovery.

The ecological vulnerability of shorelines to oil contamination varies and their self-cleaning ability may be extensive. The ice may restrict the spread of oil. In the biologically active season, oil contamination in this environment will affect an important foodchain. Both the ice and shoreline environments have elements which positively and negatively influence the planning of countermeasures for oil-spills. Offshore oil production in the Arctic is expected to be dependent on enhanced oil recovery ('EOR'). Thus any future environmental impact analyses of the offshore petroleum industry should include this aspect. It is important to analyze the functional aspects of arctic ecology to single out the most vulnerable situations. An oil-spill clean-up plan should avoid vulnerable areas and seasons of the year, and use effective countermeasures in the less sensitive situations. (Author's abstract)
W86-04482

SOME CONSIDERATIONS OF ENHANCED WATER QUALITY MONITORING IN THE NORTHWEST TERRITORIES: AN INLAND WATERS DIRECTORATE PERSPECTIVE,

Inland Waters Directorate, Yellowknife (Northwest Territories).
B. Olding.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 171-177, 1986. 1 tab, 10 ref, append.

Descriptors: *Water quality, *Monitoring, *Northwest territories, *Inland Waters Directorate, *Water pollution control, Water quality standards, Water quality control, Legal aspects, Networks, Future planning.

Environment Canada has for over 15 years operated a network of water quality stations in the NWT. The objectives of the network were to provide a baseline of water quality data against which future changes could be measured. Contemporary monitoring must now address the biological component of the aquatic environment, the effects of development on the aquatic environment, the effects of development on the aquatic environment, and the formulation and application of in-stream water quality objectives. Interjurisdictional water quality at the Territorial-Provincial border, and issues associated with precious metals, base metals, hydrocarbons, uranium exploration and long-range air pollution constitute new challenges for water quality monitoring programs. The paper considers aspects of an updated monitoring program, focusing on the delineation of ambient variability and the needs for particular research in the development of aquatic water quality criteria, guidelines and use-specific water quality objectives for northern water-courses. (Author's abstract)
W86-04489

CONTINUING THE DEVELOPMENT OF MUNICIPAL EFFLUENT GUIDELINES FOR THE NORTHWEST TERRITORIES,

Department of the Environment, Yellowknife (Northwest Territories). Northwest Territories District Office.
R. J. Kent.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 179-184, 1986. 5 tab, 7 ref.

Descriptors: *Wastewater treatment, *Effluents, *Municipal wastewater, *Northwest Territories, *Water quality standards, Standards, Cold regions.

The background to and the rationale for the Guidelines for Municipal Type Wastewater Discharges in the Northwest Territories is discussed. Particular attention is given to the development of the Effluent Quality of Municipal Wastewater Discharges table, which was based upon expected lagoon performance. Also included is a discussion of the flow ratio and dilution ratio concepts. The viability of these concepts was assessed against the available data. It appears that the guidelines misjudged both the number of coliform bacteria in northern raw sewage and the removal efficiency for these organisms in lagoons. It appears unlikely that lagoons can consistently meet the guideline requirements. More information and research is necessary before a complete assessment can be performed. (Author's abstract)
W86-04490

CHICAGO AREA'S TUNNEL AND RESERVOIR PLAN,

Metropolitan Sanitary District of Greater Chicago, IL.
F. E. Dalton, and R. R. Rimkus.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1114-1121, December 1985. 10 fig.

Descriptors: *Flood Prevention, *Combined sewer overflows, *Canals, *Navigable waters, Recreation, Cost effectiveness, Tunnels, Reservoirs, Chicago, Illinois.

The history, system characteristics, objectives, and benefits of the Tunnel and Reservoir Plan (TARP) of the Metropolitan Sanitary District of Greater Chicago are described. TARP includes about 21000 km of 2.7-to 10-m finished diameter tunnels and is intended to collect urban stormwater runoff and hold it for later treatment. The three goals of TARP are (1) preventing pollution of Lake Michigan, which now occurs due to reversal of rivers during storms. (2) elimination of combined sewer overflows, and (3) providing an outlet for floodwaters. With the improved quality of waterways, less water will have to be diverted from Lake Michigan to dilute the flow of formerly polluted rivers and streams. Diversion requirements for navigation could be reduced from 2.7 to 0.8 cu m/sec because of TARP, leaving more lake water available for municipalities. By regulating flow, TARP will make possible the more efficient use of wastewater treatment plants, thus eliminating the need for approximately $1 billion in plant expansion. The program also will save an estimated $300 million in local sewer improvements. Elimination of flooding and flood damage will yield in $1.57 in anti-flood and anti-pollution benefits for every $1.00 spent. (Rochester-PTT)
W86-04498

PROCESS CONTROL AND DATA ACQUISITION COMPUTERS IN THE WATER INDUSTRY,

Brown Boveri Kent (East Africa) Pty Ltd., Singapore.
R. A. Taylor.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 81-94, 1986. 5 fig.

Descriptors: *Data acquisition, *Computers, *Water management, *Process control, Monitoring, Information systems, Supervisory Control And Data Acquisition, SCADA, Water treatment, Wastewater treatment, Water pollution control.

In the water industry, both main frame and personal computers are used, mainly as clerical and management tools. However, this paper refers more to computers in applications which are not well known or publicized, ie. the control of processes, the monitoring of data and the transmission, displaying and logging of this informationin a form which can be utilized in various ways in the water industry. The generic jargon for this is SCADA (Supervisory Control And Data Acquisition). Discussed here is the need for SCADA systems, and how they can be applied to: (a) the treatment and distribution of potable water, (b) the treatment of wastewater and effluent, and (c) the monitoring and control of pollution levels in water and wastewater supplies, including that of primary catchment water. Some typical examples of SCADA applications in the Far East are included. (Lantz-PTT)
W86-04519

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN NON-MIGRATORY FISH FROM THE NIAGARA RIVER AREA AND TRIBUTARIES TO LAKE ONTARIO,

Indiana Univ. at Bloomington. Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-04527

EVALUATION OF MANAGEMENT ASPECTS OF A HYPERTROPHIC AFRICAN IMPOUNDMENT,

National Inst. for Water Research, Pretoria (South Africa).
J. A. Thornton, K. L. Cochrane, A. C. Jarvis, T. Zohary, and R. D. Roberts.
Water Research WATRAG, Vol. 20, No. 4, p 413-419, April 1986. 1 fig, 4 tab, 37 ref.

Descriptors: *Reservoirs, *Africa, *Evaluation, *Management planning, Hartbeespoort Dam, Eutrophication, Lake restoration, Eutrophic lakes, Ecological effects, Reservoir management, Biological treatment.

Simple empirical models were used to evaluate the potential impact of a number of eutrophication management strategies on a southern African man-made lake. Both the traditional approach to the management of eutrophic systems, that of using point source control of nutrients to restore a system to a less enriched state, and a more pragmatic approach of productively utilizing an enriched system, were considered. Predictions were made of present conditions in the lake to establish the validity of the models used, and future conditions, following implementation of point source control, were described using the models. Alternative management strategies of food chain manipulation and protein harvesting were assessed in light of the anticipated altered state of the impoundment. The present findings indicate that alternative management options are probably not viable for the impoundment under prevailing economic conditions. The need for more sophisticated models on which to base biological management decisions was demonstrated. (Author's abstract)
W86-04569

WASTE MANAGEMENT PLANNING,

Durham Univ. (England). Faculty of Law.
L. D. Guruswamy.
Journal of Environmental Management JEVMA, Vol. 21, No. 1, p 69-84, July 1985. 1 fig, 29 ref.

Descriptors: *Waste management, *Management planning, *Waste disposal, *Water pollution sources, *Water law, Environmental impact statement, Environmental effects, Project planning, Decision making, Future planning, Fate of pollutants, Air pollution, Water quality control, Water quality management, Water quality standards, England.

The possibility of managing wastes is explored within the framework of an integrated environmental resource strategy. The British Government has adopted a planning system using the concept of the best practical environmental option of integrated waste management planning. The best practical environment option involves the examination of land and air contributions to water pollution. Environmental quality objectives are used to find the solution that would allow wastes to be distributed in a way that is least harmful to the environment. In order to achieve the best balance of emissions and discharges for all media, it is necessary to ascertain the nature and extent of all wastes, together with their sources, pathways and impacts. Two statutes enable this kind of survey to be undertaken, namely, the Control of Pollution Act and the Town and Country Planning Act of 1971. The Durham County Council has shown how these two surveys could be amalgamated so that the best practical environmental options for waste disposal planning could be met. Securing the best balance of pollution loads, devising controls and methods to attain these targets, and coordinating the work of the different pollution control agencies are some of the problems that will be encountered in attempting to achieve an integrated environmental resource strategy. (Geiger-PTT)
W86-04590

ANALYSIS OF WATER QUALITY INDICES,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard, and Y. Lefebvre.
Journal of Environmental Management JEVMA, Vol. 21, No. 2, p 161-179, September 1985. 3 tab, 48 ref, append. National Research Council of Canada Grant No. A3711.

Descriptors: *Water quality standards, *Water quality, *Data collections, *Literature review, *Indexing, Water quality management, Water pollution control, Hydrologic data collections.

To facilitate communication on water quality among professionals of this resource, several summarizing tools called water quality indices were developed. Because the general features of these indices are little known, this article provides the reader with basic knowledge regarding their main components and the intrinsic characteristics of their operational process. This is then followed by a list of 20 indices grouped in a chart containing five columns headed category, goals, methodology, applicability and notes. The indices considered may be grouped by index category into general water quality indices, specific use quality indices, planning indices, statistical approaches, biological indices and trophic state indices. (Geiger-PTT)
W86-04598

STREAM ACIDITY IN SOME AREAS OF WALES IN RELATION TO HISTORICAL TRENDS IN AFFORESTATION AND THE USAGE OF AGRICULTURAL LIMESTONE,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W86-04600

MANAGEMENT OF OIL POLLUTION OF NATURAL RESOURSES IN NIGERIA,

Ibadan Univ. (Nigeria). Dept. of Geography.
C. O. Ikporukpo.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 199-206, April 1985. 4 tab, 12 ref.

Descriptors: *Oil spills, *Oil pollution, *Nigeria, *Water pollution effects, *Resources management, Resources development, Exploitation, Legislation, Environmental effects, Ecological effects, Management planning, Developing countries, Oily water, Oil recovery, Cleanup operations, Operations, Niger Delta.

Oil spills are prominent features of petroleum exploitation in Nigeria Oil pollution adversely affects the water and soil resources of the petroleum-producing Niger Delta. Oil has been known to contaminate drinking water supplies and destroy the livelihood of fisherman and farmers. Attempts have been made to manage the increasing menace of oil spills by legislative and project implementation approaches. There are various problems in the effective operation of both of these strategies, such as weaknesses in legislation, and lack of rapport between the government, oil-exploiting countries and people living in the oil-producing areas. (Geiger-PTT)
W86-04601

ROLE OF RECREATIONAL BOAT TRAFFIC IN INTERLAKE DISPERSAL OF MACROPHYTES: A NEW ZEALAND CASE STUDY,

New Zealand Electricity Dept., Hamilton.
I. M. Johnstone, B. T. Coffey, and C. Howard-Williams.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 263-279, April 1985. 5 fig, 10 tab, 44 ref.

Descriptors: *Macrophytes, *Aquatic weed control, *New Zealand, *Boating, *Models, Aquatic weeds, Case studies, Distribution patterns lakes, Navigable waters, Fishing, Recreation, North Island, Decision making.

The distribution of five submersed, long-stemmed, vegetatively reproducing aquatic weed species in 107 lakes in North Island, New Zealand, was studied. Plant distribution was significantly associated with boating and fishing activities, suggesting that dispersal is related to these human activites, rather than to natural vectors such as birds and wind. Boat inspections at 14 lakes showed that 5.4% of the boats entering the lakes carried vegetative fragments of aquatic weeds, and that, of those, 27% had come from another lake. Boats leaving lakes, however, carried weed fragments only when the haul-out area was near weed beds, suggesting that weed control near haul-out areas would greatly reduce the probability of boat-mediated interlake dispersal. Biotic factors (lateral bud frequency, internode length, resistance to desiccation) that may affect dispersal ability are described. A model for predicting the frequency of interlake dispersal of macrophytes by recreational boat traffic is developed that can help with management decisions for locally generated data. Use of the model shows that, in the North Island of New Zealand, recreational boat traffic is unlikely to spread geographically remote infestations to other lakes. (Geiger-PTT)
W86-04604

COMMUNITY RESPONSES TO NON-POINT POLLUTION FROM AGRICULTURE,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-04605

GROUNDWATER MONITORING WITHIN AN AQUIFER - A PROTOCOL,

Albuquerque Environmental Health and Energy Dept., NM.
C. D. Rail.
Journal of Environmental Health JEVHAH, Vol. 48, No. 3, p 128-132, November/December 1985. 21 ref.

Descriptors: *Monitoring, *Aquifers, *Project planning, *Water quality control, *Water quality management, Computer models, Water law, Evaluation, Groundwater management, Groundwater pollution, Water pollution sources.

Good quality water is necessary for health, aesthetic, and economic reasons. A comprehensive groundwater monitoring database including quality and quantity parameters within an aquifer is valuable, not only in terms of preventing direct contamination of an underground water area, but in applying corrective measures when problems have been identified. The basics of how to establish a systematic groundwater monitoring plan for any underground water source are presented. The initial plan should: select and assemble participants; establish a purpose and development plan, technically evaluate the aquifer by identifying pollution potential, using applicable available technologies, and determining present and future demands on the aquifer; select computer models for data summarization; evaluate water law and the responsibilities of municipalities and government; and prepare and implement the plan. Although the emphasis on

developing a groundwater monitoring plan is placed at the local level, it is recognized that in some instances implementation of such a plan must come from state or federal sources. (Geiger-PTT)
W86-04611

ORGANIC CONTAMINANTS IN GROUNDWATER,

Environmental Protection Agency, Dallas, TX. Region VI.
O. T. Love, Jr.
Southwest and Texas Water Works Journal STWJDC, Vol. 67, No. 10, p 6-8, January 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Monitoring, Test wells, Water quality standards, Organic solvents, Organic pesticides, Drinking water.

Organochlorine solvents, pesticides, or petroleum distillates are being detected in up to 20% or more of the groundwater sources of drinking water in the United States. Two of the five states in EPA Region VI, New Mexico and Texas, have an organic monitoring program under way, but it will take from two to five years to sample all the wells. Water purveyors can facilitate this program by installing a sample tap at each wellhead. Some states, such as Connecticut, Florida, California, and New Jersey have proposed (and in some cases promulgated) regulations concerning routine testing for organic chemicals in community water supplies. The EPA in 1985 proposed maximum contaminant levels for eight volatile organic chemicals (seven organohalides and one aromatic compound) along with a monitoring requirement for several dozen organic compounds that, if present, would be detected during the analysis for the 8 volatile compounds with proposed maximum concentration levels. Recommended maximum contaminant levels are being proposed for several additional synthetic organic chemicals. (Geiger-PTT)
W86-04617

SOLID WASTE MANAGEMENT FOR UTILITY RECONVERSIONS,

Stone and Webster Management Consultants, Inc., New York.
G. K. Welshans.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 29-39, September 1985. 1 fig, 3 tab, 8 ref, 4 append.

Descriptors: *Solid waste disposal, *Waste management, *Powerplants, *Public utilities, *Environmental impact statement, *Groundwater pollution, Public health, Site selection, Legal aspects, Licensing, Environmental effects, Design criteria, National Environmental Policy Act, Resources Conservation and Recovery Act.

Since the OPEC oil embargo, several utilities are reconverting some of their powerplants from oil to coal firing. In accordance with the National Environmental Policy Act and the Resource Conservation and Recovery Act, the utilities are required to develop comprehensive solid waste management plans. In most cases, the environmental licensing for these projects requires the preparation of a Draft Environmental Impact Statement, in which solid waste management impacts, as well as alternatives to disposal are discussed. Federal law seeks to protect human health and the environment by controlling all exposure pathways from pollutant degradation by solid wastes. In selecting a site for a solid waste management facility, factors of groundwater contamination, facility flooding, wetlands, and endangered species must be considered. The team of experts assigned to site selection should include a solid waste engineer, a hydrogeologist, aquatic and terrestrial ecologists, a land use and aesthetics specialist, and a noise specialist. A comprehensive subsurface study and analysis plan is needed for the selected site to determine the nature of the onsite soils, permeailities, and the depth direction, and flow characteristics of the groundwater. Groundwater monitoring wells must be installed to obtain samples for laboratory analysis. The components of a solid waste management facility application are discussed. The utility should inform the public of its plans for solid waste management to guard against public opposition to the project. (Geiger-PTT)
W86-04635

CLAY LINER CONSTRUCTION AND QUALITY CONTROL,

Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
J. J. Pierce, G. Sallfors, and E. Peterson.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 13-24, February 1986. 3 tab, 9 ref. EPA Contract No. 68-03-3149, 24-2.

Descriptors: *Hazardous materials, *Waste disposal, *Lining, *Clays, *Testing procedures, Comparison studies, Waste management, Impervious soils, Soil compaction, Quality control, Permeability coefficient.

Soil handling and liner construction practices at hazardous waste management facilities are documented. Soil characterizations, processing techniques, construction methods, and quality control of constructed liners are reviewed and compared. Results from 23 facilities nationwide indicate widely different testing and construction methods. Uncompacted lift thicknesses of 0.15-0.3 m appear to be widely accepted in the field for best compaction of a clay liner. Most clay liner construction programs do not include measurement of moisture content, and no standard procedure exists for wetting clays that are too dry for compaction. Sheepsfoot rollers are most often used for compacting clay. Two types of testing are most common for liner quality control: checking moisture and density with a nuclear density meter during and after construction; and undisturbed soil sampling for hydraulic conductivity testing of the completed liner. Field hydraulic conductivity tests are rarely used to check the integrity of a clay liner. Soil testing laboratories sometimes prepare soil samples in a manner that doe not reflect actual field conditions. (Geiger-PTT)
W86-04638

ASSESSING PHOSPHORUS CONTROL IN THE JAMES RIVER BASIN,

Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W.-S. Lung.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 44-60, February 1986. 12 fig, 4 tab, 6 ref.

Descriptors: *Water quality, *Hydrologic models, *Phosphorus removal, *Nutrients, *Estuaries, Chlorophyll, Algal growth, Eutrophication, Turbidity, Phytoplankton, Limiting nutrients, Biological oxygen demand, Phosphorus, Dissolved oxygen, Nitrogen compounds, James River, Virginia.

A tidally averaged water quality model was used to study the factors limiting the phytoplankton growth in the James River Estuary in Virginia. The water quality constituents simulated by the model are CBOD, dissolved oxygen, organic nitrogen, ammonia nitrogen, nitrite plus nitrate nitrogen, organic phosphorus, inorganic phosphorus, and chlorophyll a. The kinetics of major physical, chemical, and biological processes which link these water quality constituents are modeled in each of the 30 model segments in the longitudinal direction of the upper James River estuary. Model calibration and sensitivity analyses indicate that the phytoplankton growth plays a significant role in contributing to ultimate CBOD through respiration of live phytoplankton as well as recycling of carbon from dead algal biomass. In addition algal growth is important in balancing the dissolved oxygen budget via photosynthesis and respiration. More importantly, turbidity controls the phytoplankton growth. Nutrients (nitrogen and phosphorus) are found not to be a key limiting factor in the upper James River Estuary under the present conditions. However, the model projection analysis indicates that significant phosphorus load reduction from municipal wastewater treatment plants would reduce phosphorus to levels that limit the phytoplankton growth and thereby control phytoplankton biomass to reasonable and manageable levels. (Author's abstract)
W86-04640

RISK PENALTY FUNCTIONS FOR HAZARDOUS WASTE MANAGEMENT,

Notre Dame Univ., IN. Dept. of Civil Engineering.
A. A. Jennings, and P. Suresh.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 105-122, February 1986. 3 fig, 1 tab, 27 ref, 3 append.

Descriptors: *Hazardous materials, *Waste management, *Project planning, *Risks, *Decision making, *Algorithms, Mathematical studies, Management planning, Computer models, Mathematical models, Waste disposal, Optimization.

Presented is an algorithm to generate risk penalty functions for optimization planning of regional hazardous waste management. The method has been designed to use existing risk ranking/rating techniques, and to accommodate the relatively high degree of parameter unsurety that exists at early stages of facility planning. The algorithm has also been designed around an explicity analytical solution of the resulting 'fuzzy' matrix problem so that it may be implemented rapidly by a microcomputer. This allows the procedure to be executed in a non-intimidating planning atmosphere with strong user-interactive support. Algorithm approaches may be of great assistance to hazardous waste professionals, public decision makers, environmentalists, and the parties at risk in resolving the tumultuous differences that often result from public hazardous waste deliberations. (Geiger-PTT)
W86-04644

PRACTICAL APPLICATION OF THEORETICAL MODELS TO MAGNETOMETER SURVEYS ON HAZARDOUS WASTE DISPOSAL SITES - A CASE HISTORY,

Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W86-04654

EFFECT OF THREE DRILLING FLUIDS ON GROUND WATER SAMPLE CHEMISTRY,

Geological Survey, San Antonio, TX. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-04655

EXAMINATION OF ENVIRONMENTALLY SAFE LEVELS OF ZINC (II), CADMIUM (II) AND LEAD (II) WITH REFERENCE TO IMPACT ON CHANNELFISH NURIA DENRICUS,

Centre for Water Resources Development and Management, Kunnamangalam (India).
For primary bibliographic entry see Field 5C.
W86-04661

RAINFALL AND EPIZOOTIC RIFT VALLEY FEVER,

Food and Agriculture Organization of the United Nations, Kabete (Kenya). Veterinary Research Lab.
F. G. Davies, K. J. Linthicum, and A. D. James.
World Health Organization Bulletin BWHOA6, Vol. 63, No. 5, p 941-943, 1985. 1 fig, 20 ref. Research Grant No. DAMD 17-83-G-9517.

Descriptors: *Rift Valley fever, *Rainfall intensity, *Viruses, *Excess rainfall, Lakes, Mosquitos, Epizootiology, Public health, Kenya.

Epizootic Rift Valley fever (RVF) has occurred in Kenya four times over the last 30 years. Widespread, frequent, and persistent rainfall has been a feature of these epizootic periods. A composite statistic, based upon measurements of these rainfall characteristics, is positive during periods of epizoo-

tic Rift Valley fever. The heavy rainfall raises the level of the water table in certain areas, flooding the grassland depressions (dambos) that are the habitat of the immature forms of certain ground-pool-breeding mosquitos of the genus Aedes. RVF virus is probably transmitted transovarially in these species, very large numbers of which emerge under these damp conditions. This is when clinical signs of the disease are first seen. (Author's abstract)
W86-04663

APPLICATIONS OF FLUORESCENT DYE TRACERS IN THE PLANNING AND HYDROLOGICAL APPRAISAL OF SANITARY LANDFILLS,

Bristol Univ. (England). Dept. of Geography.
P. L. Smart.
Quarterly Journal of Engineering Geology QJEGA, Vol. 18, No. 3, p 275-286. 6 fig, 14 ref.

Descriptors: *Path of pollutants, *Sanitary landfills, *Fluorescent dye tracers, *Leachate, Hydraulic properties, Springs, Groundwater movement, Site selection, Surface water.

Four applications of artificial tracers in the study of sanitary landfill sites were investigated; confirmation of leachate contamination, determination of on-site hydrology, determination of hydraulic properties of landfill materials and prediction of leachate contamination and dilution. These applications are illustrated by seven tracing experiments undertaken at a landfill site in the Jurassic Great Oolite Limestone of the Cotswolds using fluorescent dye tracers. The tracers proved non-conservative, which limited their use in determination of hydraulic properties, but were still detectable more than 5 months after injection. Background fluorescence due to organic materials in landfill leachate and chemical instability caused problems in analysis, but these could be overcome. Overall the tests were successful in identifying the sources and paths of leachate leakage in the landfill, permitting design of effective risks of leachate contamination at surface streams in the vicinity. (Author's abstract)
W86-04679

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CONSIDERATIONS FOR DEVELOPMENT OF A BASIN MODEL FOR BANGLADESH,

Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2A.
W86-03961

OIL SPILL PROTECTION PLANNING FOR NATURAL RESOURCES IN OREGON,

Oregon State Dept. of Environmental Quality, Corvallis.
G. B. Sutherland, I. W. Jones, and R. W. Smith.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 183-186, 2 fig, 5 ref.

Descriptors: *Oil spills, *Environmental effects, *Cleanup operations, *Oregon, Mapping, Oil pollution, Oil, Columbia River, Willamette River, Yaquina Bay, Coos Bay.

A series of oil spill protection plans for natural resources has been developed for high priority areas in Oregon. This series was begun following the Toyota Maru No. 10 oil spill in the Columbia River in 1978 and has continued to the present. The plans are designed for use by the on-scene coordinator, special forces, and advisory agencies. Oil spill protection plans for the lower Columbia and Willamette rivers and the Yaquina Bay estuary are completed, and plans are being developed for the Coos Bay estuary. Each area contains high priority natural resource areas. These include National Wildlife Refuge System lands and waters, estuarine sanctuary lands and waters, critical habitats for endangered species, and spawning or breeding areas for fish and migratory birds. Considerations for access, water intakes, and commercial interests are included in the plans. The method of developing the plans for the three areas is discussed in detail. The process involves locating known vulnerable areas on a series of resource maps, describing the resources and their seasonal vulnerabilities on descriptive charts, and suggesting boom locations, oil containment sites, and access points on protective maps. Resource protection and response is analyzed, and recommendations for improving the process are included for future use by the agencies involved in pollution response and resource management. The level of interagency cooperation necessary for both spill response and detailed resource protection planning is identified. The practical value of this approach to resource protection and contingency planning is discussed. (Author's abstract)
W86-04020

OIL SPILL PREPAREDNESS IN A TROPICAL OFFSHORE AREA,

Smith Associates Consulting System Engineers Ltd., Surrey (England).
G. T. Tan.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 211-218, 3 tab, 5 refs.

Descriptors: *Oil spills, *Cleanup operations, *Planning, *Oil pollution, Environmental effects, Oil, Skimming, Dispersants, SLIK TRAK, Modeling.

The systematic process by which an oil spill preparedness plan was developed for SSB/SSPC operations in the South China Sea used local wind, current, and weather data in a SLIKTRAK model adapted to estimate the spill costs and risks resulting from a well blowout. The model shows that the Sabah and Philippines shores would be likely to be affected, while the Brunei and Sarawak shores have a low probability. The minimum period in which oil will arrive at any shore is three days after the spill. February to early August are likely months in which a spill will arrive at a shoreline. Spills from late August to January are expected to move away from the coast. Mechanical recovery of spilled oil and chemical dispersant spraying from boats is effective from March to September while natural dispersion is enhanced from September to February. The local environmental data and local availability of vessels and resources greatly influence the choice of mechanical cleanup equipment. An ecological marine macrobenthos survey has been carried out in the Sabah and Sarawak coastal waters. The fundamental aim of the program is to develop quantitative data on the current status of selected marine macrobenthic communities in these areas. This data could be used as a reference for comparison against any future surveys so that any environmental effects or modification resulting from oil spills may be assessed. A coastal resources study along the Sarawak coast also was being carried out to determine sensitive areas in order to prioritise the allocation of available oil spill control equipment and resources. Finally, the roles and development of Shell oil spill cooperatives in this region have been based on the tier concept. Under this concept, SSB/SSPC would be primarily responsible for its own spill as the first tier. It is complemented on a reciprocal basis by close cooperation with Brunei Shell as the second tier. The third tier involves the cooperation of the Shell Companies in Southeast Asia - The ROSE scheme. (Author's abstract)
W86-04021

EFFECT OF STOCHASTIC INPUTS AND PARAMETERS IN SOLUE-TRANSPORT MODELING,

Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5B.
W86-04082

MANAGEMENT OF LAKE COMO: A MULTIOBJECTIVE ANALYSIS,

Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
G. Guariso, S. Rinaldi, and R. Soncini-Sessa.
Water Resources Research WRERAO, Vol. 22, No. 2, p 109-120, February 1986. 12 fig, 12 ref.

Descriptors: *Reservoir operation, *Lake Como, *Multiobjective planning, *Multipurpose reservoirs, Italy, Optimization, Flood protection, Water supply development, Competing use, Electric power production, Management planning.

A heuristic approach for improving the performance of multipurpose reservoirs that have been in operation for a number of years is described. The main characteristic of the method is that the analyst must first learn from the past experience of the manager and synthesize it into a simple operating rule. Then the analyst must point out, with the help of the manager, what the acceptable modifications of such a rule are. After this has been accomplished, the optimal improvements of the operating rule can be obtained by using standard optimization techniques. Quite satisfactory results have been obtained by applying this approach to Lake Como (Northern Italy), which has been regulated since the end of World War II. In fact, the method shows that both flood protection on the lake shores and water supply to the downstream agricultural areas can be substantially improved, without lowering the mean yearly electricity production of the downstream run-of-river plants. For this reason the operating rule proposed by the method has been programmed on a microcomputer, which is now used every day by the manager as an essential support for his final decision. This and the fact that other actions suggested by this analysis have indeed been undertaken by the local authorities gave to this study the change to have a positive and direct impact on the lake management. (Lantz-PTT)
W86-04165

IDENTIFICATION OF WATER DEMAND MODELS FROM NOISY DATA,

A.T. and T. Bell Labs., Inc., Middletown, NJ.
For primary bibliographic entry see Field 6D.
W86-04195

OPTIMIZATION OF REAL-TIME RESERVOIR OPERATIONS WITH MARKOV DECISION PROCESSES,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W86-04198

PARAMETER ESTIMATION IN WATER RESOURCES PLANNING AND MANAGEMENT: OPTIMAL ACTIONS OR OPTIMAL PARAMETERS,

Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. M. Marin.
Water Resources Research WRERAO, Vol. 22, No. 3, p 353-360, March 1986. 7 fig, 3 tab, 16 ref.

Descriptors: *Optimization, *Water resources development, *Water management, Sampling, Management planning, Parametric hydrology.

The optimality of parameter estimates is commonly justified on the basis of their sampling properties in parameter space. However, these criteria may not be necessarily appropriate within the small sample size environment and the management rather than inferential focus of water resource planning decisions. Using two general cases, it is shown that in the presence of parameter uncertainty, 'optimal' parameters, selected on the basis of their sampling properties in parameter space, can instead lead to nonoptimal decisions relative to planning objectives. In either case, alternative Bayesian estimators are presented which, by incorporating parameter uncertainty, lead to uniform improvements in efficiency in action space over the traditional estimators. Incorporation of param-

eter uncertainty will not necessarily lead to uniform improvements, however. A counterexample is presented which shows that the use of noninformative priors, while optimal in the first case, can instead result in uniformly poorer decisions relative to the traditional estimators in the second case. The potential inefficiences due to the use of noninformative measures of uncertainty and/or the misspecification of the prior in Bayesian estimators, provide a motivation for the consideration instead of empirical Bayes methods of estimation. (Lantz-PTT)
W86-04199

COMPUTERS JOIN THE MAINTENANCE TEAM,

Saint Petersburg City Public Works, FL.
G. Sutton.
Water Engineering and Management, Vol. 133, No. 1, p 31-33, January 1986.

Descriptors: *Management planning, *Computers, *Maintenance, *Wastewater facilities, *Water treatment facilities, Decision making, Maintenance costs, Data transmission, Planning.

In St. Petersburg, Florida, the water and wastewater treatment facilities were organized under a centralized Maintenance Management System (MMS) which used an equipment specific management scheme and the CAMEO (Computer Assisted Management System for Environmental Operations) method to organize maintenance tasks. The scheduling of preventive maintenance is solely controlled by the computer. Long-range planing tools provided by the CAMEO system are the Equipment History and Master Listing reports. These documents provide cost and repair history for any specified unit, class or type of equipment. The system helps document manpower needs and can be used to justify costs if a maintenance item is challenged by budget limitations. The program can also be used in assessing resources that management will need to meet future challenges. (Geiger-PTT)
W86-04302

EVALUATING A CUMULATIVE IMPACT ASSESSMENT APPROACH,

Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
For primary bibliographic entry see Field 6G.
W86-04539

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. I. IMPLEMENTATION AND EFFECTIVENESS,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W86-04596

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. II. CONSENSUS ON CRITICAL ISSUES IN ENVIRONMENTAL MONITORING PROGRAM DESIGN,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W86-04597

SIMULATION MODEL TO FORECAST PROJECT COMPLETION TIME,

Technical Univ. of Nova Scotia, Halifax. Faculty of Engineering.
H. N. Ahuja, and V. Nandakumar.
Journal of Construction Engineering and Management (ASCE) JCEMD4, Vol. 111, No. 4, p 325-342, December 1985. 8 fig, 11 ref.

Descriptors: *Project planning, *Models, *Monte Carlo method, *Computer models, Simulation analysis, *Project Duration Forecasting Model, Dam construction, Labor, Model studies, Projection, Prediction, Forecasting.

The various significant uncertainty variables that affect the duration of an activity while it in progress, and in turn, affect the project completion time are examined. The Project Duration Forecasting Model PRODUF simulates and combines the impact of the significant uncertainty variables and incorporates it in the activity duration estimates as it revises them. PRODUF was used successfully to estimate completion dates for a dam construction project by using weather productivity relationships and data on workday type (holiday, half workday, full workday, or double shift). Limitations of the model include using only three reporting periods for considering uncertainty variables, questionable accuracy of historical input data, and lack of any statistical analysis to quantify the impact of the uncerrtainty variables. (Geiger-PTT)
W86-04620

RISK PENALTY FUNCTIONS FOR HAZARDOUS WASTE MANAGEMENT,

Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04644

6B. Evaluation Process

LARGE-SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL ISSUES,

United Nations Environment Programme, Nairobi (Kenya).
G. N. Golubev, and A. K. Biswas.
IN: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 1-5, 1 tab, 5 ref.

Descriptors: *Planning, *Evaluation, *Water transfer, *Water supply, *Water policy, Interbasin transfer, Environmental effects, Social aspects, Institutional constraints, Political constraints, Water law, Water resources development, Diversion, Water management.

Increasing water withdrawals throughout the world are leading to a new generation of water transfer projects. Unlike the small, local projects implemented to date, future transfers will tend towards large-scale, border-spanning projects with significant institutional, environmental and social issues. A framework is given to evaluate existing and planned projects. The following questions are asked. (1) Is water transfer an inevitable strategy. (2) Under what conditions is it the most efficient of alternative strategies. (3) What institutions (laws, policies, administrative structures) favor or impede implementation of water transfer strategies. (4) What trade-offs must be considered in decisions relating to water transfers. The importance of continuous monitoring and evaluation is stessed so that timely corrective actions can be taken during implementation of the project. (Cassar - PTT)
W86-03949

WATER TRANSFER IN CHINA: THE EAST ROUTE PROJECT,

L. Changming, Z. Dakang, and X. Yuexian.
In: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 103-118, 5 fig, 3 tab, 11 ref.

Descriptors: *Planning, *Evaluation, *Water transfer, Interbasin transfer, Diversion, Rivers, Canals, Grand Canal, Economic aspects, Water supply development, China, Swamps, Drainage, Irrigation, Water management.

The East Route is the planned first stage of a three-stage project to transfer water from the south of China to the north. This scheme uses the ancient Grand Canal to carry water northward from the Jiangdu pumping station to Tianjin. The average annual transfer would be 14 billion cu m, with about 30 billion cu m being transferred in dry years. Expected benefits of the East Route are expansion or improvement of about 4.3 million ha of irrigated land, 2.7 billion cu m of water available for municipal and industrial use, moderization of navigation on the canal, and drainage of water from waterlogged fields. The main disadvantage of the East Route is the power required to lift the water 65 m. Based on experiences with the Grand Canal and with water transfer projects in North Jiangsu, the East Route portion of the project was approved. Public attitudes are generally positive. (Cassar - PTT)
W86-03954

WATER TRANSFER IN A SMALL COUNTRY: HUNGARIAN EXPERIENCES AND PERSPECTIVES,

L. David.
In: Large Scale Water Transfer: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 135-156, 11 fig, 1 tab, 16 ref.

Descriptors: *Planning, *Evaluation, *Water transfer, Interbasin transfer, Environmental effects, Hungary, Tisza River, Water resources development, Water supply development, Water management.

The water transfer experiences in Hungary were analyzed. The stage of river basin development is an important factor in planning transfer projects. A formula is given for calculating a development function (D). The higher the development stage, the more necessary is water transfer. For example, calculated development functions are Tisza Valley, 38%; Danube Valley, 36%; and Hungary as a whole, 37%. In this range, water transfers are feasible but not vital. A development function is also calculated for the eutrophied Lake Balaton. The history of development and water projects in the Tisza Valley is described. The first water transfer project was completed in 1956. It transferred raw water from the Tisza to the Koros River valley. Additional canals were constructed in subsequent years. Several recommendations were developed from these experiences. (1) Water transfer should be analyzed in connection with the degree of river basin development. (2) Water transfer projects should be integrated into the overall water management system of the basin. (3) Water transfer activity should be evalunted using multicriterion decision analysis method. (4) When capital resources are limited, gradual development of water transfer projects is desirable. (5) Environmental monitoring is a vital part of a transfer project. The goal should be development of a new equilibrium between the project and its environment. (Cassar - PTT)
W86-03956

BRAHMAPUTRA RIVER BASIN DEVELOPMENT,

A. H. Khan, and S. Miah.
IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 85-98, 4 fig, 16 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *India, *Bangladesh, Economic aspects, International agreements, Water policy, Water management, Brahmaputra River, Irrigation, Flood control, Water storage, Dams, Reservoirs, Storage, Saline intrusion, Hydroelectric power.

The geographical features and hydrology of the Brahmaputra River and its basin (total, 234,000 sq miles) are described. Rising in the Himalayas, it flows 1800 miles to the Bay of Bengal at Bangladesh. The river is an important resource for Bangladesh, supplying drinking, municipal, and irrigation water; controlling saline intrusion; serving as a navigation system; and providing fish. Development in the Brahmaputra basin is necessary for flood control, irrigation in the dry season, prevention of saline intrusion from the Bay of Bengal, and improvement of transportation and navigation channels in thus rural region. Development to date consists of the following: in India--(1) flood control works which include 2380 miles of embankments, 480 miles of drainage channels, and 44 town pro-

tection schemes, (2) minor irrigation works which provide water to 1.5 million of the 7.7 million cultivable acres; in Bangladesh--(1) flood control works which include 135 miles of embankments, in addition to channel improvement and drainage, (2) irrigation works for about 1 million acres. The importance of cooperative river basin development is emphasized. One solution to the problems of flood control and irrigation is construction of storage dams in the mountains of India. However, studies show that storage reservoirs would hold only 7% of the potential storage of the basin. A major consideration in this region is seismic activity. An estimated 113 million KW of hydropower exists in the Tibetan plateau section of the basin. (Caesar - PTT)
W86-03963

GANGES BASIN DEVELOPMENT: A LONG-TERM PROBLEM AND SOME SHORT-TERM OPTIONS,

For primary bibliographic entry see Field 6E.
W86-03964

METHOD FOR RANKING BIOLOGICAL RESOURCES IN OIL SPILL RESPONSE PLANNING,

National Coastal Ecosystems Team, Slidell, LA.
J. K. Adams, A. J. Heikamp, and R. P. Hannah.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas, p 159-164, 1 fig, 4 tab, 7 ref.

Descriptors: *Oil spills, *Cleanup operation, *Planning, *Environmental effects, Oil pollution, Mapping, Oil.

A method for identifying and ranking biologically important geographic areas in spill response planning is described. Although this project was conducted to minimize environmental risks due to accidental spillage from the Louisiana Offshore Oil Port (LOOP), the methodology is widely applicable. The method has three important characteristics: it is driven by the existing information base and easily updated, applicable to all coastal and aquatic environments, and capable of producing a list of priorities within a specific spill response planning area. The rationale of selecting ranking units and ranking criteria is presented. Habitat was selected as the best available ranking unit for oil spill response planning. 'Habitat' is defined, and the attributes of habitats that make them useful analytical units are described. The ranking criteria selected (habitat recovery, persistence of oil, cleanup damage, important species supported, and habitat rarity) are defined and their evaluation explained. An application of the method is described for the LOOP spill response planning area. Habitats are identified and delineated, and values are assigned to the ranking criteria. The resultant habitat ranking is presented with recommendations for the incorporation of this analysis into a comprehensive oil spill contingency plan using a computerized geographic information system. (Author's abstract)
W86-04017

MIRG ENVIRONMENTAL ELEMENT: AN OIL SPILL RESPONSE PLANNING TOOL FOR THE GULF OF MEXICO,

ARCO Oil and Gas Co., Bakersfield, CA.
For primary bibliographic entry see Field 5G.
W86-04019

OIL SPILL PROTECTION PLANNING FOR NATURAL RESOURCES IN OREGON,

Oregon State Dept. of Environmental Quality, Corvallis.
For primary bibliographic entry see Field 6A.
W86-04020

HASBAH 6: OIL COMPANIES RESPONSE TO OIL POLLUTION IN THE ARABIAN GULF,

Gulf Area Oil Companies Mutual Aid Organization, Manama (Bahrain).
P. B. Ryan.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 371-375.

Descriptors: *Oil spills, *Oil pollution, *Cleanup techniques, Arabian Gulf, Saudi Arabia, Oily water, Oil, Hasbah 6, Case studies.

The Hasbah 6 well offshore Saudi Arabia blew out on October 2, 1980 and remained out of control for ten days. The oil which escaped from the well during this period formed a large slick which drifted south-east down the gulf, threatening the coastal areas of all states south of the blowout site. Oil spill countermeasures were mounted by several oil companies in the region either on their own initiative or upon direction from their respective states' governments in attempts to minimize the adverse effects of the spill. All of the oil companies known to be involved in responding to the oil spill were members of the Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO), an organization formed in 1972 to promote cooperation among oil companies in the Arabian Gulf for oil pollution control and cleanup in the region. The Hasbah 6 incident served to demonstrate the value of GAOCMAO in facilitating cooperative responses by member companies to a common pollution hazard and highlighted many of the problems likely to be encountered in mounting a spill cleanup operation of this magnitude in a restricted and multi-national environment such as the Arabian Gulf. (Author's abstract)
W86-04029

EXPECTED UTILITY, BENEFIT, AND LOSS CRITERIA FOR SEASONAL WATER SUPPLY PLANNING,

Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz.
Water Resources Research WRERAO, Vol. 22, No. 3, p 303-312, March 1986. 6 fig, 4 tab, 38 ref, 2 append. NSF Grant No. CEE-8300928.

Descriptors: *Water supply planning, *Irrigation practices, *Seasonal variation, Cost-benefit analysis, Benefits, Management planning.

State-of-the-art decision criteria for seasonal water supply planning under uncertainty, with particular focus on irrigation supply, is discussed. Reviewed, compared, and contrasted, are three types of criterion functions: a utility function, a benefit function, and an opportunity loss function. Economic and preferential conditions imbedded in each function are identified. Theoretical relationships between these functions are established and illustrated using real data. The result of this synthesis is a methodological framework that unifies the three types of functions and offers analysts a systematic approach to choosing an appropriate decision criterion. (Lantz-PTT)
W86-04193

OPTIMAL WATER SUPPLY PLANNING BASED ON SEASONAL RUNOFF FORECASTS,

Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz.
Water Resources Research WRERAO, Vol. 22, No. 3, p 313-321, March 1986. 10 fig, 3 tab, 23 ref. NSF Grant No. CFE-8300928.

Descriptors: *Water supply planning, *Seasonal runoff, *Runoff forecasting, *Optimum development plans, Markov Process, Model studies, Value, Dynamic programming.

Suppose a commitment of water supply for forthcoming season must be made within a prior period during which a sequence of seasonal runoff volume forecasts is available. The decision maker's dilemma is that on the average, the accuracy of forecasts increases with time, but the benefit from the supply allocation decreases as the commitment is delayed. This planning problem is modeled as a Markovian stopping process with maximization of the expected utility of outcomes as the planning criterion. The optimal decision strategy, obtained via dynamic programming, prescribes the timing of the commitment and volume of the planned supply as a function of forecasts. The strategy takes explicitly into account uncertainties in the forecasts, value of water (economic or subjective), risk attitude of the decision maker, and utility reduction factor caused by delaying the commitment. An extensive numerical example illustrates the capabilities of the model as an aid to real-time decision making and evaluation of the economic worth of forecasts. (Author's abstract)
W86-04194

RIVER RECREATION EXPERIENCE OPPORTUNITIES IN TWO RECREATION OPPORTUNITY SPECTRUM (ROS) CLASSES,

Minnesota Univ., St. Paul.
D. C. Wellmuth, J. H. Schomaker, and L. C. Merriam, Jr.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 851-857, October 1985. 2 fig, 3 tab, 28 ref.

Descriptors: *Wilderness areas, *Recreation, *Management planning, Surveys, Colorado River, Arkansas River, Public waters.

Different classes of the ROS system (the U.S. Forest Service and Bureau of Land Management method of inventorying, classifying, and managing wildlands) from the Colorado and Arkansas Rivers of Colorado were compared, using visitor survey data collected in 1979 and 1981, to see if the different classes offered different recreational experience opportunities. No differences between classes were found. Six possible reasons for this lack of difference are discussed, as follows: (1) recreation setting is not linked with experience (basic assumption violated); (2) improper classification of areas; (3) poor measurement of experience opportunities; (4) difference between studied riversegments was insignificant, despite correct assignment to different ROS classes; (5) a river recreation opportunity spectrum does not exist; and (6) information is lost in the process of classifying a multidimensional complex phenomenon into unidimensional, ordinal classes. The usefulness of ROS at the broader levels of planning and the needs at more detailed levels of planning are noted. (Rochester-PTT)
W86-04536

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

CHANG JIANG DIVERSION PROJECT: AN OVERVIEW OF ECONOMIC AND ENVIRONMENTAL ISSUES,

International Food Policy Research Inst., Washington, DC.
For primary bibliographic entry see Field 6D.
W86-03932

SIMULTANEOUS EQUATION DEMAND MODEL FOR BLOCK RATES,

Arizona State Univ., Tempe. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W86-04155

RISK COSTS FOR NEW DAMS: ECONOMIC ANALYSIS AND EFFECTS OF MONITORING,

Stanford Univ., CA. Dept. of Industrial Engineering.
M. E. Pate-Cornell, and G. Tagaras.
Water Resource Research WRERAO, Vol. 22, No. 1, p 5-14, January 1986. 1 fig, 8 tab, 44 ref. NSF Grant PFR-7815898.

Descriptors: *Risks, *Dams, *Cost analysis, *Monitoring, Dam failure, Dam stability, Auburn Dam, Teton Dam, Dickey-Lincoln School Project, Warning systems.

Presented are new developments and illustrations of the introduction of risk and costs in cost-benefit analysis for new dams. The emphasis is on a method of evaluation of the risk costs based on the structure of the local economy. Costs to agricultural property as well as residential, commercial, in-

dustrial, and public property are studied in detail. Of particular interest is the case of sequential dam failure and the evaluation of the risk costs attributable to a new dam upstream from an existing one. Three real cases are presented as illustrations of the method: the Auburn Dam, the Dickey-Lincoln School Project, and the Teton Dam, which failed in 1976. This last case provides a calibration tool for the estimation of loss ratios. For these three projects, the risk-modified benefit-cost ratios are computed to assess the effect of the risk on the economic performance of the project. The role of a warning system provided by systematic monitoring of the dam is analyzed: by reducing the risk cost, the warning system attenuates their effect on the benefit-cost ratio. The precursors, however, can be missed or misinterpreted: monitoring does not guarantee that the risks to human life can be reduced to zero. this study shows, in particular, that it is critical to consider the risk costs in the decision to build a new dam when the flood area is large and densely populated. (Author's abstract)
W86-04156

REDUCED PRESSURE IRRIGATION INVESTMENT ECONOMICS,
South Dakota State Univ., Brookings. Dept. of Economics.
D. C. Taylor.
Water Resources Research WRERAO, Vol. 22, No. 2, p 121-128, February 1986. 7 tab, 28 ref.

Descriptors: *Reduced pressure irrigation, *Economic evaluation, Energy conservation, Irrigation efficiency, Water conservation, Crop yield, Cost analysis.

Because reduced pressure irrigation is energy saving, many commentators conclude that is also cost saving. The validity of this proposition is examined in this article. A central focus is whether yields are likely to be less with reduced pressure. If yields are not likely to be less and the purchase of a new irrigation system is expected to be profitable, clearly, a reduced pressure unit should be selected. If a yield reduction is not in prospect and the conversion of an existing conventional high pressure system to reduced pressure is contemplated, the decision revolves around the present value of the prospective annual energy cost savings from reduced pressure (the break-even investment) relative to a dealer's cost for making the conversion. the article also shows that even small reductions in yield from reduced pressure irrigation (e.g., less than 5%) can completely erode the economics of investing in reduced pressure units. (Author's abstract)
W86-04166

SHARING REGIONAL COOPERATIVE GAINS FROM REUSING EFFLUENT FOR IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
A. Dinar, D. Yaron, and Y. Kannai.
Water Resources Research WRERAO, Vol. 22, No. 3, p 339-344, March 1986. 1 fig, 4 tab, 30 ref. BARD Grant No. I-101-79.

Descriptors: *Impaired water use, *Irrigation, *Cooperatives, *Cost-benefit analysis, Cost sharing, Effluents, Income distribution, Israel.

The allocation of cost and benefits from regional cooperation, with respect to reuse of municipal effluent for irrigation at the Ramla region of Israel, is discussed. An efficient regional solution provides the maximal regional income which has to be redistributed among the town and several farms. Different allocations based on marginal cost pricing and schemes from cooperative game theory like the core, Shapley value, and nucleolus are applied. The town and farm A have the main additional gains according to all allocation schemes presented. Advantages and disadvantages of these allocations schemes are examined in order to suggest a fair and acceptable allocation of the regional cooperative gains. Although no method has been preferred, the marginal cost pricing was found to be unacceptable by the participants. The conclusion is that the theory of cooperative games may provide guidelines while comparing the different solutions. (Lantz-PTT)
W86-04197

MULTIPLE COMPLETION MONITOR WELLS,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 4B.
W86-04207

COST GAP METHOD AND OTHER COST ALLOCATION METHODS FOR MULTIPURPOSE WATER PROJECTS,
Katholieke Univ. Nijmegen (Netherlands). Mathematisch Inst.
T. S. H. Driessen, and S. H. Tijs.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1469-1475, October 1985. 3 fig, 4 tab, 29 ref, 1 append.

Descriptors: *Water resource projects, *Cost allocation, *Game theory, Separable costs, Nonseparable costs, Mathematical analysis.

Four different cost allocation methods are compared that allocate the joint costs of water resources projects among their participants on the basis of separable and nonseparable costs. These are: the egalitarian nonseparable cost (ENSC) method, the separable costs remaining benefits (SCRB) method, the minimum costs remaining savings method, and a new method, called the nonseparable cost gap method, which is derived from the tau value, a game-theoretical concept. All the methods except the ENSC method can be described with the aid of lower and upper bounds for the core of the involved cost game. For convex cost games, these three methods use the same bounds for the core and hence coincide, but their cost allocation does not belong necessarily to the core. For a second class of cost games called one-convex cost games, all methods except the SCRB method coincide, and their cost allocation is the center of gravity of the core of the involved cost game. (An appendix includes a proof that convex cost games are semiconvex.) (Author's abstract)
W86-04543

SIMULATION MODEL TO FORECAST PROJECT COMPLETION TIME,
Technical Univ. of Nova Scotia, Halifax. Faculty of Engineering.
For primary bibliographic entry see Field 6A.
W86-04620

6D. Water Demand

LONG-DISTANCE WATER TRANSFER: A CHINESE CASE STUDY AND INTERNATIONAL EXPERIENCES.
United Nations Univ., Tokyo (Japan).
Water Resources Series, Volume 3, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. Edited by Asit K. Biswas, Zuo Dakang, James E. Nickum and Liu Changming. 417 p.

Descriptors: *Water transfer, *Diversion, *Canals, *Irrigation, *China, Water supply, Water supply development, Economic aspects, Environmental effects, Water storage, Water conveyance, Atmospheric water.

Because of the increased need for irrigation in many nations, all viable sources of water are being developed. Long-distance water transfer is investigated as a serious means of making existing projects more efficient. A specific water transfer project that is discussed in detail is the proposed south-north program in eastern China. Areas of concern include: land use, crop allocation, environmental implications, water balance, groundwater, atmospheric moisture balance, saltwater intrusion, and soil characteristics. Water transfer projects in Egypt, Texas, Japan, and Pakistan are also included. (Halterman-PTT)
W86-03918

LONG-DISTANCE WATER TRANSFER: PROBLEMS AND PROSPECTS,
Biswas and Associates, Oxford (England).
A. K. Biswas.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experience, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 1-13, 2 tab, 12 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Irrigation, Agriculture, Industrial water, Water use, Developing countries, Economic aspects, Engineering, Canals, Diversion.

Aspects of the large-scale artificial mass transfer of water from a water-surplus to a water-deficient region for the purpose of furthering economic development, are discussed. This water transfer can be achieved by diverting the course of a river, or by constructing a large canal. Feasibility studies must include social and environmental costs along with engineering and economic factors. The major variables to be considered are: the physical system (including water quality and quantity, land implications, and atmosphere); the biological system (aquatic and land-based life); and the human system (including uses of the water produced and socio-cultural costs). The proposed North American Water and Power Alliance (which would transfer water primarily from Canada to the United States and Mexico) is described and its problems and prospects are discussed. It is pointed out that secondary and tertiary benefits and costs of such a system should also be considered. It is essential that case studies from a few interregional water transfer projects in existence be prepared in order that certain generalized conclusions can be drawn. (Halterman - PTT)
W86-03919

RIVER NILE: MAIN WATER TRANSFER PROJECTS IN EGYPT AND IMPACTS ON EGYPTIAN AGRICULTURE,
Water Research Centre, Cairo (Egypt).
M. Abu-Zeid.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 15-34, 2 fig, 1 tab, 9 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *Irrigation, *Egypt, *Nile River, Agriculture, Dams, Canals, Economic aspects, Water use.

The River Nile is described, and Egypt's major water transfer projects along the Nile are considered. A history of Nile River water transfer projects (beginning in 2400 BC) is presented, including the Ismailia Canal (built in 1862 and connecting the Nile and the Suez Canal) and the Ibrahimia Canal (built in 1873 and irrigate Middle Egypt all year round). The effects of each of the projects on agriculture and on economic development are considered. The Aswan High Dam (construction completed in 1970) is described in detail. The impact of the dam on agriculture, on the impact of the dam on fisheries, are among the topics considered. The benefits of land reclamation projects, including the enlargement of the Ismailia Canal, the West Nubaria Canal System, and the El Salam Canal, are described. The major constraints to Egyptian agriculture today are lack of on-farm water management, waterlogging and salinity, and the need for improved irrigation systems. (Halterman - PTT)
W86-03920

AGRICULTURAL WATER MANAGEMENT AND THE ENVIRONMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 35-64, 6 fig, 1 tab, 17 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Irrigation, *Pakistan, Salinity, Waterlogging, Agriculture, Water quality, Indus River.

The importance of irrigation in water management practices is emphasized, and the two major irrigation problems encountered (salinity and waterlogging of the soil) are described. Also discussed are difficulties involved in maintaining the appropriate water quantity and quality in irrigation systems are also discussed. An irrigation system is defined, its three major components (the farm subsystem, the water delivery subsystem, and the water removal subsystem) are described, and the legal, practical and social problems encountered in the administration of such a system are considered. The majority of water quality planning efforts in irrigated agriculture are directed toward identifying measures required to control salinity. The three steps involved in river basin salinity planning are: evaluation of alternatives for each area, optimizing cost-effectiveness relationships from individual areas into a single cost-effectiveness relationships from individual areas into a single strategy, and assigning the required level of salinity control that should be implemented in each irrigated area. The process involved in the development of solutions for improving existing irrigated lands is described. The Indus Basin irrigation system in Pakistan is presented as an example of the use of this development process. (Halterman - PTT)
W86-03921

JAPANESE WATER TRANSFER: A REVIEW,

Iwate Univ., Morioka (Japan). Faculty of Agriculture.
M. Okamoto.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 65-75, 1 fig.

Descriptors: *Water transfer, *Water supply, *Irrigation, *Japan, Water use, Economic aspects, Diversion, Water supply development, Industrial water.

Interregional water transfer has become increasingly important in Japan in recent years, although the projects are all on a relatively small scale. The problems faced in the Japanese projects, including technical, socio-economic, institutional and environmental, are discussed. Several steps for planning and executing these projects are outlined. They include: examine all possible alternatives to determine the necessity; examine advantages and disadvantages associated with various routes available; plan the operation of the project to minimize conflicts of interest between different sectors; and carefully examine all potential negative effects. (Halterman - PTT)
W86-03922

TEXAS WATER SYSTEM: IMPLICATIONS FOR ENVIRONMENTAL ASSESSMENT IN PLANNING FOR INTERBASIN WATER TRANSFERS,

Indiana Univ. at Bloomington. Dept. of Geography.
C. Greer.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 77-90, 2 fig, 10 ref.

Descriptors: *Water transfer, *Texas, Water supply, Water supply development, Irrigation, Agriculture, Water use, Canals, Diversion, Environmental effects.

The Texas Water System proposal, developed during the 1960's and 1970's, is described. The key to the system is a series of reservoirs on the major rivers of east and central Texas which drain into the Gulf of Mexico. The role of these reservoirs would be to store water prior to conveyance through two major canal systems: The Coastal Canal System and the Trans-Texas Canal System. The wide range of potential environmental impacts in large interbasin transfers are discussed. They include those impacts in the exporting basin, those along the routes of conveyance, and those in the areas of delivery. The need for balanced environmental planning of the proposed transfer scheme is stressed. (Halterman - PTT)
W86-03923

CHINA'S SOUTH-TO-NORTH WATER TRANSFER PROPOSALS,

Academia Sinica, Beijing (China). Inst. of Geography.
Z. Dakang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 91-96.

Descriptors: *Water transfer, *China, Water supply, Water supply development, Irrigation, Agriculture, Industrial water, Water use, Diversion.

Because of the south-north water imbalance in China, and projected future water shortages in the north, the water conservancy department carried out some studies on northward water diversion from the various reaches of the Chang Jiang River. The history of the planning and development of that diversion from the early 1950s through the early 1980s are outlined. This discussion serves as an introduction to a series of papers delivered at a conference concerned with the many environmental aspects of the development and implementation of such a vast diversion project. (Halterman-PTT)
W86-03924

NATURAL CONDITIONS IN THE PROPOSED WATER TRANSFER REGION,

Academia Sinica, Beijing (China). Inst. of Geography.
W. Zhongyi, and Z. Chunian.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 97-114, 5 ref.

Descriptors: *Diversion, *Water transfer, *Water supply, *Geomorphology, *China, Climatic data, Precipitation, Rivers, Hydrology, Soil types.

The land area included in a south-north water transfer in eastern China is described. Background, or baseline, conditions are outlined. Geomorphological features; climatic conditions, including temperature and precipitation; rivers and hydrologic characteristics; hydrogeological conditions; and soil and vegetation types and properties are emphasized. (Halterman - PTT)
W86-03925

LAND USE AND CROP ALLOCATION IN THE PROPOSED WATER TRANSFER REGION,

Academia Sinica, Beijing (China). Inst. of Geography.
G. Huancheng, and X. Zhikang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 115-125.

Descriptors: *Water use, *China, *Diversion, *Water transfer, Water supply development, Canals, Economic aspects, Environmental effects.

Background information on land use and crop distribution, both historically and presently, in the region of a proposed water transfer in China, is provided. Existing problems in land use and crop allocation are discussed, and means for improvement are presented. The worst problems are due to drought conditions interspersed with excess surface water. Other serious problems are soil salinization and oversimplified crop structure. Increased use of available water sources, such as wells, providing sufficient drainage, and multiple cropping, are detailed, and the incorporation of these factors into the planning of the water transfer project is discussed. (Halterman - PTT)
W86-03926

SOUTH-NORTH WATER TRANSFER PROJECT PLANS,

Ministry of Water Conservancy and Power, Beijing (China).
Y. Bangyi, and C. Qinglian.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 127-149, 7 fig, 3 tab.

Descriptors: *Water transfer, *Water use, *Diversion, *China, Water supply, Water supply development, Canals, Economic aspects, Environmental effects.

Various aspects of the projected south-north water transfer program in China are discussed. Specific areas covered are the distribution of water and land resources in China, including distribution of precipitation, distribution of stream runoff, groundwater resources; the utilization of water resources in China, water needs at the end of this century, current status of major rivers in eastern China and future trends in development; and planning and research on the water transfer program. Transfer route schemes, projects for storage and regulation, and project benefits are also outlined. (Halterman - PTT)
W86-03927

ENVIRONMENTAL IMPLICATIONS OF WATER TRANSFER,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
R. Herrmann.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 151-158, 12 ref.

Descriptors: *Water transfer, *Water use, *Diversion, *Environmental effects, *China, Water supply, Canals, Water supply development.

A south-north water transfer project being planned for eastern China would impact upon a variety of aspects of the environment. Particular focus is on the impact of withdrawal of water on the aquatic environment, the impact of water transfer on adjacent terrestrial and freshwater ecosystems, and environmental impacts of irrigation development. Techniques for optimizing the water transfer, including models of cause-effect relationships between different hydraulic engineering measures and their environmental impacts, are discussed. (Halterman - PTT)
W86-03928

IMPACT OF WATER TRANSFER ON THE NATURAL ENVIRONMENT,

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6G.
W86-03929

IMPACT OF SOUTH-TO-NORTH TRANSFER UPON THE NATURAL ENVIRONMENT,

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6G.
W86-03930

INSTITUTIONS AND CHINA'S LONG-DISTANCE WATER TRANSFER PROPOSALS,

Cornell Univ., Ithaca, NY. Dept. of Asian Studies.
J. E. Nickum.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 181-191, 23 ref.

Descriptors: *Water transfer, *Water use, *Diversion, *China, Water supply, *Legal aspects, Water supply development, Canals, Environmental effects, Economic aspects.

One of the most arduous tasks related to the south-north water transfer project in China is the design-

ing or adapting of regulations to be used to allocate the water. Water rights, relations between provinces, and irrigation management are areas of special interest in this regard. These considerations are critical to making a realistic assessment of likely deleterious impact of the introduction of new water via a mass transfer and to drawing up the institutional reforms necessary to mitigate such harmful side effects, most notably the spread of secondary salinization due to excess application and improper drainage. (Halterman - PTT)
W86-03931

CHANG JIANG DIVERSION PROJECT: AN OVERVIEW OF ECONOMIC AND ENVIRONMENTAL ISSUES,

International Food Policy Research Inst., Washington, DC.
B. Stone.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 193-214, 1 tab, 32 ref.

Descriptors: *Water transfer, *Water use, *Environmental effects, *Diversion, *China, Water supply development, Water supply, Irrigation, Canals, Wells.

A proposed south-north water transfer project in China is discussed and several economic and environmental issues are outlined. Limnological deterioration and general problems of water pollution, impacts on aquatic production, lowering of the Chang Jiang estuary, and flooding and salinization of soils are key environmental problems. The trends in China's supply and demand for foodgrains, emerging issues in water requirement trends, grain production progress in North China, development of wells and the North China water table, alternative irrigation schemes in North China, alternative approaches to irrigation development, and the development of information resources are also issues that must be considered in the overall planning of the project. (Halterman - PTT)
W86-03932

WATER BALANCE IN THE WATER TRANSFER REGION,

Academia Sinica, Beijing (China). Inst. of Geography.
L. Changming, and L. Enbao.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 215-232, 7 fig, 5 tab, 1 ref.

Descriptors: *Diversion, *Water supply development, *Environmental effects, *Water transfer, *China, Economic aspects, Canals, Water supply.

The water balance in the proposed water transfer region of eastern China and the four major river basins associated with it, are analyzed. The major emphasis of the analysis is on areal distribution of water balance elements, (precipitation, runoff, evaporation, soil moisture renewal); characteristics of water-balance elements in the main provinces and autonomous region; and the temporal distribution of water balance elements. Some specific problems associated in balancing water supply and requirements include water supply analysis, water requirement analysis, and water balance and ecological equilibrium. (Halterman - PTT)
W86-03933

INTEGRATED EVALUATION OF THE SURFACE AND GROUNDWATER RESOURCES OF THE HAI AND LUAN HE BASINS,

Academia Sinica, Beijing (China).
L. Jiasan.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 233-243, 2 fig, 1 tab.

Descriptors: *Diversion, *Water transfer, *Water use, *Water supply, *China, Canals, Irrigation, Groundwater, Water supply development.

As part of the assessment of a potential water transfer project in eastern China, the surface and groundwater resources of the Hai and Luan He Basins are evaluated. The characteristics of the calculated basin stream runoff formation and the mutual recharge relationships between surface and groundwater are outlined. River runoff and composition of water resources in the basin, estimation of basin water resources, hydrological balance, and sources of plains groundwater recharge are also discussed. (Halterman - PTT)
W86-03934

PRELIMINARY ESTIMATION OF NATURAL RUNOFF IN THE HUAI HE BASIN,

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2A.
W86-03935

SHALLOW GROUNDWATER RESOURCES OF THE HUANG-HUAI-HAI PLAIN,

For primary bibliographic entry see Field 2F.
W86-03936

POTENTIAL EVAPORATION AND FIELD WATER CONSUMPTION IN THE NORTH CHINA PLAIN,

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2D.
W86-03937

ANALYSIS OF STORAGE FOR THE REGULATION OF SURFACE WATER IN THE HUANG-HUAI-HAI PLAIN FOR SOUTH-TO-NORTH WATER TRANSFER,

Hebei Inst. of Geography, Shijiazhuang (China)
For primary bibliographic entry see Field 4A.
W86-03938

PROBLEM OF WATER SUPPLY IN THE HAI-LUAN PLAIN,

Academia Sinica, Beijing (China).
H. Rangtang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 309-319.

Descriptors: *Water transfer, *Water supply, *Water conveyance, *Water supply development, *China, Diversion, Canals, Irrigation, Economic aspects, Environmental effects, Water storage.

As part of the overall assessment of the proposed south-north water transfer in eastern China, a variety of controversial issues are addressed. The conclusions drawn from this investigation include: northern water sources cannot satisfy industrial and municipal requirements, and northern water sources cannot satisfy economic requirements. Although the project is very necessary to meet water needs, the transfer presents very formidable problems. First, the project is very expensive. Second, the returns to investment are not striking, because existing state-set prices for agricultural produce are relatively low, making it difficult to have a net increase in income from irrigating with interbasin water. Third, there is a significant danger of secondary salinization. As a supplement to the water transfer, thorough and rational use of local water sources is recommended. Means of attaining this goal include fully intercepting mountain runoff, promoting underground storage, and building reservoirs suited to local conditions. (Halterman - PTT)
W86-03940

SOME ASPECTS OF THE NECESSITY AND FEASIBILITY OF CHINA'S PROPOSED SOUTH-TO-NORTH WATER TRANSFER,

Ministry of Water Conservancy and Power, Beijing (China).
Y. Bangyi, and C. Chunhuai.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 321-331.

Descriptors: *Water transfer, *Water supply, *Diversion, *Irrigation, *China, Water supply development, Canals, Economic aspects, Environmental effects, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the feasibility and necessity of the project are scrutinized. Conclusions indicate that the project to transfer water from the Chang Jiang would provide a rich source of water to the north, but it would only be a supplemental measure. Thorough use of local water resources is also necessary. Any increase in the diversion of water from the Huang He onto the Hai He plain must be premised on satisfying the requirements of the river itself and guaranteeing the water use of irrigation districts which are now diverting the Huang He. Analysis of the economic rationality of the transfer project has been insufficient, and work must be increased in this area. With its extraordinarily broad scope this project requires consideration of benefits it would provide in the form of the conditions for the development of the other departments of the national economy. Finally, the impact of the water transfer on the environment must be treated cautiously, considering improvements and negative impacts. (Halterman - PTT)
W86-03941

ATMOSPHERIC MOISTURE BALANCE IN THE PROPOSED WATER TRANSFER REGION,

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2A.
W86-03942

EFFECT OF SOUTH-TO-NORTH WATER TRANSFER ON SALTWATER INSTRUSION IN THE CHANG JIANG ESTUARY,

For primary bibliographic entry see Field 6G.
W86-03943

INVESTIGATION OF THE WATER QUALITY AND POLLUTION IN THE RIVERS OF THE PROPOSED WATER TRANSFER REGION,

Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 5B.
W86-03944

POSSIBLE EFFECTS OF THE PROPOSED EASTERN TRANSFER ROUTE ON THE FISH STOCK OF THE PRINCIPAL WATER BODIES ALONG THE COURSE,

Wuhan Inst. of Hydrobiology (China).
For primary bibliographic entry see Field 6G.
W86-03945

EFFECT OF DIVERTING WATER FROM SOUTH TO NORTH ON THE ECOSYSTEM OF THE HUANG-HUAI-HAI PLAIN,

Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science.
For primary bibliographic entry see Field 6G.
W86-03946

EXPERIMENTAL STUDY OF IMPROVING THE SALINE-ALKALI SOIL IN THE YUCHENG EXPERIMENTAL AREA, SHANDONG,

X. Yuexian, and Z. Xingquan.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 395-405, 6 fig, 1 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *Irrigation, *China, Soil moisture, Soil physical properties, Environmental effects.

As part of the overall assessment of the proposed south-north water transfer in eastern China, experiments were conducted on soil saline-alkali conditions. Measures for improving saline soil include pump wells, which lower the water table to allow increased percolation of rainwater; open channel drainage system, which increases surface water removal and therefore, the dissolved salts therein; developing soil fertility using organic fertilizers, which changes the soil structure and, therefore, increases soil porosity and moisture storing capacity; and, afforestation, which reduces wind, and increases drainage. These measures could help offset the impacts of the increased water resulting from the transfer. (Halterman - PTT)
W86-03947

LARGE SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL EXPERIENCES.
United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6E.
W86-03948

LARGE-SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL ISSUES,
United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6B.
W86-03949

INTER-BASIN WATER DIVERSION: CANADIAN EXPERIENCES AND PERSPECTIVES,
Victoria Univ. (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W86-03950

INTER-BASIN WATER TRANSFERS IN THE UNITED STATES,
Western Michigan Univ., Kalamazoo. Dept. of Geography.
For primary bibliographic entry see Field 6E.
W86-03951

PARTIAL SOUTHWARD DIVERSION OF NORTHERN AND SIBERIAN RIVERS,
For primary bibliographic entry see Field 6G.
W86-03952

INTERREGIONAL WATER TRANSFERS IN MEXICO,
H. Garduno.
In: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England 1985. p 119-134, 7 fig, 5 tab, 3 ref.

Descriptors: *Planning, *Water supply, *Water demand, *Water transfer, Interbasin transfer, Mexico, Irrigation, Political constraints, Diversion, Institutional constraints, Economic aspects, Agriculture, Water management.

Water resources and use in Mexico are described. Four zones with similar or complementary requirements for water resources development actions are designated: Pacific, Northern, Central, and Gulf/Southeastern. Interregional water transfer supply the large population of Mexico City and the arable, but dry, farmland in the Noroeste region. Excessive groundwater mining in the Mexico City area indicates the need for more interbasin transfer to this area. In this country water decisions are made through the central government. Although the overall effect has been positive, local water transfer projects are usually rejected. (Caesar - PTT)
W86-03955

WATER TRANSFER IN A SMALL COUNTRY: HUNGARIAN EXPERIENCES AND PERSPECTIVES,
For primary bibliographic entry see Field 6B.
W86-03956

RIVER BASIN DEVELOPMENT: PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON RIVER BASIN DEVELOPMENT.
United Nations Development Programme.
For primary bibliographic entry see Field 6E.
W86-03957

SOME MAJOR ISSUES IN RIVER BASIN MANAGEMENT FOR DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 6E.
W86-03958

IRRIGATION WATER REQUIREMENTS IN BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
H. R. Khan.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 150-157, 1 fig, 5 tab, 2 ref.

Descriptors: *Planning, *Water demand, *Water resources development, *Developing countries, *River basins, *Bangladesh, Water policy, Water management, Ganges River, Brahmaputra River, Meghna River, Irrigation requirements, Saline intrusion, Water use, Water supply.

In Bangladesh there are conflicting demands for water supplies during the November to May dry season. Water is needed for agriculture, domestic, and industrial purposes, for maintaining river depths to allow adequate navigation, for avoiding damage to fisheries, and for limiting upland penetration of saline water. In the dry season flow for the four major rivers is 173.40 million acre feet (MAF). The water availability (in MAF) for January, February, March, and April, respectively, is 11.10, 9.20, 10.15, and 12.69. The irrigation requirements (in MAF) for the same months, respectively, are 11.7, 12.6, 17.27, and 12.75. Any further reduction in river flows or upstream diversion to increase water supply would greatly increase salinity in southern Bangladesh. (Caesar - PTT)
W86-03968

INTERNATIONAL WATER STATISTICS - SOME CONCLUSIONS,
Wasserwerke Wien (Austria).
For primary bibliographic entry see Field 7C.
W86-04150

WATER SUPPLY BY OPTIMAL MIXING OF WATERS OF VARIABLE QUANTITY AND QUALITY,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
For primary bibliographic entry see Field 5F.
W86-04154

SIMULTANEOUS EQUATION DEMAND MODEL FOR BLOCK RATES,
Arizona State Univ., Tempe. Dept. of Economics.
D. E. Agthe, R. B. Billings, J. L. Dobra, and K. Raffiee.
Water Resources Research WRERAO, Vol. 22, No. 1, p 1-4, January 1986. 3 tab, 14 ref.

Descriptors: *Simultaneous equations, *Model studies, *Rate structure, Cost analysis, Hausman test, Mathematical models, Tucson, Arizona, Costs.

Examined is the problem of simultaneous-equations bias in estimation of the water demand function under an increasing block rate structure. The Hausman specification test is used to detect the presence of simultaneous-equations bias arising from correlation of the price measures with the regression error term in the results of a previously published study of water demand in Tucson, Arizona. An alternative simultaneous equation model is proposed for estimating the elasticity of demand in the presence of block rate pricing structures and availability of service charges. This model is used to reestimate the price and rate premium elasticities of demand in Tucson, Arizona for both the usual long-run static model and for a simple short-run demand model. The results from these simultaneous equation models are consistent with a priori expectations and are unbiased. (Author's abstract)
W86-04155

IDENTIFICATION OF WATER DEMAND MODELS FROM NOISY DATA,
A.T. and T. Bell Labs, Inc., Middletown, NJ.
L. K. Kher, and S. Sorooshian.
Water Resources Research WRERAO, Vol. 22, No. 3, p 322-330, March 1986. 3 fig, 4 tab, 24 ref.
DOE Grant No. DEAO 180 RA50256.

Descriptors: *Water demand, *Noisy data, *Model studies, Time series analysis, Regression analysis, Statistical models, Algorithms, Tucson, Arizona.

The identification of a proper water demand when all the variables are noisy is one of the major problems in the planning process. To date, this problem has been overlooked, and generally, regression or time series models have been used. It has been suggested that the existing methods to include noisy variables are fraught with problems such as nonidentifiability and unboundedness. An alternative procedure is proposed to identify a water demand model from a set of noisy data using noisy realization theory. A mathematical programming-based solution algorithm is developed to identify a first-order lag dynamical model for this noisy problem. This algorithm gives bounds on both the model parameters and on the noise covariance matrix. The unboundedness problem is addressed by using prior information about the upper bound on the noise covariance matrix. The monthly municipal water demand of Tucson, Arizona, from 1974 to 1977 is modeled as an example. The model assumes 10-30% noise in the variables and then correspondingly gives a range for each model parameter. (Lantz-PTT)
W86-04195

MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN CIUDAD JUAREZ, MEXICO,
California State Univ., Fullerton. Dept. of Geography.
W. J. Lloyd, and R. A. Marston.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 841-849, October 1985. 7 fig, 3 tab, 24 ref.

Descriptors: *Water demand, *Population dynamics, *Mexico, *Industrial Development, *Groundwater, *Water table decline, *Salinity, Hueco Bolson, Aquifers, Simulation analysis, Arid zone, Water use, Forecasting, Groundwater mining, Municipal water.

Rapid industrialization and population growth in the north Mexican desert city of Ciudad Juarez are placing a serious strain on the city's municipal water resources. Water deliveries and service area have more than doubled over the past decade, and plans for additional expansion are being implemented. This expansion is already contributing to water table declines and salinity increases in the Mexican portion of the Hueco Bolson, the sole source of water for the city. Continued water mining of the limited fresh water reserves should produce serious water supply problems in the near future. New estimates of future water consumption incorporated into a digital aquifer simulation model indicate that these problems may appear much sooner than anticipated by previous investigations. The acceleration and spread of serious water problems is likely to affect both the integrity of the municipal water utility's resource base as well as the long-term productivity of private industrial wells located around the city's periphery. These problems are exacerbated because the thickness of freshwater deposits diminishes substantially in the portion of the Hueco Bolson lying southeast of the study area. (Peters-PTT)
W86-04535

6E. Water Law and Institutions

WATER FOR HUMAN CONSUMPTION, MAN AND HIS ENVIRONMENT: PROCEEDINGS OF THE 4TH WORLD CONGRESS OF THE INTERNATIONAL WATER RESOURCES ASSOCIATION (IWRA).

International Water Resources Association, Urbana, IL.
Water Resources Series Volume 6, 1983. September 5-9, 1982, Buenos Aires, Argentina. Edited by W. Hall and C. Maxwell. 167 p.

Descriptors: *Water law, *Water resources development, *Potable water, Rural areas, Hydrology, Developing countries, Resources development, Water supply development, Institutions, Environmental aspects, Social aspects, Economic aspects, Legal aspects, United Nations, Training, Egypt, China, Indonesia.

This report includes discussions and conclusions of several International Water Resources Association (IWRA) committees and special sessions working on the problem of water for human consumption. These committees were (1) water and systems engineering,(2) educational, economic and social aspects, (3) water resources and the environment, and (4) water law and administration. The special sessions topics included (1) UNICEF: non-agricultural uses of rural water, (2) IWRA committee on oceanic water resources, (3) flatlands hydrology and management, (4) Japan's water resources, (5) UNESCO'S international hydrological program, (6) the World Bank's role in water resources development, (7) the Interamerican Development Bank's role in water resources development, (8) the United Nation's role in water resources development, (9) the water resources of Egypt, China, and Indonesia, and (10) the Salto Grande Joint Technical Commission. (Cassar - PTT)
W86-03907

TRANSFERABILITY OF WATER RIGHTS IN SOUTH AUSTRALIA,

South Australian Dept. of Engineering and Water Supply, Adelaide.
H. T. Tuckwell.
June 1985. 35 p, 3 append.

Descriptors: *Water allocation, *Resource allocation, *Available water, *Australia, Hydrologic budget, Water conservation, Water use, Water demand, Water resource development, Water distribution, Water law, Water management, Irrigation.

Water resource management in South Australia is principally concerned with irrigation and other uses of the River Murray. The development of current transfer policies, the Northern Adelaide Plains underground water rights, and Bolivar effluent water rights are also discussed. Several case histories involving implementation are presented, including those pertaining to market value of water rights movement of water rights, mortgaged land, and anticipation of increased saline inflows to a river. In the field of water resource management, South Australia is developing and implementing measures to provide for the increased transferability of water rights to increase the availability of water to promote the liklihood of water being applied as efficiently as possible. (Halterman - PTT)
W86-03912

GUIDELINES ON COMMUNITY LOCAL FLOOD WARNING AND RESPONSE SYSTEMS,

Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.
For primary bibliographic entry see Field 6F.
W86-03913

INSTITUTIONS AND CHINA'S LONG-DISTANCE WATER TRANSFER PROPOSALS,

Cornell Univ., Ithaca, NY. Dept. of Asian Studies.
For primary bibliographic entry see Field 6D.
W86-03931

LARGE SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL EXPERIENCES.

United Nations Environment Programme, Nairobi (Kenya).
Water Resources Series, Volume 7, Tycooly Publishing Ltd.: Oxford, England, 1985. Edited by Genady N. Golubev and Asit K. Biswas. 158 p.

Descriptors: *Planning, *Water policy, *Environmental effects, *Water transfer, *Water supply, Interbasin transfer, Social aspects, Economic aspects.

The environmental, economic, and social aspects of water transfer projects is emphasized in experiences from Canada, the U.S., Soviet Union, Sudan, China, Mexico, and Hungary. Although some countries have abundant water, it is often unevenly distributed. Examples are the arid western U.S. and the humid eastern U.S., the dry prairie provinces of Canada, and the water requirements of the large population concentrated in Mexico City. For developed river basins water transfer is the most feasible alternative in obtaining additional water supplies. The institutional and political constraints peculiar to each country are discussed. Central governmental control appears to favor large interbasin projects. In countries where public participation is encouraged, water transfer projects are often delayed or rejected on environmental or economic grounds. (Cassar - PTT)
W86-03948

LARGE-SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL ISSUES,

United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6B.
W86-03949

INTER-BASIN WATER DIVERSION: CANADIAN EXPERIENCES AND PERSPECTIVES,

Victoria Univ. (British Columbia). Dept. of Geography.
W. R. D. Sewell.
IN: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 7-35, 9 fig, 7 tab, 71 ref.

Descriptors: *Planning, *Political constraints, *Water transfer, Interbasin transfer, Canada, Diversion, Rivers, Reservoirs, Environmental aspects, Social aspects, Public opinion, Attitudes, North American Water and Power Alliance, Economic aspects, Water supply development, Water management.

Canada, a country of abundant water resources and very heavy water use, has implemented at least 60 interbasin water transfers as of 1980. Total flow is presently 4400 cu m/sec. These transfers have been widely accepted for several reasons: (1) small size of most transfer, (2) proximity of basins to each other, (3) lack of vigorous opposition by environmentalists. However, several proposed water transfers have generated considerable adverse reaction. Domestic schemes which have produced debate are the McGregor diversion (northern British Columbia); Aluminum Company of America Nechako River diversion; several diversions in the prairie provinces of Alberta, Saskatchewan, and Manitoba; and the James Bay scheme in Quebec. Proposals for water transfers from Canada to the U.S. are highly unpopular. The North American Water and Power Alliance scheme would divert water from rivers in Alaska and British Columbia to the western and southwestern U.S. This massive project would require construction of 240 reservoirs (highest dam, 1781 ft high; largest impoundment, 693 cu km), 112 irrigation systems, and 17 navigation channels. Several smaller schemes are also under discussion. Some concern the development of coal slurry pipelines. Studies on public reaction to international transfer show that most governmental personnel are lukewarm or totally opposed to any transfers. Environmentalists and native rights activists have been particularly vigorous in their opposition. Some Canadian citizens see water as a national resource rather than a continental resource. Finally, an increasing number of Americans are also opposed to international transfer. (Cassar - PTT)
W86-03950

INTER-BASIN WATER TRANSFERS IN THE UNITED STATES,

Western Michigan Univ., Kalamazoo. Dept. of Geography.
P. P. Micklin.
IN: Large Scale Water Transfers; Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 37-65, 8 fig, 2 tab, 62 ref.

Descriptors: *Planning, *Political constraints, *Water transfer, Interbasin transfer, Diversion, Rivers, Reservoirs, Environmental aspects, Social aspects, Public opinion, Attitudes, North American Water and Power Alliance, Economic aspects, Water supply development, Water policy, Institutional constraints, Irrigation, Texas Water Plan, California State Water Project, Water conservation, Water supply, Legal aspects, Water use efficiency, Water management.

The water crisis in the western U.S. has stimulated interest in increasing supply by large-scale, long-distance transfer. However, the concern for the environment and the huge cost of these projects has put them several decades into the future. The State Water Project in California is the only major interbasin transfer to have been constructed in the U.S. Built between 1960 and 1973 at a cost of $2.3 billion, it diverts 4 cu km/yr from the north of the state to the south. The gigantic North American Water and Power Alliance, which would divert southward large quantities of water from Canada and the northwest U.S., is unlikely to be implemented. The Texas Water Plan, not likely to be constructed in the near future, would divert water from the eastern part of the state and from the Mississippi to western Texas and New Mexico. A $20 billion scheme was proposed to supply the High Plains with 13.5 cu km of water from the Missouri River or other Mississippi River tributaries. Institutional, legal, and political considerations play a major role in implementing large interbasin water transfers. The National Environmental Policy Act requires federal agency sensitivity to environmental protection and the preparation of impact statements. Alternatives to large water transfers are water conservation, improvement of water use efficiency, price increases, and augmentation of supply by nondiversion methods (flow regulation, desalination, weather modification, etc.). (Cassar - PTT)
W86-03951

RIVER BASIN DEVELOPMENT: PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON RIVER BASIN DEVELOPMENT.

United Nations Development Programme.
December 4-10, 1981, Dacca, Bangladesh. Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. 239 p.

Descriptors: *Planning, *Water law, *Water resources development, *River basins, *Developing countries, *India, Bangladesh, Ganges River, Brahmaputra River, Water management, Legal aspects, International agreements.

A symposium at Dacca, Bangladesh, presented papers analyzing existing river basin development projects throughout the world and discussing ideas for development in the Indian subcontinent. The great rivers of this region (Ganges and Brahmaputra) travel through several countries. The potential for optimum development of these basins can be realized with international cooperation. Proper river basin development can augment food production and water supplies, improve transport, provide energy, and develop industries. Major problems on these two river systems are damaging floods and water shortages in the dry season. (Cassar - PTT)
W86-03957

SOME MAJOR ISSUES IN RIVER BASIN MANAGEMENT FOR DEVELOPING COUNTRIES,

A. K. Biswas.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 17-27, 2 tab, 14 ref.

Descriptors: *Planning, *Institutions, *Water resources development, *Developing countries, *River basins, Water conservation, Conservation, Employment, Economic aspects, International agreements, Construction, Systems analysis, Water policy, Water management.

River basin development can satisfy the demand for domestic, agricultural, industrial and hydroelectric power generation water uses. This is the reason that such work is becoming increasingly important in all developing countries. Associated with river basin development are four major issues. (1) Efficient use of water must be improved. Agricultural water losses are estimated at 57%. Greatest losses are in the canal system. In many cases less than one-quarter of the water released from a reservoir reaches the fields. Other savings can be realized by increasing recirculation of cooling water. (2) River basin development can generate employment. Labor-intensive techniques can be selected, if desired, in dam construction, tunneling, canal construction and maintenance, and drainage projects. (3) International river basin development involves conflicts among nations. Nine river and lake basins are shared by 6-12 countries; 214 are shared by at least two countries. There are 44 countries where at least 80% of the total area lies within international river basins. (4) To date developing countries have not taken enough advantage of the systems analysis tools available. (Cassar - PTT)

W86-03958

DEVELOPING THE GANGES BASIN,

G. R. Choudhury, and T. A. Khan.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 28-39, 1 fig, 5 ref.

Descriptors: *Planning, *Institutions, *Water resources development, *Developing countries, *River basins, *India, *Nepal, *Bangladesh, Ganges River, International agreements, Water policy, Water management, Irrigation, Water use, Water demand.

The Ganges River basin, shared by India, Nepal, and Bangladesh, is ready for development. A coordinated, wholehearted effort to accomplish this should be initiated. The densely populated (252 million) region drains about 431,200 sq miles. At present irrigation projects are the major form of basin development: in Nepal, 1.5 million acres; in India, 44 million acres; and in Bangladesh, 7.25 million acres. Total estimated surface water requirements from the Ganges and its tributaries by the year 2000 is about 259 MAF. The huge flow of river water that enters the sea unutilized during the flood season offers tremendous potential for storage and conservation to augment the river's dry season flow. In Nepal an additional 50-60 MAF of storage would be available if existing and potential reservoir sites are developed. Storage reservoirs in India could increase the dry-season flow by 88,000 to 130,000 cusec. An international committee of experts from each country is suggested. The first task is an inventory of resources and assessment of needs. (Cassar - PTT)

W86-03959

INTEGRATED DEVELOPMENT OF THE DELTA AND UPLAND PORTIONS OF A RIVER BASIN,

A. Volker.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 40-61, 42 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Deltas, *River basins, Developing countries, Nile River, Mekong River, Rhine River, International agreements, Water policy, Water management, Irrigation, Water use, Water demand, Flood control.

River basin development should not be attempted without considering the relationships between the delta and upland portions. For example, upstream embanking for flood protection produces the following effects downstream and in the delta: higher discharge levels and siltation of the river bed. Lower embankments combined with upstream water storage achieve better results. Upstream flood control reservoirs can produce downstream channel erosion and slow growth or erosion of the deltaic plain. Water stored in tidal lagoons and other coastal depressions tends to evaporate excessively, but it has the advantages of improving protection against storm surges, controlling saline water intrusion, and improving drainage conditions. Three case histories are cited. In the Rhine River delta, salinity derived from upstream sources was a major issue. Extensive documentation and delicate diplomacy was necessary to reach a satisfactory agreement among the involved parties. Egypt and Sudan, whose sole source of water is the Nile River, easily reached agreement on water management of this resource. Some of the adverse conditions existing downstream from the High Aswan Dam are soil salinization and wasting of irrigation water. The Mekong River and delta have been developed with a master plan with an integrated approach. No dikes have been built in the delta area. Inhabitants and crops have adapted to the floods. The major problems are siltation and salt water intrusion in the dry season. Evaluation of alternatives showed that the best plan for continued development is to use the available water to irrigate upstream areas, allowing the delta to remain in a relatively natural condition. (Cassar - PTT)

W86-03960

LOWER MEKONG BASIN DEVELOPMENT,

Chulalongkorn Univ., Bangkok (Thailand).

B. Binson.

IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 69-84, 2 fig, 1 tab, 6 ref, 1 append.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *Mekong River, Economic aspects, International agreements, Water policy, Water management.

In spite of the tremendous pre-investments as well as the existing investments in the Mekong Basin, its mainstream has not yet been crossed or its waters fully utilized, except for pumping over its banks and natural inundations. The tributaries have been made use of widely in Thailand but little has been done in Kampuchea, Lao PDR or Vietnam, mainly due to the political turmoil in those countries. That the Mekong development should have continued at all during these times is a great credit to the committee members. In the past, the Mekong Committee was free of politics and functioned well even when Thailand was at odds with Cambodia over the Phra Viharn Hill controversy. Even when three of the four riparian governments changed from being pro-Western to Socialist, the Committee continued its work. In fact, after the Interim Mekong Committee was set up in 1977, the development work of the Mekong Basin went ahead with renewed vigor. However, aid from cooperating countries is now much harder to get and, as a result, projects are progressing rather slowly. The riparian countries are also short of foreign exchange and, if politics also enter the picture, the Mekong Committee may come on very hard times in the future years. (Author's abstract)

W86-03962

BRAHMAPUTRA RIVER BASIN DEVELOPMENT,

For primary bibliographic entry see Field 6B.

W86-03963

GANGES BASIN DEVELOPMENT: A LONG-TERM PROBLEM AND SOME SHORT-TERM OPTIONS,

M. Zaman.

IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 99-109, 3 tab, 6 ref, 1 append.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *India, *Bangladesh, *Ganges River, Economic aspects, International agreements, Water policy, Water management, Irrigation, Flood control, Water storage, Dams, Reservoirs, Storage, Ganges Waters Agreement 1977, Regional planning.

Bangladesh and India hold different views of water resources development programs for the Ganges basin. The Ganges Waters Agreement of 1977, in force for 5 years, provided for sharing of dry season flows with Farakka as the sharing point. Both Bangladesh and India have prepared separate schemes for augmenting dry season flows. The Indian scheme involves transfer of 100,000 cusec of water from the Brahmaputra to the Ganges through a 209-mile canal, a third of which will pass through Bangladesh and join the Ganges at a point above Farakka in India. A barrage would be constructed at Jhogighopa in Assam. The Bangladesh scheme depends on construction of storage dams in the upper reaches of the Ganges basin in Nepal and India. These two views are so different that reconciliation seems difficult. Some short-term options are reduction of percolation losses of irrigation water, careful selection of irrigation project soils, shaping and levelling of irrigation plots, conjunctive use of groundwater and surface water, pond storage of monsoon waters, and changes in cropping patterns. (Cassar - PTT)

W86-03964

REGIONAL CO-OPERATION IN THE UTILIZATION OF WATER RESOURCES OF THE HIMALAYAN RIVER,

Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.

M. Shahjahan.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 110-123, 13 tab, 11 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *India, *Bangladesh, *Pakistan, *Nepal, Economic aspects, International agreements, Water policy, Water management, Ganges River, Indus River, Brahmaputra River, Meghna River, Irrigation, Flood control, Water storage, Dams, Reservoirs, Storage, Erosion control, Sedimentation, Regional planning.

The Himalayan river system (Indus, Ganges, Brahmaputra, and Meghna) drains a catchment area of 3.2 million sq km in which 500 million persons live. The importance of a regional water resources development strategy is emphasized. The average annual flow is 1,042 million acre feet. Statistics are given for surface water, groundwater, future water availability (1980-2000), and hydropower potential for Pakistan, Nepal, India, and Bangladesh. At present a large proportion of the water from the three main rivers flows to the sea unutilized, particularly in the monsoon season. Regional cooperation is vital for effective utilization of this vast water resource. The destructive floods, especially in downstream India and Bangladesh, could be effectively controlled by constructing storage reservoirs in the tributaries. Bangladesh receives 2-3 billion tons of unwanted sediments from Nepal and India, which lose large quantities of topsoil. This could be reduced by increasing vegetative cover and forest lands in the upstream areas. The best location for hydroelectric power structures is Nepal, a small country with limited capital. Pooling of funds for this purpose is desirable. Shared technology, such as data exchange and environmental monitoring, is another opportunity for regional cooperation. (Cassar-PTT)

W86-03965

FUNCTIONS OF INTEGRATED NATIONAL WATER PLANNING IN THE NETHERLANDS AND BANGLADESH,

K. P. Blumenthal.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 124-136, 2 fig, 10 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *Bangladesh, *The Netherlands, Water policy, Water management, Polders, Dikes, Drainage, Flood control.

Granting the many differences, the Netherlands and Bangladesh have many technical aspects of water management problems in common. A description of the historic water developments of a country like The Netherlands contains some useful hints concerning local aspects of development policy. Development begins in small communities. It is therefore instrumental for development policy to give farmers and agricultural communities the incentive of serving their own interests by making the necessary effort. A national integrated water management plant in a developed country has a different function for such a plan in a developing country: in the latter case, it is a frame of reference to judge the usefulness and priorities of projects. Because of its multidisciplinary nature, policy analysis can hardly be done in most countries, developed or otherwise, without external help: it should, however, include the training necessary to continue with the country's own resources. The discussion leaves the question open as to whether or not a policy analysis effort might be a useful object for development aid. The experience that developments desired by everyone take far more time than anyone expects is not limited to developing countries. Disappointments may, however, be used in a constructive way. (Author's abstract)

W86-03966

MANAGEMENT OF RIVER SYSTEMS IN THE GANGES AND BRAHMAPUTRA BASINS FOR DEVELOPMENT OF WATER RESOURCES,

M. F. A. Siddiqui.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 137-149, 4 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *Bangladesh, *India, Water policy, Water management, International agreements, Ganges River, Brahmaputra River, Meghna River, Flood control, Saline intrusion, Navigation, Water storage, Storage, Reservoirs.

Water and politics are closely interconnected. Invariably, the final decision to develop international water resources projects is part of the political process. Engineers do not make final decisions nor do they pass legislation that affects the planning process. They do evaluate the cost effectiveness of alternative proposal which helps the politicians' decisionmaking. In fact, water resources planning, project authorization and financing are all essentially political processes. Conflict and distrust among the nations of the Indian subcontinent complicates the exchange of data and the negotiation process. Thus far, these countries are determined to get their fair share of water resources rather than work together. India has been discussing separate plans for Ganges River development with Nepal and Bangladesh, rather than one agreement among all the involved parties. Unless the outlook changes, the possibility of establishing pooled resources are very remote. (Cassar - PTT)

W86-03967

INTERNATIONAL RIVER LAW,

D. A. Caponera.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 173-184.

Descriptors: *Planning, *Water law, *Political constraints, *Water resources development, *River basins, *International law, Developing countries, Water policy, Water management, Legal aspects, Water rights.

International water law gives a state the right to develop unilaterally that section of the watercourse which traverses or borders its territory, insofar if the development is not likely to cause substantial and lasting injury in the territory of another state or inconvenience incompatible with good neighborly relations. If an injury is likely to be substantial and lasting, the development may be undertaken only subject to prior agreement. Although a state is not required to obtain the prior consent of other basins states for a water development project, there is a legal duty to give notice wherever another state's rights are seriously affected. Close cooperation between all basin states should be firmly established. This involves exchange of technical data, exchange of plans and proposals, coordination of plans among co-basin states, and joint management for the operation of major hydraulic structures. The ideal is joint planning for development of the whole basin. Cooperation must be established on good faith, good neighborliness, equality and reciprocity. All basin states should consider not only their own interests but those of the basin community as a whole. (Cassar - PTT)

W86-03970

INSTITUTIONAL AND LEGAL FRAMEWORK FOR CO-OPERATION BETWEEN BANGLADESH AND INDIA ON SHARED WATER RESOURCES,

M. Zaman.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 185-194, 4 ref.

Descriptors: *Planning, *Water law, *Water resources development, *River basins, *Bangladesh, *India, Treaties, Developing countries, Water policy, Water management, International law, Legal aspects, Water rights, Political constraints, Ganges River, Institutional constraints, International agreements, Ganges Waters Agreement of 1977, Equitable apportionment.

Treaties are a common mechanism for sharing water resources in international river basins. India and Bangladesh have entered into two treaties for harnessing the water resources of the rivers common to them. The Agreement of 1972, which created the Joint River Commission. is a forum for maintaining liason between the two countries regarding maximum benefits, flood control works, irrigation projects, and research on advanced warning for floods and cyclones. The Ganges Waters Agreement of 1977, more elaborate and specific, requires the two states to devise means to augment dry season flows, allocates dry season flows, provides a joint committee to supervise the sharing, provides for review of the Agreement, and requires that disputes be referred to the two governments for settlement. (Cassar - PTT)

W86-03971

LAW OF INTERNATIONAL WATER RESOURCES SYSTEMS,

City Univ. of New York.

R. D. Hayton.

In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 195-239, 13 ref, 6 annexes.

Descriptors: *Planning, *Water law, *International law, *Water resources development, *Rivers, Water policy, Water management, Legal aspects, Water rights, International agreements, Institute of International Law, International Law Association, United Nations, Equitable appropriation, Helsinki Rules, International Law Commission.

International river law is summarized. History is discussed with attention to navigation laws, non-navigation laws, and the awareness of water's harmful effects. Work of two groups is described. The Institute of International Law is a private professional organization concerned with river law. The International Law Association, a professional organization devoted to international law, has produced the well-used Helsinki Rules, based on the equitable utilization principle. Many supplements to the Rules have been formulated to address specific topics such as flood control and marine pollution. Several intergovernmental organizations, including United Nations organs and conferences, are also active. The International Law Commission has published a number of special reports. Currently, international law is based on the principle of equitable utilization, which is now universally accepted. However, application of this principle is not always easy. The concept of shared natural resources is also firmly entrenched. Navigation laws are quite clear, with some loss of individual freedom compared with the last century. Recently, the duty to consult has become well established. Several annexes to the paper present excerpts from the International Law Commission's 32 session (May-July 1980), the Helsinki Rules, post-1966 articles of the International Law Association, the Institute of International Laws' statements on use of international non-maritime waters except for navigation and river and lake pollution, and draft propositions on international river law by the Asian-African Legal Consultative Committee. (Cassar - PTT)

W86-03972

GROUND WATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,

Robert S. Kerr Environmental Research Lab., Ada, OK.

For primary bibliographic entry see Field 5G.

W86-04043

SATURATED THICKNESS FOR DROUGHT AND LITIGATION PROTECTION,

Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 4B.

W86-04280

COOPERATIVE SERVICE ARRANGEMENTS,

Department of Commerce, Washington, DC.

For primary bibliographic entry see Field 5G.

W86-04283

CURRENT STATUS IN USE OF FLEXIBLE EFFLUENT STANDARDS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.

For primary bibliographic entry see Field 5G.

W86-04329

GROUNDWATER CONTAMINATION: A NATIONAL PROBLEM WITH IMPLICATIONS FOR STATE AND LOCAL ENVIRONMENTAL HEALTH PERSONNEL,

Winnebago County Dept. of Public Health, Rockford, IL.

For primary bibliographic entry see Field 5B.

W86-04609

6F. Nonstructural Alternatives

GUIDELINES ON COMMUNITY LOCAL FLOOD WARNING AND RESPONSE SYSTEMS.

Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.

August 1985. 104 p, 12 fig, 2 tab, 34 ref, 2 append.

Descriptors: *Flood protection, *Flood basins, *Flood control, Flood channels, Floodproofing, Flood damage, Flood data, Flooding, Public relations, Benefits, Public participation.

The heavy loss of life and property resulting from the occupation of flood-prone lands adjacent to water sources has resulted in the need for flood

warning and response systems. A variety of aspects of such systems are discussed. The specific topics include: local flood warning systems, community response systems, an integrated local flood warning and response system, the role of government agencies, dam safety activities, the Unified National Program for Flood Plain Management, and the Association of State Flood Plain Managers. (Halterman - PTT)
W86-03913

6G. Ecologic Impact Of Water Development

CLASS III CULTURAL RESOURCE INVENTORY, PARADOX VALLEY UNIT, COLORADO RIVER BASIN SALINITY CONTROL PROJECT, MONTROSE COUNTY, COLORADO,
Complete Archaeological Service Associates, Cortez, CO.
N. S. Hammack.
Report No. 4, November 25, 1985. 37 p, 20 fig, 10 ref, 1 append. Contract No. 4-CS-40-01630.

Descriptors: *Archaeology, *Water resources development, *Resources development, *Saline water, *Colorado, Salinity, Colorado River Basin, Water conveyance, Dolores River.

A Class III cultural resource inventory of 360 acres and four miles of 450 foot wide linear right-of-way was carried out by Complete Archaeological Service Associates (CASA) in the Paradox Basin of west central Colorado for the Bureau of Reclamation. This project is part of the Paradox Valley Unit of the Colorado River Basin Salinity Control Project. During this inventory eight new sites were recorded and one isolated flaked lithic artificat was located. One previously recorded site was reevaluated. The eight newly recorded sites include four historic sites and four prehistoric lithic scatters. None of the historic sites are considered to be eligible for nomination to the National Register of Historic Places and only three of the prehistoric sites contained sufficient research potential for inclusion in the NRHP. (Author's abstract)
W86-03911

CLASS II CULTURAL RESOURCE SURVEY UPPER GILA WATER SUPPLY STUDY CENTRAL ARIZONA PROJECT, VOLUME 1,
Deuel and Associates, Inc., Albuquerque, NM.
R. C. Chapman, C. W. Gossett, and W. J. Gossett.
October 1985. 212 p, 13 ill, 28 tab, 9 ref. Contract No. 3-CS-30-00150.

Descriptors: *Archaeology, *Water resources development, *Resources development, Water use, Water delivery, Water demand, Central Arizona Project, Water conveyance, Resources allocation.

The results of a Class II cultural resource survey, carried out as part of the Bureau of Reclamation Upper Gila Water Supply Study for the Central Arizona Project, are presented in a two-volume report. Volume I includes discussions of four projects along the Upper Gila River in the vicinity of Cliff, New Mexico and three projects along the lower San Francisco River northeast of Clifton, Arizona. Central features of the field effort included an experimental attempt to use digitized LANDSAT data interactively during the course of the survey, a sample design area emphasizing vegetative and topographical strata, and field studies of vegetation, mineral resources, and geomorphology. Significant new research concerning ceramics and lithic artifacts are summarized. (Halterman - PTT)
W86-03915

CLASS II CULTURAL RESOURCE SURVEY UPPER GILA WATER SUPPLY STUDY CENTRAL ARIZONA PROJECT, VOLUME 2,
Deuel and Associates, Inc., Albuquerque, NM.
R. C. Chapman, C. W. Gossett, and W. J. Gossett.
October 1985. 210 p, 24 ill, 42 tab. Contract No. 3-CS-35-00150.

Descriptors: *Archaeology, *Water resources, *Resources development, *Water conveyance, Water use, Water delivery, Water demand, Central Arizona Project, Development, Resources allocation.

The results of a Class II cultural resource survey, carried out as part of the Bureau of Reclamation Upper Gila Water Supply Study for the Central Arizona Project, are presented in a two-volume report. Volume II presents discussions of lithic artifacts assemblages and their implications for geographical space and organizational systems, architecture and use of site space, patterns in prehistoric space use and organizational systems in the upper San Francisco and Gila Rivers, a historic settlement along the upper Gila and low San Francisco Rivers, and summary and conclusions of the the entire study. (Halterman - PTT)
W86-03916

LONG-DISTANCE WATER TRANSFER: A CHINESE CASE STUDY AND INTERNATIONAL EXPERIENCES,
United Nations Univ., Tokyo (Japan).
For primary bibliographic entry see Field 6D.
W86-03918

LONG-DISTANCE WATER TRANSFER: PROBLEMS AND PROSPECTS,
Biswas and Associates, Oxford (England).
For primary bibliographic entry see Field 6D.
W86-03919

RIVER NILE: MAIN WATER TRANSFER PROJECTS IN EGYPT AND IMPACTS ON EGYPTIAN AGRICULTURE,
Water Research Centre, Cairo (Egypt).
For primary bibliographic entry see Field 6D.
W86-03920

AGRICULTURAL WATER MANAGEMENT AND THE ENVIRONMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 6D.
W86-03921

JAPANESE WATER TRANSFER: A REVIEW,
Iwate Univ., Morioka (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 6D.
W86-03922

TEXAS WATER SYSTEM: IMPLICATIONS FOR ENVIRONMENTAL ASSESSMENT IN PLANNING FOR INTERBASIN WATER TRANSFERS,
Indiana Univ. at Bloomington. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-03923

CHINA'S SOUTH-TO-NORTH WATER TRANSFER PROPOSALS,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6D.
W86-03924

LAND USE AND CROP ALLOCATION IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6D.
W86-03926

ENVIRONMENTAL IMPLICATIONS OF WATER TRANSFER,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 6D.
W86-03928

IMPACT OF WATER TRANSFER ON THE NATURAL ENVIRONMENT,
Academia Sinica, Beijing (China). Inst. of Geography.
X. Yuexian, and H. Jialian.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 159-167, 1 ref.

Descriptors: *Water transfer, *Water use, *Environmental effects, *China, *Diversion, Water supply, Canals, Water supply development.

The impacts of the projected south-north water transfer project in China include several related to the natural environment. Major areas of concern are impacts on water resources in the Chang Jiang Basin, impacts on the navigation channel of the Chang Jiang, impacts on seawater intrusion in the Chang Jiang estuary, impacts on aquatic life, such as algae, aquatic weeds, plankton, benthos and fish, impacts on the quality of transported water, impacts on the migration patterns of schistosomiasis, impacts on climate, and the salinization of irrigated lands. (Halterman - PTT)
W86-03929

IMPACT OF SOUTH-TO-NORTH TRANSFER UPON THE NATURAL ENVIRONMENT,
Academia Sinica, Beijing (China). Inst. of Geography.
L. Changming, and Z. Dekang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 169-179, 2 ref.

Descriptors: *Water transfer, *Water use, *Environmental effects, *China, Diversion, Canals, Water supply, Water supply development, Natural resources.

Several potential impacts of the south-north water transfer project in China are discussed. Impacts on the natural environment are emphasized for the water exporting region, the transfer region, and the water importing region. Protection of water resources by controlling the amount of water diverted, enacting laws to protect water quality during transfer, and lining canals to minimize seepage loss, are outlined. Similarly, steps to assure the protection of soil resources as well as aquatic and mineral resources are discussed. (Halterman - PTT)
W86-03930

CHANG JIANG DIVERSION PROJECT: AN OVERVIEW OF ECONOMIC AND ENVIRONMENTAL ISSUES,
International Food Policy Research Inst., Washington, DC.
For primary bibliographic entry see Field 6D.
W86-03932

WATER BALANCE IN THE WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6D.
W86-03933

PROBLEM OF WATER SUPPLY IN THE HAI-LUAN PLAIN,
Academia Sinica, Beijing (China).
For primary bibliographic entry see Field 6D.
W86-03940

EFFECT OF SOUTH-TO-NORTH WATER TRANSFER ON SALTWATER INSTRUSION IN THE CHANG JIANG ESTUARY,
S. Huanting, M. Zhichang, G. Guochuan, and X. Pengling.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 351-359, 1 fig, 1 tab.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *China, Canals, Irrigation, Economic aspects, Environmental effects, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the patterns of saltwater intrusion into the Chang Jiang are explored, and possible impacts are estimated. If water is transferred at the rate of 1,000 cu m per second, saltwater intrusion will definitely be worsened in the Chang Jiang estuary, primarily in the dry season. This will alter the environment of fishery resources. The interbasin transfer of water closely affects both the importing and exporting basins. Water sources in north China must be considered, so the water needs from outside can be estimated. The south-north water transfer must be joined with the drawing up of comprehensive long-term plans for the Huang He and Chang Jiang basins. (Halterman - PTT)
W86-03943

POSSIBLE EFFECTS OF THE PROPOSED EASTERN TRANSFER ROUTE ON THE FISH STOCK OF THE PRINCIPAL WATER BODIES ALONG THE COURSE,

Wuhan Inst. of Hydrobiology (China).
Y. Xuefang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 373-388, 1 fig, 6 tab, 3 ref, 1 append.

Descriptors: *Water transfer, *Environmental effects, *Fish, *Fisheries, *Water supply development, *China, Diversion, Irrigation.

As part of the assessment of the proposed east route of the south-north water transfer in eastern China, the influence on fish stock of the water bodies along the route were studied. The general condition of the principal water bodies along the route is discussed. The relation between the runoff in the Chang Jiang and the fish stock in the lower reaches and the estuary are outlined. The fish in the estuary and offshore waters are described, with emphasis on migratory fish. The effects of pumping stations on the fish are discussed, and the changes in the biocommunity of the transit lakes after the transfer of water are projected. In general, the project is expected to have an adverse effect on several aspects of the fisheries involved. (Halterman - PTT)
W86-03945

EFFECT OF DIVERTING WATER FROM SOUTH TO NORTH ON THE ECOSYSTEM OF THE HUANG-HUAI-HAI PLAIN,

Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science.
Z. Shouquanm, W. Zunqin, and H. Yi.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 389-394, 5 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *Environmental effects, *China, Irrigation, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the potential impacts on the environment of the Huang-Huai-Hai plain are discussed. Following a presentation of background information, on the characteristics of plains, several potential effects are outlined. Examples of impacts are: altered water-salt balance, interference with existing drainage systems, altered flood control and drainage systems, and altered cropping structure. Several recommendations for improving the ecology of the plain increasing the effectiveness of the project, are outlined, including thorough scientific study prior to construction, and sound and scientific management of the program once it is built. (Halterman - PTT)
W86-03946

LARGE SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL EXPERIENCES.

United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6E.
W86-03948

PARTIAL SOUTHWARD DIVERSION OF NORTHERN AND SIBERIAN RIVERS,

G. V. Voropaev, and A. L. Velikanov.
IN: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 67-83, 4 fig.

Descriptors: *Planning, *Environmental effects, Water transfer, Interbasin transfer, Diversion, Rivers, Reservoirs, Social aspects, Russia, Economic aspects, Water supply development, Irrigation, Water conservation, Volga River, Climatology, Caspian Sea, Azov Sea, Fish, Salinity, Siberia, Water level, Water management.

The uneven distribution of the Soviet Union's vast water resources (84% concentrated in Siberia) led to two water transfer projects initiated about 20 years ago: (1) partial redistribution of water from northern European part of the country to the Caspian Sea basin and (2) partial diversion of Siberian rivers to the Urals and several sections in Asiatic part of the country. Details of the research on these diversions are used to illustrate the planning used for diversion projects. For the Volga River diversion from northern rivers, engineering study results recommended an annual diversion of 19-20 cu km by the year 2000, in three stages. Among the probable decreased streamflow, increased water temperature, drainage of swampy areas, increase in eutrophication, better flood control, disruption of fish migration and navigation. Fish production would be enhanced in some locations and adversely affected in others. In the Caspian Sea region receiving the water transfer would help to stabilize the dropping Caspian Sea levels. The Siberian rivers diversion involves 25-27 cu km of water annually. The region of the water source would show lower summer water temperatures, poorer water quality in winter, little alteration in sea water quality or climate, drainage of some existing swamps and formation of swamps in other areas, loss of fodder, and reduction in fish spawning area and in fish production. Social and economic aspects of both diversions are considered. (Cassar - PTT)
W86-03952

JONGLEI CANAL: A CONSERVATION PROJECT OF THE NILE,

Associated Consultants, Khartoum (Sudan).
Y. A. Mageed.
In: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 85-101, 6 fig, 5 ref.

Descriptors: *Planning, *Environmental effects, Water transfer, Interbasin transfer, Diversion, Rivers, Canals, Social aspects, Economic aspects, Water supply development, Livestock, Jonglei Canal, Sudan, Fish, Swamps, Drainage, Wildlife, Migration, Nile River, Water management.

The Jonglei Canal, Sudan, is designed to reduce Nile River water losses by diverting 20 million cu m/day of water from the river at Bor through a 360 km canal to the mouth of the River Sobat, bypassing the swamps, where evaporation losses are considerable. The environmental, economic, and social impacts of the canal were studied. It is believed that no climatic changes will be perceived. The natural variation in the swamp area is greater than the changes induced by the canal. In unusually dry years, the water withdrawals can be regulated so that swamps with their associated wildlife and beneficial uses are preserved. The traditional movements of tribes and their livestock have been considered in planning the alignment of the canal to minimize disruption of traditional land use patterns. Ferries and bridges will also be provided to facilitate crossing. Canal modification facilitates swimming by livestock and wildlife. Livestock grazing will be enhanced by both the permanent water source provided by the canal and the addition of drained swamp to the pasture area. However, migration and movement of some wildlife, notably the migratory tiang, will be curtailed. Important economic benefits include improved travel by canal and bank road, a permanent water supply, and the year-round availability of fish. (Cassar - PTT)
W86-03953

RIVER BASIN DEVELOPMENT: PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON RIVER BASIN DEVELOPMENT.

United Nations Development Programme.
For primary bibliographic entry see Field 6E.
W86-03957

INTEGRATED DEVELOPMENT OF THE DELTA AND UPLAND PORTIONS OF A RIVER BASIN,

For primary bibliographic entry see Field 6E.
W86-03960

MODEL OF THE AQUIFERS IN THE LLOBREGAT DELTA (CATALONIA, SPAIN),

Curso International de Hidrolgia Subterranea, Barcelona (Spain).
For primary bibliographic entry see Field 2F.
W86-03976

MODELING OF THE SUBSIDENCE OF VENICE,

Centro di Ricerca IBM di Venezia (Italy).
G. Gambolati, P. Gatto, and R. A. Freeze.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 143-150, 6 fig, 2 tab, 4 ref.

Descriptors: *Environmental effects, *Groundwater, *Subsidence, *Model studies, Venice, Italy.

A model was used to study the effects of several groundwater pumping schemes on the subsidence of Venice, Italy, which lies at an elevation of 0.5 to 1.5 m above sea level. Since the pumping rate has been reduced by 60% as of the end of 1976, subsidence has probably been arrested. Total subsidence increased from zero in 1930 to a high of 12.5 cm in 1970, then leveled off at 11 cm, where it is predicted to remain until 2000. (Cassar - PTT)
W86-03987

MODELING OF GROUND-WATER HYDROLOGY IN THE HOUSTON DISTRICT, TEXAS,

Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W86-03989

MULTIPLE COMPLETION MONITOR WELLS,

McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 4B.
W86-04207

ASSESSING POPULATION EFFECTS FROM ENTRAINMENT OF FISH AT A LARGE VOLUME WATER INTAKE,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 8I.
W86-04383

CHANNEL FORM AND STREAM ECOSYSTEM MODELS,

Arkansas Univ., Fayetteville. Dept. of Zoology.
P. P. Brussock, A. V. Brown, and J. C. Dixon.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 859-866, October 1985. 2 fig, 48 ref. NSF ISP 8011447.

Descriptors: *Aquatic habitats, *Bottom sediments, *Channel morphology, Sand, Lithology, Runoff, Geomorphology, Lotic environment, Stream Classification, Ecosystems.

A system is proposed to classify running water habitats based on their channel form, which can be considered from three different sedimentological settings: a cobble and boulder bed channel, a gravel bed channel, or a sand bed channel. Three physical factors (relief, lithology, and runoff) were selected as state factors that control all other interacting parameters associated with channel form. When these factors are integrated across the conterminous United States, seven distinct stream regions are evident, each representing a most probable succession of channel forms downstream from the headwaters to the mouth. Coupling these different channel profiles with typical biotic community structures associated with each of the channel types should result in considerable refinement of the applicability of the River Continuum Concept and other holistic ecosystem models by realizing the nonrandomness of the effects of geomorphology on stream ecosystems. This regional perspective of streams should serve to make persons concerned with water resources more aware of the geographical considerations that affect their study areas. (Rochester-PTT)
W86-04537

EVALUATING A CUMULATIVE IMPACT ASSESSMENT APPROACH,

Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
C. K. Contant, and L. Ortolano.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1313-1318, September 1985. 2 tab, 18 ref.

Descriptors: *Impact assessment, *Cumulative impacts, *Project planning, Corps of Engineers, San Francisco, Monitoring, Statistical analysis, permits.

A new procedure was formulated to predict and monitor the cumulative impacts of projects requiring Corps of Engineers permits. To evaluate the effectiveness of this new assessment approach, hypotheses describing relationships between an independent variable, use of the cumulative impact approach, and nine dependent variables were developed. A quasi-experiment, in which the cumulative impact assessment approach was the treatment, was conducted to determine how the approach influenced the permit review process. The evaluation procedure was applied to the test implementation of the cumulative impact assessment approach at the San Francisco District. The primary weakness of this application of the quasi-experimental evaluation procedure was that statistical arguments about the effectiveness of the new assessment approach could not be made due to limited data. Another limitation was that application of the quasi-experimental design in only one study area does not allow direct generalization to other locations. The principal strength of this research is the quasi-experimental design, which provides a clear, systematic structure for collecting and evaluating information on the effectiveness of any cumulative impact assessment technique. (Rochester-PTT)
W86-04539

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. I. IMPLEMENTATION AND EFFECTIVENESS,

Washington Univ., Seattle. Dept. of Civil Engineering.
J. S. Richey, B. W. Mar, and R. R. Horner.
Journal of Environmental Management JEVMA, Vol. 21, No. 2, p 135-146, September 1985. 2 fig, 9 ref. EPR1 Project RP-1729-1.

Descriptors: *Project planning, *Delphi technique, *Monitoring, *Decision making, *Questionnaires, *Management planning, Evaluation, Design criteria, Water resources development, Future planning, Ecological effects, Environmental effects.

The effectiveness with which a panel of experts, operating within the context of a Delphi technique, could be used to develop data for use in environmental monitoring program design and environmental decision-making was studied. The Delphi technique was evaluated to determine selection criteria for an expert panel, how many panelists are needed, what types of data can be considered effectively, and how many iterations are necessary. The selection criteria used to choose a panel of professionals involved in the field of electrical utility monitoring to participate in the Delphi technique are outlined. Small panels consisting of <10 individuals representing a variety of areas of experience appeared sufficient for developing information about conceptual or philosophical issues. Neither large nor small panels were effective for considering factual or data-based issues. Two iterations (initial questionnaire with one follow-up) were adequate to determine the panel consensus. The costs of implementing the Delphi technique were 10 to 60% of those of retaining a panel of experts or the nominal group technique. (Geiger-PTT)
W86-04596

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. II. CONSENSUS ON CRITICAL ISSUES IN ENVIRONMENTAL MONITORING PROGRAM DESIGN,

Washington Univ., Seattle. Dept. of Civil Engineering.
J. S. Richey, R. R. Horner, and B. W. Mar.
Journal of Environmental Management JEVMA, Vol. 21, No. 2, p 147-159, September 1985. 1 tab, 14 ref. EPR1 Project RP-1729-1.

Descriptors: *Project planning, *Monitoring, *Delphi technique, *Environmental effects, *Electric powerplants, Evaluation, Decision making, Questionnaires, Design criteria, Water resources development, Future planning, Ecological effects, Management planning.

In many complex environmental assessment tasks, the utilization of expert opinion is necessary when quantitative information is inadequate and when the cost of obtaining new knowledge is too expensive or too time consuming. The consensus of a panel of experts on a number of critical issues relating to the design of environmental monitoring programs is presented. Included in the set of issues studied are the general structure and content of environmental monitoring program, the major causes and effects of changes brought about by thermal electric powerplants on aquatic environments, the protocol for defining hypotheses to test, and estimates of natural variability and sampling errors associated with tests of specific hypotheses in an aquatic environment. Consensus opinions for these issues developed from a Delphi process used with a panel of 62 experts provide a point of departure for future design of environmental monitoring programs. As a result of the scoring system used in the Delphi questionnaire, importance rankings for the various criteria of the monitoring program were also identified. (Geiger-PTT)
W86-04597

7. RESOURCES DATA

7A. Network Design

METHODS OF HYDROLOGICAL COMPUTATIONS FOR WATER PROJECTS.

United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
UNESCO: Paris, France, 1982. Edited by B. S. Eichert, J. Kindler, G. A. Schultz and A. A. Sokolov. 122 p, 6 tab, 331 ref.

Descriptors: *Data collections, *Hydrology, *Model studies, *Planning, *Water resources development, Surface water, Hydrologic models, Meteorologic data collections, Hydrologic data collections, Sediment, Statistical analysis, Mathematics, Regional planning, Flow, Reservoirs, Flood control, Hydroelectric power, Multipurpose reservoirs, Water storage, Storage, Data interpretation, Frequency analysis, Design floods, Wind, Wave action, Environmental effects, Computer programs.

This guidebook for surface water hydrologic computations is directed to engineers and hydrologists planning water resources projects. Details of the computations are not included; the user is referred to information in other publications. The basic steps in water resources development are planning, design, construction, and operations. An overview of hydrological computations presents background information on hydrologic and meteorological data and its processing. Hydrological techniques are introduced. These include regional analysis for generation of missing data, reestablishment of natural flows, analysis of flow variability, and hydrologic modeling. Methods are given for estimating: (1) reservoir projects (general and reservoirs with flood control storage, hydroelectric power storage, conservation storage, multipurpose use, mixes of reservoirs), (2) nonreservoir projects (flood control, water quality control, irrigation, drainage, water supply, navigation, and recreation), and (3) basin-wide long-term planning of integrated water resource development. The many techniques available for water projects are classified into several broad categories: regional analysis of data, natural flows, annual flow variability and intra-annual flow distribution, extreme-discharge and stage frequency curves, design floods, freeboard requirements for wind and wave action, water surface profiles, reservoir storage requirements, reservoir operation, and the effects of projects on flow, evaporation, sediment movement, groundwater, and environmental quality. (Caesar - PTT)
W86-04000

SOME CONCEPTS PERTAINING TO INVESTIGATIVE METHODOLOGY FOR SUBSURFACE PROCESS RESEARCH,

Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W86-04086

MONITORING STATISTICS,

National Research Council, Washington, DC.
For primary bibliographic entry see Field 5A.
W86-04137

CHEMICAL CONTAMINATION OF WATER SUPPLIES,

North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5C.
W86-04147

MEASUREMENT, SCALE, AND SCALING,

Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. H. Cushman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 129-134, February 1986. 1 fig, 21 ref.

Descriptors: *Measuring instruments, *Theoretical analysis, *Theoretical values, Heterogeneity, Laboratory equipment, Variability, Measured values, Computed values.

The relationships between measurement, scale, and scaling are discussed and analyzed in detail. It is pointed out that only certain fundamental properties can be measured and that these properties do not include constitutive variables. the interrelationships between scale and measurement are shown to manifest themselves in two types of heterogeneity which we label as explicit and implicit. An important issue that is addressed for the first time is the necessity of scaling instruments when scaling laboratory experiments up to field scale or vice versa. Explicit constraints that scaled instruments must satisfy are derived for the frequency response of the instrument. It is shown that linear interpolators can be reviewed as filters (instruments), but that these interpolators don't preserve the scale constraints of the instrument used in making the field measurements. The relationship between signal conditioning and the instrument's window is isolated and shown to be a multiple convolution over the spatial coordinates (corresponding to the

window) followed by a temporal convolution for the signal conditioning. (Author's abstract)
W86-04167

OPTIMIZATION OF A SNOW NETWORK BY MULTIVARIATE STATISTICAL ANALYSIS,

Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
For primary bibliographic entry see Field 2C.
W86-04395

SOME CONSIDERATIONS OF ENHANCED WATER QUALITY MONITORING IN THE NORTHWEST TERRITORIES: AN INLAND WATERS DIRECTORATE PERSPECTIVE,

Inland Waters Directorate, Yellowknife (Northwest Territories).
For primary bibliographic entry see Field 5G.
W86-04489

GROUNDWATER MONITORING WITHIN AN AQUIFER - A PROTOCOL,

Albuquerque Environmental Health and Energy Dept., NM.
For primary bibliographic entry see Field 5G.
W86-04611

SHALLOW SEISMIC REFRACTION SURVEY OF NEAR-SURFACE GROUND WATER FLOW,

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W86-04658

7B. Data Acquisition

GROUNDWATER POLLUTION IN NORTHWEST ARKANSAS,

Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04074

DIELECTRIC PROPERTIES OF SATURATED SOILS,

Oklahoma State Univ., Stillwater. Dept. of Physics.
For primary bibliographic entry see Field 2G.
W86-04087

ADAPTATION OF THE CARTER-TRACY WATER INFLUX CALCULATION TO GROUNDWATER FLOW SIMULATION,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W86-04206

TRANSIOMETER: AN ALTERNATIVE METHOD OF SOIL MOISTURE MEASUREMENT IN SLOWLY PERMEABLE SOILS,

Science and Education Administration, Fort Collins, CO. Agricultural Research.
For primary bibliographic entry see Field 2G.
W86-04216

ELECTRONIC SENSING DEVICES USED FOR IN SITU GROUND WATER MONITORING,

Woodward-Clyde Consultants, Overland Park, KS.
J. D. Ritchey.
Ground Water Monitoring Review, Vol. 6, No. 2, p 108-113, Spring 1986. 3 fig, 3 tab, 24 ref.

Descriptors: *Electronic equipment, *Sensors, *Groundwater monitoring, Computers, Water quality, Monitoring, Temperature, Measuring instruments, Hydrogen ion concentration, Conductance, Dissolved oxygen, Data acquisition, Data storage.

Progress in the field of electronics and computers has produced data acquisition equipment beneficial to groundwater field studies. This equipment controls data collection from sensing devices and saves the data for later processing. There are many types of sensors available for in situ use in water quality monitoring wells, observations wells, and water supply wells. Sensors are separated into two groups, those used to measure water levels and those used to measure water quality parameters. There are three major types of sensors for measuring water levels. They are floats, transducers and acoustic devices. Most types have proven accuracy and can be successfully applied to short-term monitoring and long-term field studies. They are most cost-effective when augmented with the programmability of computers. Sensors to measure water quality include those that measure temperature, pH, specific conductance, dissolved oxygen and specific ions. A potential use of water quality sensors for in situ investigations is to aid in surveillance monitoring to indicate the arrival of contaminants at the earliest possible moment. This has a narrow limit of practicality at this time because of problems associated with sensor accuracy. (Lantz-PTT)
W86-04217

FM RADIOTELEMETRY COUPLED WITH SONIC TRANSDUCERS FOR REMOTE MONITORING OF WATER LEVELS IN DEEP AQUIFERS,

Corps of Engineers, Winchester, VA. Middle East Div.
J. W. Alderman.
Ground Water Monitoring Review, Vol. 6, No. 2, p 114- 116, Spring 1986.

Descriptors: *Radiotelemetry, *Sonic transducers, *Remote sensing, *Aquifers, Water levels, Monitoring, Observation wells, Temperature effects.

Instrumentation specialists at Waterways Experiment Station, Vicksburg, Mississippi, were tasked with providing a complete system for monitoring the piezometric surface in five observation wells. The design criteria, which was provided, was complex and included several major factors. These included: (1) The well owners were not technically oriented and needed a simple system requiring little effort in physically collecting or reducing the data to a usable form for the well field management; (2) The geographical spread of the observation wells; (3) There was no electrical transmission provided to any observation well, thus requiring an alternative power source; (4) The surface temperature in the well field area varies from more than 50 C in the summer to a -4 C in the winter; and, (5) The depth to the water surface. Although the observation wells varied in depth from 300 m to 1,600 m, the piezometric surfaces fell within a range of depths from 108 m to 146 m affected by artesian pressures in four of the five wells. The system that was ultimately installed at each well included two shoe box-sized units, which were actually placed within the well casing and suspended 2 m below the ground surface. The system developed, monitors changes exceeding 15 m in fluid levels to a high degree of accuracy and repeatability along with the capability of easily resetting the sensor to a different depth if the range of levels changes. The power supply for this system is a 12 VAC gel-cell battery. The battery box contains a trickle charger regulating the flow of current from the solar photoelectric cell. The FM receiver not only receives the data signal but prepares the signal for the computer printer by formatting the data. The data received from each transmitter includes a four-digit data number for the depth of elevation, the code number of each transmitter, and the consistency code number. This FM telemetry system performed with a degree of sensitivity and reliability far better than expected. Field assembly and operation were proven to be uncomplicated. The range of potential uses run from monitoring liquid levels in storage tanks to checking tidal fluctuations among remote stretches of coastline to observing water levels in multiple wells during elaborate pumping tests. Any need for frequent monitoring of liquid levels at remote sites with difficult access. (Lantz-PTT)
W86-04218

FIELD TERMINAL FOR COLLECTION AND ANALYSIS OF GEOLOGICAL AND HYDROGEOLOGICAL DATA,

BAT Envitech, Inc., Long Beach, CA.
A. M. Petsonk.
Ground Water Monitoring Review, Vol. 6, No. 2, p 130-134, Spring 1986. 7 fig, 1 tab, 3 ref. Swedish Council for Building Research Project No. 840895-3 and NSBTD Project No. 83-5657.

Descriptors: *Field tests, *Data acquisition, *Data interpretation, *Computers, Geohydrology, Terminals, Hydraulic conductivity, Soil profiles, Soil porosity, Water networks, Case studies.

Having immediate, automated field access to data gathered during geological and hydrogeological investigations can be crucial to definition of the scope and direction of test procedures, as well as to the interpretability of results. A portable, briefcase-sized data collection and analysis instrument has therefore recently been developed, capable of operating as a stand-alone or operator-guided field unit. This terminal is pre-programmed for a number of standard applications. An operator's terminal and independent data collection microcontroller are the major components of this system. Data may be collected from any combination of four ports: an internal, programmable interval timer, a pulser (shaft encoder), and two 14-bit analog-to-digital (A/D) inputs. The latter are primarily used for pressure or resistance transducers. Reading of data may be triggered automatically by the timer and/or pulser, or be performed upon operator command. Many thousands of data points may be stored in the microcontroller, representing one or several tests of any type, intermixed. Via the operator's terminal, any subset of this stored data may be examined, erased, modified or analyzed. A 25-character LCD display and a four-color printer/plotter are used to record data and results of analyses. Data may also be transferred to an external computer for more extensive manipulation. Three examples of how this terminal may be used in the field in connection with site investigations are presented in this paper. They involve (a) measurement of saturated hydraulic conductivity, (b) determination of soil stratigraphy using pore pressure sounding, and (c) water network profiling. (Lantz-PTT)
W86-04221

MICRO COMPUTERS APPLIED TO GROUND WATER MONITORING AND TESTING,

Dames and Moore, Baldwinsville, NY.
For primary bibliographic entry see Field 2F.
W86-04222

SELECTING AND APPLYING MAGNETIC FLOWMETERING SYSTEMS,

Fischer and Porter, Co., Warminster, PA.
For primary bibliographic entry see Field 8C.
W86-04297

MONITORING CHANGES IN TOTAL AND UNFROZEN WATER CONTENT IN SEASONALLY FROZEN SOIL USING TIME DOMAIN REFLECTOMETRY AND NEUTRON MODERATION TECHNIQUES,

Department of Agriculture, Ottawa (Ontario).
For primary bibliographic entry see Field 2G.
W86-04305

PARAMETER ESTIMATION FOR A MODEL OF SPACE-TIME RAINFALL,

Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 2B.
W86-04321

NEW APPROACH FOR INSTANTANEOUS RAIN AREA DELINEATION IN THE MIDLATITUDES USING GOES DATA,

Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W86-04325

IDENTIFYING HYDRAULICALLY CONDUCTIVE FRACTURES WITH A SLOW- VELOCITY BOREHOLE FLOWMETER,

Geological Survey, Denver, CO. Water Resources Div.
A. E. Hess.
Canadian Geotechnical Journal CGJOAH, Vol. 23, No. 1, p 69-78, February 1986. 15 fig 18 ref.

Descriptors: *Borehole flowmeter, *Heat-pulse flowmeter, *Borehole geophysics, *Flow measurement, Low flow, Tag-trace principle, Granitic rock, Manitoba, Canada.

The U.S. Geographical Survey used a recently developed heat-pulse flowmeter to measure very slow borehole axial water velocities in granite rock at a site near Lac du Bonnet, Manitoba, Canada. The flowmeter was used with other geophysical measurements to locate and identify hydraulically conducting fractures contributing to very slow vertical water flow in the two boreholes selected for study. The heat-pulse flowmeter has no moving parts and operates on a tag-trace principle. It is an improved version of the flowmeter developed by the Water Research Centre in England in 1975. The U.S. Geological Survey's heat-pulse flowmeter has a flow measuring range in water of 0.06-6 m/min, and can resolve velocity differences as slow as 0.01 m/min. This is an order of magnitude slower than the stall speed of spinner flowmeters. The flowmeter is 1.16 m long and 44 mm in diameter. It was calibrated in columns of 76 and 152 mm diameter, to correspond to the boreholes studied. The heat-pulse flowmeter system is evaluated and problems peculiar to the measurement of very slow axial water velocities in boreholes are discussed. (Author's Abstract)
W86-04337

IMPROVED ROTATING CYLINDER TECHNIQUE FOR QUANTITATIVE MEASUREMENTS OF THE SCOUR RESISTANCE OF CLAYS,

Ecole Polytechnique, Montreal (Quebec).
R. P. Chapuis, and T. Gatien.
Canadian Geotechnical Journal CGJOAH, Vol. 23, No. 1, p 83-87, February 1986. 4 fig, 16 ref.

Descriptors: *Clays, *Soil erosion, *Scour resistance, *Physical chemistry, Shear stress, River channels, Water quality, Measuring instruments, Erosion.

The methods developed to predict the action of eroding fluid on cohesive soils lead to contradictory positions. Most of them are questionable since they ignore the physicochemical parameters that seem to control the erosion process. In order to study the scour resistance of intact of remolded cohesive soils, a rotating cylinder technique allowing for the control of essential parameters was recently approved. Intact or remolded samples can be used. The water quality is controlled in order to respect the in situ physicochemical conditions. The shear stress transmitted by water to the clay surface is directly and accurately derived. The dry weight of eroded material per unit time and unit area, for given conditions, is also directly and adequately measured. The influence of water quality, or of any treatment of the clay, may be quantitatively analyzed. (Author's Abstract)
W86-04338

INSTRUMENTS AND METHODS. FIELD PH DETERMINATIONS IN GLACIAL MELT WATERS,

Manchester Univ. (England). Dept. of Geography.
R. C. Metcalf.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 106-111, 1984. 5 fig.

Descriptors: *Laboratory equipment, *Melt waters, *Glaciers, *Hydrogen ion concentrations, Field tests, Sample preparation, Sample preservation.

Early glacial melt-water pH work was conducted in laboratories months after samples had been collected. Earlier work has shown that major solute changes can occur during such storage, and it has been suggested that summer melt waters can be greatly undersaturated with respect to atmospheric CO2, and that laboratory pH values can change significantly from in situ measurements for the same water sample. This study was undertaken to discover the cause of the cited discrepancies between laboratory and field measurements, and to develop a reliable field method for routine determination of pH in glacial melt waters, using commonly available equipment. A method is presented which enables field pH measurements that are reproducible within + or - 0.04 pH units to be made in glacial melt waters, using commonly available digital pH meters with combination electrodes. During initial spring snow melt in May 1981 at Gornergletscher. Switzerland, melt waters in the proglacial stream leaving the glacier terminus were oversaturated with respect to atmospheric p CO2, and rapidly increased pH during CO2 outgassing at in situ temperature and pressure. Summer ice melt from glaciers which are temperate in the ablation zone are usually undersaturated by about ten times with respect to atmospheric p CO2, and rapidly lower their pH values to achieve equilibrium upon encountering the atmosphere, as observed at Gornergletscher during July and August 1981. Gornergletscher summer proglacial stream waters, sometimes show pH increases from rock weathering, with the rate limited by the transfer rate of CO2 across the air-water interface to drive the weathering reactions. Throughout the year, any water parcel at equilibrium with atmospheric CO2 is generally at an equilibrium pH value, if filtration prohibits solute enrichment. For these reasons, laboratory pH measurements are unacceptable for quantitative studies of melt-water chemistry and should be discontinued. (Lantz-PTT)
W86-04355

SOIL WATER SAMPLERS IN ION BALANCE STUDIES ON ACIDIC FOREST SOILS,

Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
L. Rasmussen, P. Joergensen, and S. Kruse.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 563-570, April 1986. 2 fig, 1 tab, 6 ref.

Descriptors: *Soil water, *Water sampling, *Lysimeters, *Acidic soils, *Soil water suction, *Aeration zone, Percolation, Field tests, Sorption.

Sorption characteristics of different types of soil water samplers (lysimeters) were examined under acidic soil conditions, both by installation in the field and by laboratory experiments, and a new method is introduced for current and constant soil water sampling under varying soil suctions in the unsaturated zone. As expected, during late spring and summer, increased mineralization resulted in increased elemental concentrations in the soil water; this was particularly apparent with percolation lysimeters. Although Al decreased during the summer with the porcelain cup lysimeter, other elements increased unexpectedly during summer (increases: Ca, 20%; Mg, 60%; Mn, 220%; Na, 30%; Ni, 30%; and Zn, 90%). Laboratory experiments established that by passage of the ceramic cup both soil leachates and blanks were enriched with considerable amounts of most applicable under all conditions. Percolation lysimeters also seem to work under all conditions. Although teflon disc lysimeters are not suited for soils with low clay content, they have the advantage of no important elemental adsorption enrichment of soil solutions, whereas the ceramic cup lysimeter should not be used at all in ion budget studies of acidic soils. (Rochester-PTT)
W86-04364

FLAVOR PROFILE ANALYSIS: TASTE AND ODOR CONTROL OF THE FUTURE,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5F.
W86-04370

CASE STUDY OF GEOSMIN IN PHILADELPHIA'S WATER,

Philadelphia Water Dept., PA.
For primary bibliographic entry see Field 5F.
W86-04371

CHEMISTRY AND PHYSIOLOGY OF ODOR SENSITIVITY,

Agricultural Research Service, Albany, CA. Western Regional Research Center
For primary bibliographic entry see Field 5F.
W86-04373

EARLY WARNING SYSTEM FOR TASTE AND ODOR CONTROL,

Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W86-04374

PERFORMANCE TESTS FOR THE MEASUREMENT OF PH WITH GLASS ELECTRODES IN LOW IONIC STRENGTH SOLUTIONS INCLUDING NATURAL WATERS,

Freshwater Biological Association, Ambleside (England).
W. Davison, and C. Woof.
Analytical Chemistry, Vol. 57, No. 13, p 2567-2570, November 1985. 3 tab, 20 ref.

Descriptors: *Measuring instruments, *Hydrogen ion concentration, *Glass electrodes, *Natural waters, Ion selective electrodes, Saline buffers, Electrodes, Acids.

Use of normal electrodes and established procedures for the measurement of the pH of low ionic strength freshwaters does not guarantee the accuracy. The prime source of error is associated with the liquid junction of the reference electrode. The performance of different commercial reference electrodes, used to measure pH of low ionic strength natural waters, has been tested against a renewable free diffusion junction. Comparative measurements on synthetic solutions were partially successful in predicting performance. Errors determined in dilute buffers, dilute acids, and distilled water were similar to those observed in natural waters, but the response in NBS buffers failed to reveal any problems. Poor electrodes depressed the pH from its true value, more so in stirred rather than quiescent solutions. The shift in pH upon stirring was largest for the worst electrodes in the most dilute solutions. Better electrodes were characterized by high flow rates of internal filling solution through the junction. As no one test could guarantee electrode performance, the adoption of a standard reference procedure to test electrodes was recommended. (Lantz-PTT)
W86-04451

GEOPHYSICAL TECHNIQUES TO DELINEATE SATURATED ALLUVIAL ZONES FOR THE SITING OF HVDC POWER TRANSMISSION RETURN ELECTRODES,

Ertec Western, Inc., Long Beach, CA.
For primary bibliographic entry see Field 2F.
W86-04471

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,

Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry, and R. J. Hart.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 70-73, Fall 1985. 8.

Descriptors: *Observation wells, *Hazardous waste sites, *Hollow-stem auger, Groundwater protection, Groundwater pollution, Aquifers, Boreholes.

Twelve observation wells were installed at 3 hazardous waste sites in Kansas, using procedures to prevent contamination. Utmost care was taken to ensure that samples obtained from the wells were representative of the groundwater within the aquifer. This was accomplished by: (1) keeping the hollow-stem auger bit and flights clean, (2) clean-

ing the well casing and screen thoroughly before installation, (3) allowing only the formation of water to enter the hollow-stem auger, (4) preventing any surface material or borehole cuttings from falling into the well casing, and (5) allowing the saturated sand to collapse around the well screen and casing while withdrawing the auger. Because the use of water during well installation could contaminate the aquifer or dilute contaminants already present in the aquifer, two methods of well installation that did not introduce outside water to the borehole were used. The first method involved using a slotted 3/4-inch coupling that was attached to the bit plate of the hollow-stem auger, allowing formation water to enter the auger, thereby preventing sand-plug formation. This method proved to be adequate, except when drilling through clay layers, which tended to clog the slotted coupling. The second method involved screened well swab that allowed only formation water to enter the hollow-stem auger and prevented sand from plugging the hollow-stem auger when the bit plate was removed. (Lantz-PTT)
W86-04474

BIOLOGICAL ACCUMULATION AND MONITORING OF CHEMICAL WASTES IN ARCTIC WATERS,

Solway Marine Investigations, Maryport (England).
For primary bibliographic entry see Field 5B.
W86-04475

ANALYSES OF WELL-AQUIFER RESPONSE TO A SLUG TEST,

Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-04541

USE OF ENHANCED LANDSAT IMAGERY FOR MAPPING LAKE DEPTH,

Winnipeg Univ. (Manitoba). Dept. of Geography.
S. Hathout.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 253-261, April 1985. 4 fig, 2 tab, 10 ref.

Descriptors: *Satellite technology, *Mapping, *Lake morphology, Bathymetry, Remote sensing, Water depth, Vegetation, Clear Water Lake, Moose Lake, Cormorant Lake, Manitoba.

The image enhancement technique using a density slicer was applied in a preliminary investigation to map the water depth in three lakes in Northern Manitoba, namely Clear Water Lake, MooseLake and Cormorant Lake. Through the use of various combinations of color densities at a scale of 1:250,000 of Landsat imagery bands 5 and 7, it was possible to discriminate between various water depths from band 5 and to delineate shoreline, emergent vegetation and wind currents from band 7. The best interpretations of general color-enhanced images were obtained by a combination of 32 levels of color density and various combinations of gamma densities. Less than 32 level densities resulted in either fewer images or images with indistinct boundaries. The lake depths interpreted from the present study are very similar to those obtained from bathymetric maps of the three lakes. (Author's abstract)
W86-04603

DEDUCING THE MICROPHYSICAL CHARACTER OF PRECIPITATION FROM MULTIPLE-PARAMETER RADAR POLARIZATION MEASUREMENTS,

Applied Research Corp., Landover, MD.
For primary bibliographic entry see Field 2B.
W86-04625

AIRBORNE DOPPLER RADAR OBSERVATIONS OF A CONVECTIVE STORM,

National Severe Storms Lab., Norman, OK.
For primary bibliographic entry see Field 2B.
W86-04633

RETRIEVAL OF PRECIPITABLE WATER FROM BHASKARA-II MICROWAVE MEASUREMENTS AND ITS COMPARISON WITH NOAA-7 AND RADIOSONDE DATA,

Indian Space Research Organization, Ahmedabad. Space Applications Centre.
R. M. Gairola, B. S. Gohil, and P. C. Pandey.
Remote Sensing of the Environment RSEEA7, Vol. 18, No. 2, p 125-135, October 1985. 5 fig, 3 tab, 16 ref.

Descriptors: *Radiosonde, *Water vapor, *Microwaves, *Satellite technology, *Remote sensing, Bhaskara-II, NOAA-7, Cloud liquid water, Wind velocity, Mathematical analysis, Regression analysis, Statistical analysis.

The Satellite Microwave Radiometer (SAMIR-II) on board the second Indian remote sensing satellite, Bhaskara-II, measured microwave radiation at 19.35, 22.235, and 31.4 GHz. These measurements are primarily influenced by water vapor, cloud liquid water, and wind speed. The effect of collinearity among SAMIR-II channels has been examined to determine the effectiveness of a two- or three-channel subset for retrieving precipitable water (PW). The analysis indicated a decreasing correlation coefficient value from 0.87 to 0.65 with increasing frequency separation due to dynamical interdependence of meteorological variables on brightness temperature measurements. A correlation coefficient of 0.65 between two window channels, 19.35 and 31.4 GHz, is suggestive of using either of the two channels for water vapor retrieval. Performance of SAMIR-II channels has therefore been evaluated by retrieving (PW) using regression technique with all the three channels of SAMIR-II and its subset of the two channels, 19.35/22.235 and 22.235/31.4 GHz and comparing the results from NOAA-7 supplied PW and limited radiosonde derived PW. Comparison of PW derived from the regression models and NOAA-7 gave an rms difference of 0.7 to 1.0 g/sq cm. Retrievals of PW using 19.35 and 22.235 GHz channels and its comparison with near concurrent coastal radiosonde observations gave an rms difference of 0.32 gsq cm, comparable to the accuracy (0.2-0.4 g/sq cm) obtained from previous satellite-borne microwave radiometers. (Author's abstract)
W86-04653

PRACTICAL APPLICATION OF THEORETICAL MODELS TO MAGNETOMETER SURVEYS ON HAZARDOUS WASTE DISPOSAL SITES - A CASE HISTORY,

Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W86-04654

INTERPRETATION OF VLF RESISTIVITY DATA FOR GROUND WATER CONTAMINATION SURVEYS,

University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W86-04656

METHOD FOR SIMULTANEOUS IN SITU MEASUREMENT IN THE VADOSE ZONE OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY AND THE CONDUCTIVITY-PRESSURE HEAD RELATIONSHIP,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W86-04659

COMPARISON OF GAUZE SWABS AND MEMBRANE FILTERS FOR ISOLATION OF CAMPYLOBACTER SPP. FROM SURFACE WATER,

Nutrition Inst., Cairo (Egypt).
For primary bibliographic entry see Field 5A.
W86-04666

7C. Evaluation, Processing and Publication

INTERNATIONAL WATER STATISTICS - SOME CONCLUSIONS,

Wasserwerke Wien (Austria).
P. Suchomel.
Aqua AQUAAA, No. 1, p 14-18, 1986. 9 fig.

Descriptors: *Water Statistics, *Data interpretation, *Water use, *Available water, *Competing use, Spain, Italy, France, Norway, Industrial water, Domestic water, Statistical analysis, Information exchange.

The International Water Statistic Commission was formed in 1968 in order to compile comparable data of water supplies on an international level. After the definition of terms and the coordination of the manner of enquiries, a first ten-year report, 1968-1977, was published. The complete data of 10 countries of Western Europe is on hand. Only the available documentation from Spain, Italy, France and Norway is insufficient for a common presentation. By means of diagrams the development of the population, the water availability, the consumption and the types of water as well as the specific consumption figures, absolute and relative, are shown. A strong convergence of the various index numbers appears, whereby the high values stagnate and the low ones increase - the extreme values move closer together. The industrial consumption was strongly retrogressive in favor of the domestic consumption. The development of both tends into opposite directions. Besides these statistical observations, suggestions are made to complement the statistics in future by additional data. The creation of new statistical documentation brings better information, and opens doors to new problems areas. (Author's abstract)
W86-04150

PROGRAM TO CALCULATE AQUIFER TRANSMISSIVITY FROM SPECIFIC-CAPACITY DATA FOR PROGRAMMABLE CALCULATORS,

Geological Survey, Denver, CO. Nuclear Hydrology Program.
J. B. Czarnecki, and R. W. Craig.
Groundwater GRWAAP, Vol. 23, No. 5, p 667-672, September-October 1985. 2 fig, 6 tab, 6 ref.

Descriptors: *Computer Programs, *Aquifer Characteristics, *Transmissivity, Well Capacity, Storage Coefficient.

A program that will calculate aquifer transmissivity from the specific capacity of a well was developed for handheld programmable calculators. The program extends previous approaches which used the visual graphical interpolation of transmissivity values from type curves and solves directly a nonlinear equation for transmissivity, using a modified Regula Falsi solution algorithm. The program eliminates errors associated with visual interpolation of transmissivities obtained from type curves, especially for values of small transmissivities, and provides a quick and portable method of obtaining transmissivity values onsite. Results obtained with this technique are in good agreement with previously published results for both confined and unconfined aquifer-transmissivity determinations. (Author's abstract)
W86-04243

PERCENTILE ESTIMATION PROCEDURES FOR WATER QUALITY MANAGEMENT,

Water Research Centre, Swindon (England). Swindon Engineering Centre.
R. W. Crabtree, I. D. Cluckie, and C. F. Forster.
Effluent and Water Treatment Journal, Vol. 26, No. 2, p 46-50, February 1986. 3 fig, 4 tab, 16 ref. Serc Gr/B/87870.

Descriptors: *Probability distribution, *Effluent discharge data, *Parametric techniques, *Nonparametric techniques, Statistics, England, Water quality data, Rivers, United Kingdom, Percentile estimates.

Mathematical probability distribution fitting techniques were applied to 334 water quality data sets from a variety of rivers and effluent discharge in England. The results indicated that the 'best' estimate of the 95th percentile from a data set should be based upon probability distribution fitting. The three parametric distributions selected (normal, lognormal, and Pearson type 3) could only be fitted to half the data sets. The conclusion from this study is that each data set should be taken as being unique and should be analyzed individually with automatically using a particular technique or assuming a particular distribution. The estimate of the 95th percentile should be based on either the fitting of an appropriate parametric distribution or, if this is impossible, a non-parametric estimate should be used. It is invalid to make any assumptions about the distribution of any particular variable or sample type. The results of this study suggest that the two most commonly used methods used in the United Kingdom for water quality percentile estimation may not result in the best estimates of the 95th percentiles. (Rochester-PTT)
W86-04340

DIGITAL DISTRIBUTION SYSTEM RECORDS: A JOINT VENTURE,

North Surrey Water Co., Staines (England).
E. G. Moss, and R. H. Morgan.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol 40, No. 1, p 59-69, February 1986. 4 fig, 2 ref.

Descriptors: *Management planning, *Pipelines, *Digital computers, *Maps, *Networks, *Utilities, *Data storage and retrieval, England, Costs.

The digital records system developed jointly by Rickmansworth Water Company, North Surrey Water Company, and Inspectorate E.A.E., Ltd. (all in England) is described. Development, commissioning, digitizing procedures, applications, and costs and benefits of the system are described. Hardware in each system includes a Prime 2250 computer, with from 0.5 to 1.5 megabyte core and 68 megabyte or 226 megabyte hard disc storage, a digitizing work station, with a high resolution graphics terminal with light pen and detachable keyboard and a A0 sized digitizer, a video display unit, dot matrix printer and an A3 flat bed plotter and an A0 drum plotter. In addition to providing plans in various scales, this system was adapted to network analysis, and various types of information can be recorded, such as 'burst mains' incidents. The digital records approach involved an estimated initial capital cost of 70,000 British pounds, with maintenance of equipment costing 5,500 pounds per annum. The initial cost of digitizing the existing records was estimated at 30,000 pounds. (Rochester-PTT)
W86-04380

METHODS FOR VALIDATION OF PRECIPITATION PH: APPLICATIONS TO TEXAS DATA,

Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
For primary bibliographic entry see Field 5A.
W86-04389

EMPIRICAL EQUATIONS OF GROUNDWATER RECHARGE PATTERNS,

Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W86-04390

OPERATIONAL TESTING OF HYDROLOGICAL SIMULATION MODELS,

National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 13-24, March 1986. 1 fig, 10 ref.

Descriptors: *Testing procedures, *Hydrologic models, *Land use, *Simulation, *Climate, Geography, Mathematical models, Environmental changes.

A hierarchical scheme for the systematic testing of hydrological simulation models is proposed that ties the nature of the test to the difficulty of the model task. The testing is referred to as operational, since its merely to assess the performance of a model in situations as close as possible to those in which it is supposed to be used as practice; in other words, to assess its operational adequacy. The measure of the quality of performance is the degree of agreement between the simulation results and observations. Hence, the power of the tests being proposed is rather modest, and even a fully successful result can be seen only as a necessary, rather than a sufficient, condition for model adequacy vis-a-vis the specific modeling objective. The scheme contains no new or original ideas; it is merely an attempt to present an organized methodology based on standard techniques. Its main aim is to accomodate the possibility of testing model transposability, both of the simple geographical kind and of more complex kinds, such as transposability between different types of land use, climate, and other types of environmental changes. (Author's Abstract)
W86-04391

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,

Kennedy/Jenks Engineers, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W86-04472

PROCESS CONTROL AND DATA ACQUISITION COMPUTERS IN THE WATER INDUSTRY,

Brown Boveri Kent (East Africa) Pty Ltd., Singapore.
For primary bibliographic entry see Field 5G.
W86-04519

FOURIER INFERENCE: SOME METHODS FOR THE ANALYSIS OF ARRAY AND NON-GAUSSIAN SERIES DATA,

California Univ., Berkeley. Dept. of Statistics.
D. R. Brillinger.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 743-756, October 1985. 13 fig, 2 tab, 44 ref. NSF DMS-8316634.

Descriptors: *Fourier analysis, *Network data, *Cloud physics, *Storms, *Statistical analysis, *Runoff rates, Sonar, Mississippi River, Time series analysis, Nonlinear regression, Finite element, Method, Mathematical models, Regression analysis, Data interpretation.

Basic notations, definitions, and statistical properties of the Fourier transforms of (large) segments of stationary processes are set forth and it is shown how these properties may be employed to build analyses and to suggest techniques for making statistical inferences. To illustrate the approach, procedures are developed for the following: (1) estimating cloud and storm motion, (2) passive sonar, and (3) fitting a model for river runoff by making use of both the power spectrum and bispectrum. The last of these cases is illustrated with a preliminary analysis of monthly observations of Mississippi River runoff data. The processes to which the techniques discussed may be applied include time functions, space functions, or spatial-temporal functions (or even point processes). The statistics computed may be linear, quadratic, cubic, or more complicated. The situation may be modeled via a dimensional parameter or not. (Rochester-PTT)
W86-04530

PARAMETRIC/NONPARAMETRIC MIXTURE DENSITY ESTIMATION WITH APPLICATION TO FLOOD-FREQUENCY ANALYSIS,

Texas Univ. at El Paso. Dept. of Mathematics.
For primary bibliographic entry see Field 2E.
W86-04531

BAYESIAN MODELS OF FORECASTED TIME SERIES,

Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W86-04532

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: I. REVIEW, ALGORITHM, AND SIMULATION EXPERIMENTS,

Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 2E.
W86-04533

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: II APPLICATION TO THE POTOMAC RIVER,

Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 2E.
W86-04534

ANALYSIS OF WATER QUALITY INDICES,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5G.
W86-04598

COMPUTER DATA BASE FOR OVERVIEW OF GROUND WATER POLLUTION INVESTIGATIONS,

New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
J. L. Hoffman.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 76-79, Winter 1986. 5 fig, 4 ref.

Descriptors: *Data storage and retrieval, *Groundwater pollution, *Groundwater management, Data collections, Computers, New Jersey, Input-output analysis.

A vast amount of managerial information is needed to efficiently conduct and monitor concurrent investigations of groundwater pollution sites. The New Jersey Geological Survey has developed a computer data base to summarize these data and provide a template for their systematic collection. A series of computer programs access the data base and produce a variety of reports, such as: ABCSORT (case by site), PINDEX (computer data base data), INITSORT (computer database active cases), GWPSORT (shortened data display for active sites), CNTYSORT (active cases by county), QUADSORT (all cases by quadsheet), STATSORT (all sites by status; a shortened version of the data base), and, SUMMARY (summary of all data). These reports greatly simplify the review of groundwater pollution case loads, geographical distribution and allocation of resources. The accuracy and usefulness of the reports are directly related to the timeliness of the information in the data base. Descriptions of the input data and the output reports show the utility of this method for information storage and retrieval. These programs could easily be adapted to other situations requiring similar types of data. Copies of the programs are available from the author. (Lantz-PTT)
W86-04657

8. ENGINEERING WORKS

8A. Structures

RISK COSTS FOR NEW DAMS: ECONOMIC ANALYSIS AND EFFECTS OF MONITORING,

Stanford Univ., CA. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 6C.
W86-04156

DESIGN AND CONSTRUCTION OF NEW SPILLWAYS AND OTHER REMEDIAL WORKS TO THE LITTON RESERVOIRS, NEAR BRISTOL,

Watson Hawksley, London (England).
M. C. Bailey.
Intitution of Water Engineers and Scientists Jour-

nal JIWEDI, Vol. 40, No. 1, p 37-53, February 1986. 9 fig, 1 tab, 6 ref.

Descriptors: *Design standards, *Dam construction, *Spillways, *Litton Reservoir, *Bristol, England, Dams, Reservoirs, Slope protection, Hydraulic engineering, Engineering, Fisheries, Silt.

The design and construction are described of various remedial works needed at the Upper and Lower Litton reservoirs, near Bristol, England. These improvements to the two 130-yr-old facilities have added very many years of further service. Included are: a brief history of the reservoirs, a summary of inspecting engineer's reports, hydrological and hydraulic studies a summary of consulting engineer's report on recommended work, description of the design of the remedial works for the lower dam (increasing spillway size and stilling basin), upper dam (increasing size of spillway and bywash channel), upstream slope protection, upper dam core protection, refurbishment of scour and draw-off arrangements at the two dams, work on recirculation facility for fish rearing, silt removal from the reservoirs and repairs to masonry retaining walls supporting the upstream and downstream toes. (Peters-PTT)
W86-04379

CHICAGO AREA'S TUNNEL AND RESERVOIR PLAN,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5G.
W86-04498

8B. Hydraulics

FLOW RECIRCULATION IN CENTRIFUGAL PUMPS,
McGraw-Edison Co., Harrison, NJ. Worthington Div.
W. H. Fraser.
Water Engineering and Management, Vol. 132, No. 8, p R14-R17, July 1985. 5 fig.

Descriptors: *Pump testing, *Hydraulic design, *Recirculated water, *Impellers, Hydraulic machinery, Hydraulic equipment, Cost analysis, Mathematical studies.

When flows less than that of peak efficiency occur in a centrifugal pump impeller, the pressure field becomes increasingly distorted until at some point the pressure gradient reverses and a localized reversal of the flow takes place. This is the point of recirculation, which can occur at the discharge or the suction of the impeller, or at both of these points. Suction recirculation can cause surging and cavitation at the inlet vanes of the impeller. Similarly, extensive damage to the pressure side of the impeller vane at the discharge has been observed in many pumps operating at reduced flow rates. The hydraulics of suction and discharge recirculation are described along with methods of predicting recirculation. The recommended minimum flow to prevent recirculation in actual operation will depend upon the size of the pump, as well as the fluid pumped. Analyses of suction recirculation have shown that the higher design suction specific speed, the closer will be the point of suction recirculation to the rated capacity. Similarly, the closer discharge recirculation capacity is to the rated capacity, the higher will be the efficiency. Both the designer and user of centrifugal pumps should know the flow rates at which suction and discharge recirculation occur. (Geiger-PTT)
W86-04294

OPTIMAL DISCHARGE PROFILES FOR SUDDEN CONTAMINANT RELEASES IN STEADY UNIFORM OPEN-CHANNEL FLOW,
For primary bibliographic entry see Field 5E.
W86-04344

INLET DESIGN FOR RECTANGULAR SETTLING TANKS BY PHYSICAL MODELING,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
L. Y. Yee, and A. F. Babb.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1168-1177, December 1985. 9 fig, 3 tab, 58 ref.

Descriptors: *Sedimentation basins, *Hydraulic engineering, *Flow characteristics, Model tests, Fluid density, Wastewater facilities, Sanitary engineering.

This research was intended to develop an understanding of the hydraulics of right angle approach channels and to present suggestions for design that will furnish relatively uniform flow at the upstream end of a rectangular wastewater sedimentation tank. Because of the effect of density currents on the overall tank flow patterns, including those at the entrance, the theory of variable density flow is discussed. The design principles are illustrated by model tests with both homogeneous and variable density fluids. Although symmetrical approach flow should be used when possible, an asymmetrical inlet configuration can be made to perform reasonably well with careful design. Poorly designed inlet designs often are not detected until a plant is operating at higher capacities. The prime causes for skewed distributions are uneven flow distributions in the inlet trough and deflection by the baffle in the inlet zone. Three methods used to achieve a more uniform flow across the tank width are: (1) create a higher head loss in the inlet ports relative to that in the trough if breaking up of flocs is not a concern; (2) relocate the inlet ports away from the tank sides; and (3) add partitions in the inlet zone to reduce the baffle deflection effect. Heavier density currents tend to stabilize flow patterns and are important in generating uniform velocity across the tank width. (Rochester-PTT)
W86-04505

ANALYSIS OF WELL-AQUIFER RESPONSE TO A SLUG TEST,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-04541

HYDRODYNAMIC PRESSURE ON A DAM DURING EARTHQUAKES,
Indian Inst. of Science, Bangalore. Dept. of Applied Mathematics.
A. Chakrabarti, and V. N. Nalini.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 111, No. 12, p 1435-1439, December 1985. 1 fig, 3 ref.

Descriptors: *Dams, Earthquakes, *Mathematical studies, *Hydrodynamics, *Fourier analysis, Water pressure, Theoretical analysis, Mathematical equations, Dam stability.

A straightforward analysis involving Fourier cosine transforms and the theory of Fourier series is presented for the approximate calculation of the hydrodynamic pressure exerted on the vertical upstream face of a dam due to constant earthquake ground acceleration. The analysis uses the 'Parseval relation' on the Fourier coefficients of square integrable functions, and directly brings out the mathematical nature of the approximate theory involved. (Author's abstract)
W86-04621

FINITE ELEMENT MODELING OF INFINITE RESERVOIRS,
Laurentian Univ., Sadbury (Ontario). Dept. of Civil Engineering.
S. K. Sharan.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 111, No. 12, p 1457-1469, December 1985. 8 fig, 20 ref, 2 append.

Descriptors: *Dams, *Reservoirs, *Finite element method, *Mathematical studies, Numerical analysis, Mathematical models, Model studies, Hydrodynamics, Boundary conditions.

A technique is developed to model the effects of radiation damping in the finite element analysis of hydrodynamic pressures on dams subjected to a harmonic horizontal ground motion. The water in the reservoir is treated as being compressible; however, its vibration is assumed to be two-dimensional and of small amplitude. In finite element modeling, an infinite reservoir must be truncated at a finite distance from the dam, and a suitable boundary condition must be imposed at the truncation surface. Sommerfeld or similar existing boundary conditions are found to be satisfactory for excitation frequencies greater than the fundamental frequency of the reservoir. However, for lower frequencies, which are of greater importance in the seismic response analysis of dams, such boundary conditions require a very large extent of the reservoir to be considered in the analysis. The principal merit of the proposed boundary condition is that the reservoir may be truncated at a very short distance from the dam, resulting in great computational advantages. The effectiveness of the proposed method is demonstrated by analyzing several cases. (Author's abstract)
W86-04622

8C. Hydraulic Machinery

MOTOR CONTROL ELIMINATES ERRATIC DISTRIBUTION PRESSURE,
El Reno City Public Works, OK.
For primary bibliographic entry see Field 5F.
W86-04296

SELECTING AND APPLYING MAGNETIC FLOWMETERING SYSTEMS,
Fischer and Porter, Co., Warminster, PA.
M. F. Griffin.
Water Engineering and Management, Vol. 132, No. 12, p 33-36, November 1985. 2 fig, 1 tab.

Descriptors: *Flowmeters, *Comparison studies, Hydraulic equipment, Cost analysis, Flow measurement, Measuring instruments, Electrodes.

A magnetic flowmetering system consists of a flowtube installed in the process pipeline and a transmitter mounted on the flowtube or in a remote location. An understanding of both a-c and pulsed d-c systems is important in selecting and applying magnetic flowmetering equipment. Applied to a conventional magnetic flow-meter, the moving conductor or fluid passes through a magnetic field in the flowtube where a pair of electrodes picks up the induced voltage. Conventional flowtubes may be metallic (and lined with an insulated material) or nonmetallic. In most water and wastewater applications, AISI Type 316 stainless steel electrodes are used. A special, conical-shaped electrode, which protrudes into the process stream for self-cleaning, is especially desirable on sludge flows. Conventional a-c systems provide the broadest application possibilities, but pulsed d-c systems provide high accuracy, wide range capability, and automatic zeroing for the measurement of homogeneous processes. This latter feature and the ability to handle both the signal cable and power leads on the same conduit or cable tray make the d-c systems more economical than the a-c flowmeter systems. (Geiger-PTT)
W86-04297

MDS PROJECT - MAIN DIMENSIONS AND ECONOMICS,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
Z. Shalev.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 74-88, September 1985. 6 fig, 4 tab.

Descriptors: *Tunnels, *Hydroelectric plants, *Economic aspects, *Conveyance structures, *Feasibility studies, Project planning, Pumping plants, Conduits, Pipelines, Design criteria, Water conveyance, Israel.

The conveyance capacity of the tunnel designed to move water from the Mediterranean Sea to a power station on the Dead Sea was calculated to refill the Dead Sea to its historic level at rate

which maximizes the project's net benefits. The generation capacity of the project was calculated to make optimal use of the amounts of water thus conveyed. In calculating the dimensions of these two main components of the scheme, as well as those of other facilities, the long-term economic impact of the project on the entire Israeli national power system was evaluated. These studies formed part of the feasibility study which proceeded in parallel with outline design of the facilities. Both engineering and economic studies have adopted a rather conservative approach and included numerous iterations and sensitivity tests. The feasibility study concludes with a recommendation to implement the scheme on the grounds of direct quantifiable benefits only, even though there are several other benefits to the power system, and to the national economy in general. (Author's abstract)
W86-04637

8D. Soil Mechanics

IMPROVED ROTATING CYLINDER TECHNIQUE FOR QUANTITATIVE MEASUREMENTS OF THE SCOUR RESISTANCE OF CLAYS,
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 7B.
W86-04338

8E. Rock Mechanics and Geology

CLOSED-SYSTEM FREEZING OF SOIL IN EARTH DAMS AND CANALS,
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
C. W. Jones.
Canadian Geotechnical Journal CGJOAH, Vol. 23, No. 1, p 1-8, February 1986. 10 fig, 12 ref.

Descriptors: *Dam stability, *Freezing, *Dam designs, *Earth dams, *Canals, *Soil density, Soil water, Soil shrinkage, Soil tests, Teton Dam, Idaho, Snow, Cold regions.

Field and associated laboratory experiments with closed-system freezing in earth embankment dams and canals are presented. This type of freezing can cause a redistribution of soil density and moisture, which needs to be considered in the design of soil structures used as water barriers in cold regions. Frost-depth measurements are made during the winter of 1978-1979 on two earth dams during interruption of their construction, and on the Teton Dam remnant in Idaho, are shown, along with associated soil conditions, air freezing indexes, and insulating effects of snow and, for one dam, a loose soil cover. Some trends of density and moisture changes near the embankment surfaces where established. Keeping in mind the known affects of freezing on soils, the paper raises questions about possible changes in soil density and shrinkage of embankments in contact with rock abutments that might adversely affect the safety of earth dams. (Author's Abstract)
W86-04336

8G. Materials

TRY TACKLING A CORROSION INVESTIGATION,
Los Angeles City Dept. of Water and Power, CA.
D. W. Heumann.
Water Engineering and Management WENMD2, Vol. 132, No. 11, p 32-34, October 1985. 4 fig, 4 ref.

Descriptors: *Water distribution, *Pipes, *Corrosion control, Corrosion, Utilities, Monitoring, Data storage and retrieval, Pipelines.

There are a number of preliminary steps that should be taken by water utility departments before consulting outside firms to aid in handling problems of water main corrosion. The Los Angeles Department of Water and Power (LADWP) has established a material recovery program which tags sections of removed corroded pipe before it is sold for scrap. Field crews are instructed to photograph and label tagged sections and the photographs are organized by location and date to give a realistic and permanent record of system conditions. The LADWP also maintains records of consumer complaints of 'red water' by address of the complainant, service zone, and problem description in computer storage. Celerity tests are made regularly in the LADWP and a special form is used by the department to maintain records of repaired pipe leaks to help locate where corrosion was producing the main leaks. Iron analysis are performed routinely on all water sources feeding Los Angeles. The prevailing flow directions in the distribution network must be established to detect sources of corrosion. The corrosion detection methods used by the LADWP are not beyond the means of smaller water utilities. (Geiger-PTT)
W86-04619

8I. Fisheries Engineering

ASSESSING POPULATION EFFECTS FROM ENTRAINMENT OF FISH AT A LARGE VOLUME WATER INTAKE,
Battelle Pacific Northwest Labs., Richland, WA.
R. H. Gray, T. L. Page, D. A. Neitzel, and D. D. Dauble.
Journal of Environmental Science and Health JESEDU, Vol. A21, No. 2, p 191-209, 1986. 4 fig, 5 tab, 14 ref.

Descriptors: *Water intake, *Power plants, *Entrainment, *Salmon, *Columbia River, *Seasonal variation, Rainbow trout, Fish populations.

A method is described for estimating the entrainment of juvenile chinook salmon (Oncorhynchus tshawytscha) at the intake of Washington Public Power's Hanford Generating Project on the Columbia River. The method involved sampling fish in the river and entrained fish (both marked recaptures and naturally-occurring downstream migrants) within the intake, and estimating (1) the total number of fish entrained, (2) the size of the natural population, and (3) the percentage of the natural population affected. Rainbow trout (Salmo gairdneri) juveniles were used in the mark-recapture studies, whereas natural populations of chinook salmon were sampled within the intake during the annual downstream migration. Young-of-the-year chinook salmon are not susceptible to impingement or entrainment until they become free swimming and pass the intake. Impingement and entrainment generally involved fry ranging in size from 3.3-5.5 cm fork length. Peak impingement and entrainment of chinook salmon fry occurred before maximum catches in seine hauls, suggesting that the intake is a more efficient sampler of smaller fish. As average fish size increased during early June in seine samples, chinook salmon impingement and entrainment fell to near zero. (Rochester-PTT)
W86-04383

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH: PROCEEDINGS,
Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
For primary bibliographic entry see Field 2F.
W86-04042

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SELECTED WATER RESOURCES ABSTRACTS

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

VOLUME 19, NUMBER 11
NOVEMBER 1986

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 19, NUMBER 11
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MARCH 3, 1849

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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06 WATER RESOURCES PLANNING

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07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

NEW METHOD FOR OBTAINING A SPATIALLY AVERAGED INFILTRATION RATE FROM RAINFALL AND RUNOFF RATES,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2G.
W86-05074

EFFECT OF QINGHAI-TIBET PLATEAU FORCING ON THE MESO-SCALE RAIN-BEARING CIRCULATION SYSTEMS OVER EASTERN CHINA DURING PRESUMMER RAINY SEASON,

European Centre for Medium Range Weather Forecasts, Reading (England).
For primary bibliographic entry see Field 2B.
W86-05090

APPROACH FOR FREQUENCY ANALYSIS OF MULTIYEAR DROUGHT DURATIONS,

Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
K. S. Lee, J. Sadeghipour, and J. A. Dracup.
Water Resources Research WRERAO, Vol. 22, No. 5, p 655-662, May 1986. 7 fig, 3 tab, 20 ref. NSF Grant No. 77-1137 and University of California Water Resources Center Grant W-615.

Descriptors: *Frequency analysis, *Drought, Streamflow, Water supply profiles, Mathematical analysis, Water shortage, Probabilistic process, Model studies, Feather River, California.

A practical approach is developed for the frequency analysis of multiyear drought durations of annual streamflow series. The proposed approach utilizes a technique which smooths the frequency-curve irregularity of drought durations, which then reduces the statistical uncertainties associated with sample-size limitations. Several hazard-function models are examined with regard to their ability to represent the duration-dependent termination rate of a drought data set. The logistic model with an exponential correction for short durations is considered to have sufficient flexibility for describing most portions of the termination-rate function. The parameters of the logistic model are identified using a piecewise linear regression for the linearized termination probability curve. Once the form of the hazard model is specified and its parameters are estimated, the probability distribution and exceedance probability of drought durations can be determined from their corresponding relationships with the hazard model. The historic droughts of Feather River, California, are used to demonstrate the methodology. Results indicate that the observed nine-year drought of Feather River has a return period of 360 years. (Lantz-PTT)
W86-05212

DISPERSION IN FRACTAL FRACTURE NETWORKS,

Disposal Safety, Inc., Washington, DC.
For primary bibliographic entry see Field 5B.
W86-05230

STATISTICAL INFERENCE OF SPATIAL RANDOM FUNCTIONS,

Hebrew Univ. of Jerusalem (Israel). Dept. of Agricultural Economics.
E. Feinerman, G. Dagan, and E. Bresler.
Water Resources Research WRERAO, Vol. 22, No. 6, p 935-942, June 1986. 5 fig, 15 ref.

Descriptors: *Statistical analysis, *Statistical hydrology, *Spatial random functions, *Flow profiles, Mathematical studies, Probabilistic process, Analysis of variance.

A methodology to infer the spatial distribution of the statistical moments of a stationary normal random spatial function based on a finite set of measured values is described. The uncertainty of estimation of the parameters characterizing the probability density function (pdf) is incorporated in the process of inferring and conditioning. Relationships generalizing the traditional approach of stochastic interpolation and simulation have been derived. They yield: 1) an estimate of the conditional expectation; 2) an estimate of the conditional multivariate normal (MVN) covariance and variance; and 3) a new quantity, the variance of the estimated variance. The method is illustrated for a two-dimensional synthetic example with both estimated mean and variance regarded as random. A set of 60 points was generated within a square of sides equal to unity from a MVN population with zero mean, unity variance and exponential covariance with a linear integral scale of 0.3. Contour maps of the inferred expected values and variances were drawn and compared with maps of kriged values and maps of kriged variances. The unconditional and conditional statistical moments of the space average (block value), z', were also evaluated. The reduction of the uncertainty of the inferred random variable z' as the number of measured points increases is demonstrated with the same synthetic example. (Lantz-PTT)
W86-05254

UPDATED CLIMATE FEEDBACK DIAGRAM,

Maryland Univ., College Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W86-05314

2B. Precipitation

DETERMINATION OF THE PARAMETERS OF WATER INTAKE BY SOIL WITH THE ENERGY CHARACTERISTICS OF RAIN TAKEN INTO ACCOUNT,

Moscow Inst. of Agricultural Engineers (USSR).
For primary bibliographic entry see Field 2G.
W86-04732

STUDY OF THE DYNAMICS OF DROP EROSION UNDER LABORATORY CONDITIONS,

Lajos Kossuth Univ., Debrecen (Hungary).
For primary bibliographic entry see Field 2J.
W86-04879

INSTRUMENTATION FOR STUDIES OF THE EROSIVE POWER OF RAINFALL,

National Coll. of Agricultural Engineering, Silsoe (England).
For primary bibliographic entry see Field 7B.
W86-04881

ACID RAIN IN WESTERN EUROPE AND NORTHEASTERN UNITED STATES - A TECHNICAL APPRAISAL,

Ford Motor Co., Dearborn, MI. Chemistry Dept.
For primary bibliographic entry see Field 5B.
W86-05039

RAINFALL INVESTIGATIONS AT CARDINGTON AND WINCHCOMBE 1954-67,

British Meteorological Office, Bracknell (England).
R. P. W. Lewis.
Meteorological Magazine, Vol. 115, No. 1364, p 86-94, March 1986. 2 fig, 9 ref.

Descriptors: *Rainfall, *Cardington, *Winchcombe, Open scale strip chart, Tilting siphon, Rainfall intensity, Rain gages, Urban runoff, Storm sewers, Weather data collections, Data acquisitions.

An account is given of the setting up and operation of two investigations carried out by the Meteorological Office into the fine-scale structure in space and time of heavy downfalls of rain using networks of synchronized open-scale rain recorders, one in flat and one in hilly country during the period 1954 to 1967. The work was planned and coordinated by the Joint Committee on Rainfall and Run-off (JCRR). One investigation was near Cardington in Bedfordshire, and the other near Winchcombe in the Cotswolds. The Instrument Development Branch at Harrow devised an open scale chart mechanism which could be attached to the normal Meteorological Office tilting siphon (T/S) rain recorder in place of the daily drum. While the Winchcombe investigation was in progress, the one at Cardington ran its course and the network there was closed down in June 1963. Data from about 150 storms was collected. Considerable care was taken to allow for losses in catch during the siphoning process, an important matter for intense falls of rain. Much attention was also given to the relative efficiency of catch of the various gauges by comparing long term totals, and to the elimination, as far as possible, of the inevitable errors of synchronization introduced into the records by the way in which the strip charts tended to jump sprockets, or slip, or pull alternately too taut and too loose. The data have been used in design studies for storm water sewers (Department of the Environment 1976) and for the pattern of urban runoff. (Peters-PTT)
W86-05045

YES, PRECIPITATION FORECASTS HAVE IMPROVED,

National Weather Service, Silver Spring, MD. Techniques Development Lab.
H. R. Glahn.
Bulletin of the American Meteorological Society, Vol. 66, No. 7, p 820-830, July 1985. 6 fig, 4 tab, 22 ref.

Descriptors: *Weather forecasting, *Precipitation forecasting, Probable maximum precipitation, Rainfall, Forecasting.

A 1982 analysis of published verification scores of National Weather Service (NWS) forecasts of measurable precipitation concluded that except in winter in the eastern and central regions, any increase in accuracy from 1966 to 1978 was negligible, with improvement even harder to achieve in summer. A study was undertaken to gain a better understanding of these conclusions and to see whether they would hold over a longer period of record. The study was based on 11 of the 12 years used in the 1982 study and 4 additional years. The scores used are percent correct and skill score. There is strong evidence that probability of precipitation forecasts have improved over the 15-year period from 1967 to 1982. The main reason for improvement in precipitation forecasting over the 1967-81 period is the improvement of numerical-weather-prediction (NWP) models. Contributing factors may be improved interpretation of the NWP models through statistical and subjective procedures and the more timely delivery of the NWP products and statistical guidance to field forecasters. (Khumbatta - PTT)
W86-05070

EFFECT OF QINGHAI-TIBET PLATEAU FORCING ON THE MESO-SCALE RAIN-BEARING CIRCULATION SYSTEMS OVER EASTERN CHINA DURING PRESUMMER RAINY SEASON,

European Centre for Medium Range Weather Forecasts, Reading (England).
S. Chen, and L. Dell'Osso.
Journal of the Meteorological Society of Japan, Vol. 64, No. 1, p 53-63, February 1986. 8 fig, 14 ref.

Descriptors: *Rainfall, *China, *Atmospheric physics, *Weather forecasting, Qinghai-Tibet plateau, Meso-scale system, Orography, Monsoons, Model studies.

The low level jet and the associated low level south-west vortex are the main mesoscale systems which bring heavy rains over East Asia. The influence of Qinghai-Tibet Plateau (QTP) on these circulation systems was examined using the ECMWF grid point limited area model for a typical heavy rainfall case during the presummer rainy (Mei-yu) season. A control experiment, in which the orography represents the mean value over a grid box, reproduced the variation of the low level jet, the

formation of the south-west vortex and the heavy rainfall area. When the height of QTP is halved, the south-west monsoon south of the Plateau interacts with the middle latitude westerlies. A baroclinic then develops instead of the meso-scale systems, and the heavy rainfall zone is shifted to the east. Increasing the QTP height causes the meso-scale systems to be enhanced and restricted to the vicinity of the Plateau, and the rainfall zone is shifted to the west. In an experiment with an envelope orography, the south-west monsoon flow travels round the Plateau. With the westward shift of the Western Pacific Subtropical High (WPSH), the Low Level Jet (LLJ) becomes a southerly flow parallel to the east flank of the Plateau. The south-west vortex is not well formed and no Mei-yu cyclone appears over the Yangtze Valley. The heavy rainfall restricted to the Sichuan Basin suggests that no typical Mai-yu occurs. The formation and maintenance of the LLJ is mainly due to the southern boundary effect to the south-west monsoon. The Plateau restricts the interaction between westerlies and south-west monsoon which is essential for the vortex genesis over the Plateau and the consequent evolution of the rain bearing systems east of the Plateau. Enhancing the interaction or reducing the interaction causes a dramatic change of the Mai-yu circulation. WTP forcing has a significant effect on the heavy rainfall regime over eastern China. Precipitation areas are shifted to the northeast when the Plateau height is reduced and to the southwest when the height is increased. (Peters-PTT)
W86-05090

TWO-WAVELENGTH (0.86 CM AND 3.2 CM) RADAR OBSERVATION OF MICROPHYSICAL PROCESS IN STRATIFORM PRECIPITATION PART I. ATTENUATION OF RADAR WAVE DUE TO PRECIPITATION PARTICLES AND CORRECTION METHOD,

Nagoya Univ. (Japan). Water Research Inst.
T. Yokoyama.
Journal of the Meteorlogical Society of Japan, Vol. 63, No. 6, p 1097-1108, December 1985. 1 tab, 6 fig, 18 ref.

Descriptors: *Precipitation, *Radar, *Rain, *Snow, Precipitation rate, Atmospheric physics, Model studies, Rainfall intensity.

The attenuation of K-, X- (3.2 cm) and C-band (5.6 cm) waves was calculated based on a model of precipitation, for three precipitation intensities, i.e., heavy (32 mm/hr), ordinate (4 mm/hr) and weak (0.5 mm/hr) precipitations. The attenuation coefficient is larger in the melting layer by one or two orders than in the lower raindrop region. The effect of the size distribution on the attenuation abruptly increases as the attenuation is enhanced. The attenuation of X- and C-band waves are small enough to be neglected except for heavy precipitation. In the case of heavy precipitation, K-band wave is severely attenuated, especially in the melting layer, so that the signals cannot be detected by the radar receiver. In the cases of ordinary and weak precipitations, true radar reflectivity factors of the K-band wave can be obtained by corrections of the attenuation. A correction method using the radar reflectivity factor of the X-band radar was investigated. After the correction, precipitations weaker than about 4 to 7 mm/hr can be safely observed within an error of 2dB by the two wavelength radar technique using K- and X-band radars in the raindrop region. In the melting layer, the correction method can be used without a large error when the precipitation is weaker than 2 to 4 mm/hr. (Peters-PTT)
W86-05091

TWO-WAVELENGTH (0.86 CM AND 3.2 CM) RADAR OBSERVATION OF MICROPHYSICAL PROCESS IN STRATIFORM PRECIPITATION PART II. STUDY ON SIZE DISTRIBUTION CHANGE OF PRECIPITATION PARTICLES,

Nagoya Univ. (Japan). Water Research Inst.
T. Yokoyama, and Y. Ishizaka.
Journal of the Meteorological Society of Japan, Vol. 63, No. 6, p 1109-1126, December 1985. 1 tab, 10 fig, 21 ref.

Descriptors: *Precipitation, *Radar, *Rain, *Snow, Precipitation rate, Model studies, Atmospheric studies, Rainfall intensity.

Whether the size distribution change due to coalescence or breakup of melting snowflakes and raindrops occur significantly in the lower half region of the melting layer and the raindrop region was investigated by two wavelength radar observations together with model calculations. The response of the radar reflectivity factor to size distribution transition between two altitudes is dependent on the radar wavelength. Two radars with wavelength of 3.2 cm (X-band) and 0.86 cm (K-band) were used. The two wavelengths gave significantly different radar reflectivity factors. Comparison of the observed and calculated results gives strong evidence for particle size distribution transition equivalent to coalescence in the lower half region of the melting layer for stably uniform precipitations. The activity of the distribution transition does not depend on the precipitation intensity. For the same type of the precipitation, when the precipitation rate is relatively large, increase of medium sized particles (0.1 to 0.25 cm in diameter) is likely to be predominant in the raindrop region just below the melting layer. (Peters-PTT)
W86-05092

EXPERIMENTS ON AEROSOL SCAVENGING BY NATURAL SNOW CRYSTALS PART III. THE EFFECT OF SNOW CRYSTAL CHARGE ON COLLECTION EFFICIENCY,

Hokkaido Univ., Sapporo (Japan). Graduate School of Environmental Science.
For primary bibliographic entry see Field 2C.
W86-05093

NEW TECHNIQUE FOR MONITORING THE WATER VAPOR IN THE ATMOSPHERE,

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
H. D. Black, and A. Eisner.
Journal of Geophysical Research, Vol. 91, No. C2, p 2331-2337, February 15, 1986. 2 tab, 2 fig, 16 ref.

Descriptors: *Water vapor, *Precipitation, *Satellite technology, *Atmosphere, Doppler data, Tropospheric effects, Refraction integral, Atmospheric water, Mathematical studies.

A technique for obtaining realistic values of precipitable water vapor (PWV) is discussed. In correcting satellite doppler data for tropospheric effects, it has been found that the PWV can be inferred at the tracking site. The determination proceeds via a least squares fit of a refraction parameter, along with several others, to each 15-minute pass of data. For its success the technique depends on having an ephemeris for the satellite, an analytic model for the refraction range effect that is good to a few centimeters, doppler (range difference or cycle count) data with a noise level below 10 cm, and a surface pressure/temperature measurement at the tracking site. The PWV is a byproduct of the computation necessary to correct the doppler data for tropospheric effects. Attempts to reliably isolate the tropospheric refractive effect in the doppler shift measurement were successful recently due to a formulation of the refraction integral that minimizes the necessity for explicit water vapor, temperature, and pressure profiles. (Peters-PTT)
W86-05097

ACHIEVING IMPROVED FREQUENCY RESPONSE OF THE RAIN STRUCTURE FROM SPACEBORNE RADAR ALTIMETERS BY EMPLOYING DECONVOLUTION METHODS,

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
J. Goldhirsh, and F. M. Monaldo.
Journal of Geophysical Research, Vol. 91, No. C2, p 2338-2344, February 15, 1986. 5 fig, 14 ref.

Descriptors: *Radar, *Rain, *Reflectance, *Satellite technology, Rain structure, Deconvolution methods, Frequency response, Virginia, Wallops Island, Data interpretation, Fourier analysis, Mathematical studies, Altimeters.

A technique is described for arriving at improved measurements of the rain structure near the earth's surface from satellite-borne radars. By combining the beam-averaged reflectivity profile and the beam pattern information, a resultant structure is obtained which contains improved spectral content compared to that of the beam-averaged structure. The method uses deconvolution and Fourier transform procedures and assumes a knowledge of the antenna beam pattern. As an example, the method is directed toward the application of future spaceborne radar altimeters that may contain additional range gates to permit the measurement of rain in the lower troposphere. Using a radar-measured rain reflectivity profile acquired at Wallops Island, VA, in a simulation example, it is demonstrated that improved measurements of the spatial frequency spectrum of the rain structure may be deduced by means of deconvolution methods, as compared to the measured spectrum derived by beam averaging. Rain measurements are considered vital from the standpoint of providing a flag for altimeter data that may be corrupted by rain over the oceans where few or no such data are available for the meteorologist or the communicator interested in space diversity communications. (Peters-PTT)
W86-05098

ACCURACY OF RAINFALL ESTIMATES BY RADAR, PART I: CALIBRATION BY TELEMETERING RAINGAUGES,

British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
C. G. Collier.
Journal of Hydrology, Vol. 83, No. 3/4, p 207-223, March 1986. 3 tab, 6 fig, 10 ref.

Descriptors: *Rainfall, *Radar, *Raingages, Estimates, Telemetry, Rainfall rate, England, Data interpretation.

The accuracy of the estimates of hourly rainfall derived from both calibrated and uncalibrated C-band (5.6 cm wavelength) radar located in north-west England has been assessed. Calibrated radar data are provided in real time to both meterological and hydrological users. The accuracy of these data, assessed by comparison with raingage measurements, is comparable to the accuracy attained in the Dee Weather Radar Project. The calibration procedure improves the overall accuracy of the uncalibrated data within about 75 km of the radar site in frontal rainfall even when bright band effects are present. In convective rainfall, calibration has on average a smaller affect, although it may have a large effect on individual cases. Problems encountered with the real time operation of the raingage calibration procedure include: (1) calibration gage interrogation failures due to failures in communication links or broken gages; (2) fluctuations in rainfall type, and (3) application of inappropriate calibration factors. (Peters-PTT)
W86-05109

ACCURACY OF RAINFALL ESTIMATES BY RADAR, PART II: COMPARISON WITH RAINGAUGE NETWORK,

British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
C. G. Collier.
Journal of Hydrology, Vol. 83, No. 3/4, p 225-235, March 1986. 1 tab, 4 fig, 14 ref.

Descriptors: *Rainfall, *Radar, *Rain gages, Telemetry, Rainfall rate, England, Flood forecasting.

The measurement of hourly point rainfall by a sparse telemetering raingage network was investigated. Radar was used to estimate rainfall within a real time flood forecasting system, which also acquires rainfall information from a number of telemetering raingages over and above those used to calibrate the radar. The bias and random errors in hourly point rainfall totals derived from the telemetering gage network alone, and from the radar, calibrated using data from only a few gages, are compared. The best method of real time rainfall measurement for use with the flood forecasting system was assessed. The most appropriate method of measurement depends upon the rainfall type; the calibrated radar estimates are more accurate within

75 km of the radar site than those using the telemetering raingage network alone. (Peters-PTT)
W86-05110

ACCURACY IN RAINFALL ESTIMATES BY RADAR, PART III: APPLICATION FOR SHORT-TERM FLOOD FORECASTING,

British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
C. G. Collier, and J. M. Knowles.
Journal of Hydrology, Vol. 83, No. 3/4, p 237-249, March 1986. 6 fig, 23 ref.

Descriptors: *Rainfall, *Radar, *Rain gages, *Flood forecasting, Telemetry, Rainfall rate, England, Hydrologic models, River flow, Hydrographs, Thunderstorms, Rainfall intensity.

Simulations of river flow using a simple hydrological model and the sensitivity of the simulations were compared to rainfall data derived from a weather radar. In thunderstorm rainfall, radar calibration factors derived in real time may not be representative of rain falling over a river catchment some distance from the calibration raingages. Radar may also underestimate the rainfall resulting in an underestimation of the peak flow. The use of radar data, calibrated using the data from a number of telemetering raingages, as input to hydrological models, may lead on occasions to river hydrographs which are considerably in error. Likewise, the use of telemetery raingage data, particularly in localized rainfall, may also lead to incorrect flow forecasts. Only if ways can be found for dealing with errors in radar estimates of rainfall, will radar attain its potential in hydrological forecasting. (Peters-PTT)
W86-05111

OBSERVATIONAL RAINFALL-RUNOFF ANALYSIS FOR ESTIMATING EFFECTS OF CLOUD SEEDING ON WATER RESOURCES IN NORTHERN ISRAEL,

Tel-Aviv Univ. (Israel). Dept. of Statistics.
For primary bibliographic entry see Field 3B.
W86-05115

TIME VARIATION OF RN 222 PROGENY CONCENTRATIONS IN RAINWATER,

Fukui Univ. (Japan). Faculty of Engineering.
T. Nishikawa, M. Aoki, and S. Okabe.
Health Physics, Vol. 49, No. 6, 1284-1289, December, 1985. 4 fig, 2 tab, 10 ref.

Descriptors: *Fate of pollutants, *Precipitation, *Rainfall, *Radon radioisotopes, *Temporal distribution, Seasonal variation, Rain, Chemistry of precipitation, Snow, Monitoring, Radioactive isotopes.

Radon-222 progeny that is brought to the ground surface by the scavenging effects of precipitation may cause a temporary increase in environmental gamma radiation and may upset monitoring efforts near nuclear facilities. Radon-222 progeny concentrations in precipitation were measured in Fukui Prefecture from 1982-1984 and examined in relation to such factors as atmospheric Rn-222 progeny, seasonal variation, and precipitation rate. Results showed that when the precipitation rate is low, the Rn-222 progeny concentration in rain is distributed over a wide range of values, and sometimes the concentration in a low-precipitation-rate rainfall is lower than the value of high-precipitation-rate rainfall. The statistics of deposited Rn-222 progeny showed an approximate linear relation to the precipitation rate. The Rn-222 progeny concentration in rain during the winter is about two times that which occurs during the other three seasons. Such seasonal variation is considered to be due to a high atmospheric Rn-222 progeny concentration in the air mass coming from Siberia or China during the winter. (Geiger-PTT)
W86-05142

RAINWATER FOR DRINKING IN SRI LANKA,

Loughborough Univ. of Technology (England). WEDC Group.
For primary bibliographic entry see Field 3B.
W86-05145

STATE ESTIMATION OF A SCALAR DYNAMIC PRECIPITATION MODEL FROM TIME-AGGREGATE OBSERVATIONS,

Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
K. P. Georgakakos.
Water Resources Research WRERAO, Vol. 22, No. 5, p 744-748, May 1986. 1 tab, 9 ref.

Descriptors: *Estimating equations, *Precipitation, *Dynamic modeling, Data interpretation, Time-series analysis, Kalman filter, Model studies, Mathematical studies.

An exact, recursive, state estimator for linear, scalar systems was developed. Its observables are time integrals, over an interval delta-t, of linear functions of the state. In general, implementation of the estimator results in excessive computations. The computationally inexpensive, ordinary Kalman filter with inflated observation error variance is used to approximate the developed estimator in terms of prediction accuracy. Comparisons between the exact estimator and the Kalman filter, using precipitation data of various aggregation intervals delta-t, and a scaler dynamic precipitation model, shows that the Kalman filter develops a prediction bias as delta-t increases. (Lantz-PTT)
W86-05220

OVERLAND FLOW HYDROGRAPHS FOR SCS TYPE II RAINFALL,

Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05239

BINARY TIME SERIES OBTAINED FROM CONTINUOUS TIME POINT PROCESSES DESCRIBING RAINFALL,

Washington Univ., Seattle. Dept. of Statistics.
P. Guttorp.
Water Resources Research WRERAO, Vol. 22, No. 6, p 897-904, June 1986. 4 fig, 2 tab, 26 ref, append. NSF Grant MCS-8302573.

Descriptors: *Time series analysis, *Rainfall, Model studies, Data interpretation, Statistical analysis, Mathematical analysis, Poisson ratio, Mathematical studies, Washington.

Continuous time point process models have been used in recent work on modeling rainfall occurrence. In many cases the available data is not sufficiently precise to properly fit such a model. For example, if only occurrence or nonoccurrence of precipitation is given daily, a more appropriate model would be a binary time series. In this work, some parameters of the time series obtained, are related to parameters of the underlying (but not observed) continuous time process. The details for several models proposed in the literature, such as the Neyman-Scott Poisson cluster process and the Smith-Karr renewal Cox process are carried out. An application of the theory is illustrated on some Washington State rainfall data. (Lantz-PTT)
W86-05249

PREDICTING PH, ALKALINITY, AND TOTAL ACIDITY IN STREAM WATER DURING EPISODIC EVENTS,

Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5B.
W86-05250

SEASONAL AND REGIONAL VARIABILITY OF PARAMETERS FOR STOCHASTIC DAILY PRECIPITATION MODELS: SOUTH DAKOTA, U.S.A.,

Agricultural Research Service, Tucson, AZ.
D. A. Woolhiser, and J. Roldan.
Water Resources Research WRERAO, Vol. 22, No. 6, p 965-978, June 1986. 9 fig, 9 tab, 27 ref.

Descriptors: *Seasonal variation, *Regional variation, *Precipitation, *Model studies, *South Dakota, Mathematical models, Markov process, Fourier analysis.

Fourier series are used to describe the seasonal variation of the five parameters for a stochastic model of daily precipitation, utilizing a first-order Markov chain for the occurrence process and a mixed exponential distribution for the daily precipitation amounts (MCME model). Spatial variability of the means of each parameter for 16 stations in South Dakota has been illustrated by mapping isopleths. MCME parameters for 4 stations not included in the analysis are more closely described by the arithmetic mean of parameters for the 6 nearest stations, than by using parameters for the nearest neighboring station or parameters estimated by spline fitting or linear interpolation. MCME parameters estimated by all interpolation methods were significantly different from parameters identified for each of the four stations by maximum likelihood techniques. The principal source of this spatial variability, at distances on the order of 100 km, is data inconsistency due to methodological differences affecting small precipitation amounts related to observation time. Sampling error, possible parameter identifiability problems, and real differences in the precipitation regime on a scale smaller than the station spacing also contribute to the observed variability. (Lantz-PTT)
W86-05257

UPDATED CLIMATE FEEDBACK DIAGRAM,

Maryland Univ., College Park. Dept. of Meteorology.
A. Robock.
Bulletin of the American Meteorological Society, Vol. 66, No. 7, p 786-787, July 1985. 1 fig, 10 ref. NSF Grant No. ATM-8213184.

Descriptors: *Climate, *Feedback, Vegetation, Thermal inertia, Meltwater, Air temperature, Albedo.

Three new climate elements have been added to the Kellogg and Schneider climate feedback diagram: vegetation, thermal inertia, and meltwater. These more clearly distinguish external forcing and heat fluxes. This diagram will be of use in understanding the complex interactions in the climate system that can feed back on surface air temperature. (Author's abstract)
W86-05314

DISTRIBUTION OF ACID DEPOSITION IN GERMANY,

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
For primary bibliographic entry see Field 5B.
W86-05413

ATMOSPHERIC AMMONIUM SULPHATE DEPOSITION AND ITS ROLE IN THE ACIDIFICATION AND NITROGEN ENRICHMENT OF POORLY BUFFERED AQUATIC SYSTEMS,

Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5B.
W86-05414

EFFECTS OF ACID DEPOSITION ON CROPS AND FORESTS,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-05415

2C. Snow, Ice, and Frost

EXPERIMENTS ON AEROSOL SCAVENGING BY NATURAL SNOW CRYSTALS PART III. THE EFFECT OF SNOW CRYSTAL CHARGE ON COLLECTION EFFICIENCY,

Hokkaido Univ., Sapporo (Japan). Graduate School of Environmental Science.
M. Murakami, C. Magono, and K. Kikuchi.

Group 2C—Snow, Ice, and Frost

Journal of the Meteorological Society of Japan, Vol. 63, No. 6, p 1127-1137, December 1985. 2 tab, 9 fig, 25 ref.

Descriptors: *Snow, *Aerosols, Crystals, Electrostatic charge, Precipitation.

The collection efficiency of charged snow crystals for micron and submicron aerosol particles was studied in an aerosol chamber, and compared with that of uncharged snow crystals to investigate the effect of electrostatic forces on collection efficiency. The collection efficiency of charged natural snow crystals for aerosol particles of 0.1 micrometers to 6 micrometers in diameter was experimentally examined under conditions where phoretic forces and external electric fields were negligible. The enhancement of collection efficiency due to electrostatic charges on snow crystals increased with the decreasing aerosol size, and became maximum around 0.2 milimeters in diameter. Coulombic force was the dominant electrostatic force under these experimental conditions. (Peters-PTT)
W86-05093

CATASTROPHIC LAKE DRAINAGE WITHIN THE HOMATHKO RIVER BASIN, BRITISH COLUMBIA,
British Columbia Hydro and Power Authority, Vancouver. Geotechnical Dept.
For primary bibliographic entry see Field 2H.
W86-05104

PHOTOSYNTHETIC PRODUCTION OF A BRACKISH WATER COMMUNITY OF CHARA TOMENTOSA L. AND ITS DEPENDENCE ON ENVIRONMENTAL CONDITIONS,
Rostock Univ. (German, D.R.). Dept. of Biology.
E. Libbert, and T. Walter.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 3, p 359-368, 1985. 3 tab, 5 fig, 11 ref.

Descriptors: *Photosynthesis, *Respiration, *Algal growth, *Primary productivity, *Brackish water, Kerr Bight, Salinity, Hydrogen ion concentration, Temperature effects, Chlorophyll, Seasonal variation.

Continuously recording devices were used to measure diurnal and seasonal variations in net photosynthesis, dark respiration and net primary production of the alga Chara tomentosa in a brackish water bight, Kerr Bight, beside the Zingster Strom. The diurnal variations in the net photosynthesis rate closely followed the variations in the photosynthetically active radiation (PhAR) flux under water. The dependence of the net photosynthesis rate on the PhAR flux is represented by a saturation curve with the light compensation point at 1.9 J/sq cm/hr and light saturation >25 J/cu cm/hr. The net photosynthesis fluence correlated with the PhAR fluence. The dependence of net photosynthesis fluence on the PhaR fluence was linear and showed no tendency towards light saturation under the natural light regime. Photosynthesis correlated better with the PhAR under water than with global radiation. Net photosynthesis did not correlate with the temperature, salinity or hydrogen ion concentration of the water or with the chlorophyll content of the plants, but only with radiation. Dark respiration correlated positively with the water temperature and, possibly, negatively with the salinity. There was a negative correlation between net primary production and water temperature. The chlorophyll content of Chara tomentosa was subject to seasonal variations which exhibited a delayed inverse relationship to similar variations in the radiation fluence. (Peters-PTT)
W86-05151

MONTE CARLO SIMULATION OF SNOW DEPTH IN A FOREST,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M. -K. Woo, and P. Steer.
Water Recources Research WRERAO, Vol. 22, No. 6, p 864-868, June 1986. 5 fig, 1 tab, 7 ref.

Descriptors: *Snow surveys, *Runoff forecasting, *Monte Carlo method, *Simulation analysis, *Snow depth, *Forests, Cost analysis, Field tests, Mathematical analysis, Model studies, Mathematical studies, Ontario, Spruce trees.

To reduce the cost of extensive field sampling for obtaining mean depths of snow in forests, a simulation model was developed. First the location of individual trees in a representative portion of the forest is either surveyed in the field, or simulated based on the statistical characteristics pertaining to the distribution of trees. In this forest, a large number of randomly located sample points is generated by Monte Carlo technique. The azimuth and distance from each point to the nearest tree is determined, and a snow depth simulated based on the observed snow depth distribution around individual trees. The model was applied successfully to a northern spruce forest in subarctic Ontario, showing that this simulation provides a useful approach to determine mean snow depth. (Lantz-PTT)
W86-05244

2D. Evaporation and Transpiration

PREDICTIONS OF SOIL-WATER POTENTIALS IN THE NORTH-WESTERN SONORAN DESERT,
California Univ., Los Angeles. Dept. of Biology.
For primary bibliographic entry see Field 2G.
W86-04695

SEASONAL AND DIURNAL VARIATION OF ENERGY BUDGET COMPONENTS IN CONIFEROUS FORESTS,
Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
A. Lindroth.
Journal of Hydrology, Vol. 82, No. 1/2, p 1-15, November 1985. 6 fig, 1 tab, 29 ref.

Descriptors: *Seasonal variation, *Diurnal variation, *Energy budget, *Coniferous forests, *Evapotranspiration, Net radiation, Heat flux, Energy storage, Sweden, Air temperature, Soil water, Precipitation.

Simultaneous measurements of evapotranspiration from the ground vegetation and the whole forest were made in a coniferous forest in Sweden. About 59% of the net radiation was used for latent heat flux, 32% for sensible heat flux, and 9% for storage. Only 13% of the latent heat flux came from the ground vegetation while more than 50% of the sensible heat flux originated from the ground. The rate of latent heat flux from forests does not constitute a constant fraction of the net radiation. Monthly mean daytime latent heat flux varies relatively little during the season for a specific forest. Soil water availability, averaged over a longer period, might be a better scaler for mean rate of latent heat flux than the density of the forest. (McFarlane-PTT)
W86-05296

2E. Streamflow and Runoff

HYDRAULICS OF TWO FLOWING LAYERS WITH DIFFERENT DENSITIES,
Scripps Institution of Oceanography, La Jolla, CA.
L. Armi.
Journal of Fluid Mechanics, Vol. 163, p 27-58, 1986. 6 fig, 28 ref, 2 append.

Descriptors: *Two-layer flow, *Froude number, *Density currents, *Sill, *Contraction, *Mathematical analysis, *Critical flow, Subcritical flow, Supercritical flow, Fluid mechanics, Internal hydraulics, Channel width, Flow contraction.

A theoretical and experimental study describes the basic hydraulics of two flowing layers. A new treatment of their internal hydraulics of two-layer flows parametrized the flows in terms of the internal Froude numbers for each layer. This permitted presentation of all possible flows for two layers through contractions and over sill for selected values of the flow ratio, q sub r. The effects of a sill on a two-layer flow differ from those of a contraction, because the sill only directly contacts the bottom layer and the upper layer's response is indirect. With parametrization in terms of the internal Froude numbers and presentation of flow solutions as curves of the Froude-number plane, the conditions for critical flow, which define all of the essential characteristics of the internal hydraulics, become a straight line separating the plane into subcritical and supercritical regions. This has allowed the solutions to be easily interpreted and shows clearly the location of controls, including virtual controls, multiple solutions, matching conditions, and hydraulic jumps. For a contraction, specification of the flow rate alone does not lead to a unique solution. In the general case, with control at the narrowest section of a contraction, there are two distinct solutions. Laboratory experiments confirm their existence. In contrast to free-surface flows, two-layer flows can be internally critical at other than the narrowest section of the channel. (Rochester-PTT)
W86-04714

RIVER MECHANICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2J.
W86-04750

DAILY FLOW STATISTICS OF ALASKAN STREAMS,
National Weather Service, Anchorage, AK. Alaskan River Forecast Center.
For primary bibliographic entry see Field 4A.
W86-04784

ADVANCES IN HYDROMETRY.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W86-04785

UP-DATING OF DISCHARGE RATING CURVES BY MEANS OF MATHEMATICAL MODELS,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 7B.
W86-04789

METHOD FOR UNIFORMIZING THE STAGE-DISCHARGE RELATIONS OF STABLE RIVER BEDS AND ITS APPLICATION,
Yangtze Valley Planning Office, Wuhan (China).
For primary bibliographic entry see Field 7B.
W86-04790

EQUATIONS FOR ESTIMATING DISCHARGE IN STEEP CHANNELS WITH COARSE BED MATERIAL,
Institute of Hydrology, Wallingford (England).
J. C. Bathurst.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 63-71, 5 tab, 10 ref.

Descriptors: *Channels, *Mathematical equations, *Discharge measurement, *River beds, *Stage-discharge relations, Flow discharge, Mathematical models, Sediment transport, Model studies, Hydrometry, Flow characteristics.

The use of process-based conveyance equations for estimating discharge in steep channels with coarse bed material is discussed. As the hydraulic characteristics of such channels often preclude direct gagin techniques, it is necessary to use the indirect slope-area method in which peak discharges are calculated as functions of channel slope and conveyance, the latter itself being a function of channel cross-sectional shape and bed material size. Previous application has been hampered by a lack of knowledge concerning flow processes in steep channels but, with the equations now available, variations of conveyance with depth, bed material size and sediment movement can be estimated.

Using data from the Yemen Arab Republic, it is shown that discharge predictions by these equations have an accuracy of about 10% for low flows and are of the correct order of magnitude at a flood flow. The construction of a stage/discharge relationship is demonstrated and assumptions behind the method are discussed. (See also W86-04785) (Author's abstract)
W86-04791

MULTILAYER WIDTH-INTEGRATED VELOCITY MEASUREMENT METHOD,

Fujian Provinicial Hydrometric Station, Fuzhou (China).
For primary bibliographic entry see Field 7B.
W86-04792

SATELLITE DATA AS BASIS FOR THE ESTIMATION OF RAINFALL AND RUNOFF,

Bochum Univ. (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W86-04809

DETERMINATION OF A MEASURING NETWORK ALONG RIVERS,

Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W86-04811

RIVER BASINS,

Food and Agriculture Organization of the United Nations, Rome (Italy).
For primary bibliographic entry see Field 8I.
W86-04816

RECENT DEVELOPMENTS IN THE EXPLANATION AND PREDICTION OF EROSION AND SEDIMENT YIELD.

International Association of Hydrological Sciences.
For primary bibliographic entry see Field 2J.
W86-04896

EFFECTS OF WATER DEVELOPMENT ON THE HYDROLOGY AND MORPHOLOGY OF PLATTE RIVER CHANNELS, SOUTH-CENTRAL NEBRASKA,

Geological Survey, Denver, CO.
R. F. Hadley, and T. R. Eschner.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 3-10, 4 fig, 1 tab, 10 ref.

Descriptors: *Industrial development, *Agricultural hydrology, *Water resources development, *Hydrological aspects, Water level, Water management, Streamflow, Water supply development, Dams, Platte River, Colorado, Wyoming, Nebraska.

The channels of the Platte River and its major tributaries, the North Platte and South Platte Rivers in Colorado, Wyoming and Nebraska have undergone major changes in hydrologic regime and morphology since about 1860. These changes are attributed here to water development for agricultural, municipal, and industrial uses. Prior to water development in the nineteenth century, the Platte River was a wide (approximately 2 km), shallow (1.8 - 2.4 m) river characterized by bankfull spring floods and low summer flows. Since development, the channels have changed significantly. Channel widths in the 1970's at six locations between Cozad and Ashland, Nebraska, ranged from 9 to 92% of the 1860 widths. Flow regulation by onstream dams and reservoirs, diversions of surface water, power generation, and other uses have also had significant effect on the hydrology of the basin. (See also W86-04896) (Author's abstract)
W86-04897

EFFECTS OF SLOPE LENGTH AND TERRACING ON RUNOFF AND EROSION ON A TROPICAL SOIL,

International Inst. of Tropical Agriculture, Ibadan (Nigeria).
R. Lal.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 23-31, 5 fig, 5 tab, 11 ref.

Descriptors: *Runoff, *Soil erosion, *Erosion control, Soil stability, Erosion rates, Sediments, Sediment control, Sediment erosion, Agricultural engineering, Nigeria, Slopes.

Runoff and soil erosion measurements were made for 5, 10, 12.5, 15, 20, and 37.5 m slope lengths on tropical soils of 10 and 15% slopes in western Nigeria. Comparisons were also made for runoff and erosion from terraced and unterraced basins of 3-4 ha in size and managed with the conventional and no-tillage systems. Runoff per unit area was more from short than long slopes and decreased at the rate of 6 mm/m/yr. On the contrary, the soil erosion increased linearly with the increase in slope length at the rate of 2.4 t/ha/m for slope lengths between 5 and 20 m. The sediment load per unit runoff also increased with the increase in slope length at the rate of 25 kg/mm/m. Terracing decreased erosion and water runoff on ploughed basins, and was not necessary on untilled basins. The no-till system with crop residue mulch is an effective erosion preventive measure. (See also W86-04896) (Author's abstract)
W86-04899

LONG TERM PREDICTION OF THE EXTREMES OF RIVER BED LEVEL FLUCTUATIONS,

Institute of Meteorology and Water Management, Warsaw (Poland).
J. Branski, and J. Zelanzinski.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 117-122, 1 fig, 1 tab, 3 ref.

Descriptors: *Stream flow, *Erosion, *Sediments, *River beds, transport, Sediment erosion, Flow, Sediment load, Sediment carrying capacity, Flow measurement, Vistula River, River mechanics.

The extremes of river bed fluctuations are controlled by accumulation processes which are closely related to flow variations. Because of problems in developing a physically-based model of such fluctuations it is useful to consider them as a random process and to develop probabilistic models for prediction. Data obtained for a number of flow gaging stations on the River Vistula have been used to develop long term records of bed level fluctuations. These fluctuations have been described using a simple probabilistic model with a linear trend component and a normal random deviation component. This model has been fitted successfully to records from five gaging stations on the Vistula and permits prediction of bed level variations up to the year 2020. (See also W86 - 04986) (Author's abstract)
W86-04909

SURFACE FLOW AND EROSIONAL PROCESSES IN SEMIARID MESCOSCALE CHANNELS AND DRAINAGE BASINS,

Scarborough Coll., Westhill (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W86-04910

GULLY HYDROLOGY AND RELATED SOIL PROPERTIES IN LESOTHO,

National Univ. of Lesotho, Roma.
Th. Faber, and A. C. Imeson.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 135-144, 3 fig, 7 tab, 16 ref.

Descriptors: *Gullies, *Hydrology, *Runoff, *Rainfall-runoff relationships, Erosion, Africa, Soil properties, Sedimentation, Hydrographs, Lesotho, Roma, Maama Gully.

The lowland soils and recent sediments of western Lesotho in southern Africa have been and are being seriously damaged by gully erosion. The runoff events recorded during the wet season of 1979/1980 in the Maama Gully near Roma, Lesotho, are described together with a number of soil properties which are thought to influence gully runoff and erosion. Runoff events are of very short duration and constitute only a small percentage of the total basin precipitation. Most rainfall was easily retained by the catchment soils. Relationships between rainfall and runoff events are described and discussed. It is concluded that most runoff is generated close to the gully on the motorable trackways and that during the period of study more material was eroded from the gully headcuts than left the gully at the gauging station. The evacuation of sediment must be the result of runoff events more extreme than those observed. Attention is drawn to differences between the Maama gully and many of the other gullies in Lesotho where piping is important. (See also W86-04896) (Author's abstract)
W86-04911

DEVELOPMENT OF A PROCEDURE TO ESTIMATE RUNOFF AND SEDIMENT TRANSPORT IN EPHEMERAL STREAMS,

Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
For primary bibliographic entry see Field 2J.
W86-04925

REAERATION RATE ESTIMATION USING THE LAG IN DISSOLVED OXYGEN CONCENTRATION,

Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
M. G. Waldon.
Journal of Environmental Science and Health JESEDU, Vol A20, No. 6, p 661-679, August 1985. 3 fig, 1 tab, 6 ref. Dept of Interior cooperative agreement 14-34-0001-1120, OWRT project no. A-054-LA.

Descriptors: *Reaeration coefficient, *Dissolved oxygen concentration *Peak lag method, Hydrology, Streams.

Two new methods are derived for the estimation of the reaeration coefficient in a stream. The first method, termed the 'peak lag method' (PLM), calculates the reaeration coefficient, K, using the observed time lag between solar noon and the maximum afternoon dissolved oxygen concentration. Computer simulation demonstrates that this technique is less accurate for small values of K or short day length. By using a correction term calculated from the observed time lag and the day length, a second technique, termed the 'modified PLM,' is developed which has improved accuracy in these situations. These methods require only 3 to 5 hours of monitoring to determine the time of the peak, avoiding the logistical problems associated with monitoring throughout the night. Moreover, the PLM does not require data on stream temperature or light intensity, and requires dissolved oxygen data only during the afternoon around the time of its peak value. The PLM also may provide secondary estimates of the reaeration coefficient to corroborate the estimates of older and more widely accepted techniques. (Doria-PTT)
W86-05060

HYDROLOGIC CHARACTERISTICS AND MODELLING OF A SMALL FORESTED CATCHMENT IN SOUTHEASTERN NEW SOUTH WALES. PRE-LOGGING CONDITION,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water

and Land Resources.
I. D. Moore, S. M. Mackay, P. J. Wallbrink, G. J. Burch, and E. M. O'Loughlin.
Journal of Hydrology, Vol. 83, No. 3/4, p 307-335, March 1986. 3 tab, 11 fig, 33 ref.

Descriptors: *Australia, *Catchment basins, *Rainfall-runoff relationships, New South Wales, Geebung Creek, Hydraulic conductivities, Model studies, Forests, Storm runoff, Vegetation effects, Hydrologic models, Storm seepage, Saturation zone, Land use, Hydrologic properties.

Analysis of the storm event rainfall and runoff data and other physical data from the undisturbed Geebung Creek catchment (about 30 km inland from the southeast coast of New South wales in the 51,300 ha Yambulla State Forest, Australia) shows that its hydrologic behavior is well described by the variable source area concept. Runoff is believed to occur mainly from saturated source areas that are fed by rapid subsurface flow from upslope. A theoretical steady-state saturation zone model has been applied to identify the size and location of zones of saturation in the landscape under a range of wetness conditions. Field observations confirm the general predictions made by the model. Linkage of the results from this model with a simple rainfall-runoff model provides a means of modelling the hydrologic response of the catchment to precipitation in terms of the dynamic expansion and contraction of the saturated source areas. The results of the rainfall-runoff simulation on the Geeburg Creek catchment are very good, indicating that this methodology may have considerable potential for evaluating impacts of land use change on the hydrology of certain types of catchments, at the process level. The modelling techniques adopted have the potential to greatly increase the predictive power of such process models. It may thus provide a rational and quantitative basis for the extrapolation of results obtained from limited observations on experimental treatment effects imposed on the vegetation and soils of specific catchments. (Peters-PTT)
W86-05116

OBJECTIVE IDENTIFICATION OF MEANDERS AND BENDS,

State Univ. of New York at Buffalo. Dept. of Geography.
M. P. O'Neill, and A. D. Abrahams.
Journal of Hydrology, Vol 83, No. 3/4, p 337-353, March 1986. 2 tab, 9 fig, 34 ref.

Descriptors: *Meanders, *Bends, Mansfield Creek, Channel morphology, New York, Mathematical studies, Stream banks, Streams.

A distinction is made between simple half-meanders, which contain a single bend, and complex half-meanders, which contain multiple bends. A method of objectively identifying such half-meanders and bends along a channel reach is developed. Traditional methods of studying meander planform geometry have assumed that meanders contain a single bend or apex and that the inflection points or half-meander endpoints can be identified unambiguously. Along many meandering channel reaches both assumptions are often violated. The planform differencing technique is based on direction-change measurements made at a fixed-point interval along the channel and uses a single criterion variable, the half-meander tolerance, to identify half-meanders and bends alike. A second criterion variable, the bend tolerance, is employed to determine the lengths of bends. The planform differencing technique permits meanders and bends to be identified on the basis of explicitly stated quantitative criteria and yields reproducible and spatially consistent results. When the technique was applied to a small meandering stream in Western New York (Mansfield Creek, approximately 65 km south of Buffalo, NY), it revealed that almost half the bends do not contain pools. The dearth of pools in relatively open bends is at odds with the idea that bends form at pools by the lateral migration of the outswinging channel thalweg. The development of bends at locations other than pools appears to be caused mainly by inhomogeneities in the bank material. (Peters-PTT)
W86-05117

EPIPELIC ALGAL FLORA OF THE RIVER WYE SYSTEM, WALES, UK. 1. PRODUCTIVITY AND TOTAL BIOMASS DYNAMICS,

University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W86-05158

SOME OBSERVATIONS ON HOCHSTETTER'S FROG IN THE CATCHMENT OF THE MOTU RIVER, EAST CAPE,

Department of Scientific and Industrial Research, Havelock North (New Zealand). Ecology Div.
For primary bibliographic entry see Field 2H.
W86-05197

DRAINAGE FROM A UNIFORM SOIL LAYER ON A HILLSLOPE,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
F. Stagnitti, M. B. Parlange, T. S. Steenhuis, and J.-Y. Parlange.
Water Resources Research WRERAO, Vol. 22, No. 5, p 631-634, May 1986. 1 fig, 17 ref. University Research Grant and Australian Research Grant Scheme F 84161771.

Descriptors: *Drainage, *Rainfall-runoff relationships, *Uniform soil layer, *Slopes, *Runoff, Streamflow, Model studies, Mathematical studies, Appalachian Mountains, Richards equation, Mathematical models, Soil water, Hydrologic models.

A simplified drainage model adapted from previous research, has been demonstrated to provide a good approximation of Richard's equation when applied to the this data was obtained through observations collected from a small and well-defined hillslope segment at the Coweeta Hydrological Laboratory, in the southern Appalachian mountains. The model gives reliable prediction of both short- and long-term drainage. The one distinct advantage that the simplified drainage model exhibits over other models, is that it is fully analytic and can be used to predict drainage and cumulative drainage profiles instantly and without recourse to computer algorithms. Such simplicity suggests possible future integration into existing models used for predicting watershed discharge. (Lantz-PTT)
W86-05209

MIGRATION PATTERNS OF AN ASYMMETRIC MEANDERING RIVER: THE ROUGE RIVER, QUEBEC,

National Hydrology Research Inst., Hull (Quebec).
M. F. LaPointe, and M. A. Carson.
Water Resources Research WRERAO, Vol. 22, No. 5, p 731-743, May 1986. 13 fig, 40 ref.

Descriptors: *River flow, *Meanders, *Rouge River. *Quebec. *Bank erosion, Sediment transport, Flow pattern, Flow velocity, Channel flow, Erosion, Suspended sediments.

The migration patterns responsible for the asymmetry of the highly sinuous Rouge River meanders, are described and related to the hydraulic and sediment transport patterns controlling bank erosion in these bends. Two elements of the overall migration patterns play important roles in maintaining asymmetry, and raise fresh questions concerning the understanding of erosion processes. The first is that significant outer bank erosion starts remarkably early at bend entrances, well before crossover of the high velocity filament. Second, such erosion extends far along the cross-valley reaches, despite the very gentle channel curvatures between meander apices. Data on high-flow suspended sediment transport and helix structure suggest how, beyond the control exerted near-bank shear stresses, the spatial patterns of near-bed primary and secondary flows can also exert an influence on the distribution of bank erosion, by controlling the evacuation of the influxes of eroded bank materials. (Lantz-PTT)
W86-05219

WATER DISCHARGE AND SUSPENDED SEDIMENT CONCENTRATIONS IN THE AMAZON RIVER: 1982-1984,

Washington Univ., Seattle. School of Oceanography.
J. E. Richey, R. H. Meade, E. Salati, A. H. Devol, and C. F. Nordin.
Water Resources Research WRERAO, Vol. 22, No. 5, p 756-764, May 1986. 6 fig, 3 tab, 18 ref. NSF Grant No. BSR-8107522.

Descriptors: *Water discharge, *Suspended sediments, *Amazon River, Water measurement, Sediment transport, Sediment load, Data acquisition, Data interpretation, Vargen Grande, Rio Madeira, San Jose du Amatari, Brazil, Current meters, Sampling, Velocity.

An equal-width-increment procedure was developed to measure water discharge and the suspended sediment load of the Amazon River and its principal tributaries. A variable speed hydraulic winch deploys an instrument array of a sounding weight, Price current meter, and collapsible bag sampler by lowering it from the surface to the bottom and back at a constant velocity. Eighteen verticals are taken at main stem stations (fewer on tributaries), with positioning determined by shipboard observation with a sextant monitoring angles from a three-marker baseline on the shore. Confidence intervals (95%) for discharge and the fluxes of fine (<0.063 mm) and coarse (>0.063 mm) suspended sediments (CSS) were 5%, 10% and 20% respectively. Water discharge varied from 31,700 cu m/s to 203,000 cu m/s downriver at Obidos. Concentrations of fine suspended sediments (FSS) generally decreased downstream from 220-490 mg/L at Vargem Grande to 110-250 mg/L at Sao Jose do Amatari. Large concentrations fo FSS at high water in the Rio Maderia of 590-770 mg/L increased downstream concentrations of FSS in the Amazon. CSS had some of the same distribution and transport patterns as the FSS, but with only 20-30% of the concentration. (Lantz-PTT)
W86-05222

FLOOD FREQUENCY ANALYSIS WITH HISTORICAL AND PALEOFLOOD INFORMATION,

Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and T. A. Cohn.
Water Resources Research WRERAO, Vol. 22, No. 5, p 785-793, May 1986. 6 fig, 5 tab, 43 ref, append. NSF Award CEE-8351819.

Descriptors: *Floods, *Frequency analysis, *Historic floods, Literature reviews, Monte Carlo method, Flood recurrence interval, Flood forecasting, Statistical analysis.

An investigation was made of flood quantile estimators which can employ 'historical' and paleoflood information in flood frequency analyses. Through an extensive literature review, two categories of historical information were obtained: 'censored' data, where the magnitudes of historical flood peaks are known; and 'binomial' data, where only threshold exceedance information is available. A Monte Carlo study employing the two-parameter lognormal distribution shows that maximum likelihood estimators (MLEs) can extract the equivalent of an additional 10-30 years of gage record from a 50-year period of historical observation. The MLE methods performed well even when floods were drawn from other than the assumed lognormal distribution. (Lantz-PTT)
W86-05225

PREDICTION OF SURFACE SATURATION ZONES IN NATURAL CATCHMENTS BY TOPOGRAPHIC ANALYSIS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
E. M. O'Loughlin.
Water Resources Research WRERAO, Vol. 22, No. 5, p 794-804, May 1986. 8 fig, 17 ref.

Descriptors: *Surface water, *Saturation zone, *Topography, *Storm runoff, *Soil saturation, Catchment basins, Drainage patterns, Geohydrology, Soil properties, Transmissivity, Slopes, Prediction, Surface runoff, Transpiration.

The topography of hillslopes or whole catchments is analyzed numerically to calculate local geometric and drainage attributes that can be combined to test for the expectation of soil waterlogging. At locations where the accumulated drainage flux from upslope exceeds the product of soil transmissivity and the local slope, saturation to the soil surface occurs. Results of an analysis of specific landscapes are presented as a location dependent function. The function may be mapped as isolines to define successive boundaries of zones of soil saturation, depending on the wetness state of the landscape as a whole. The analysis is applied to two catchments, to predict the growth or contraction of zones of waterlogging for a range of drainage fluxes, and to simulate the effects of transpiration changes in part or all of the catchment. In the second application, the predicted boundaries of saturated zones are used to calculate the minimum proportion of a catchment's area that produces rapid surface runoff. This proportion is shown to depend on the value of a normalized wetness parameter. Storm runoff data has been shown to support the predicted form of the relationship. (Lantz-PTT)
W86-05226

OVERLAND FLOW HYDROGRAPHS FOR SCS TYPE II RAINFALL,

Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. O. Akan.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 276-286, September 1985. 10 fig, 11 ref.

Descriptors: *Overland flow, *Rainfall-runoff relationships,*Hydrographs, *Rainfall, *Infiltration, Mathematical analysis, Mathematical equations, Kinematic waves, Flow profiles, Runoff.

A mathematical model, founded on the kinematic-wave and Green-Ampt equations, is presented for the conjunctive overland flow-infiltration process. The following conclusions were drawn from this study: 1) Only three physically-based nondimensional parameters are sufficient to describe the conjunctive overland flow-infiltration process resulting from any rainfall of which the time distribution of intensity is specified; 2) Overland flow hydrographs for the 24-hr SCS-Type II rainfall can be approximated by triangular hydrographs; 3) It is possible to evaluate the triangular hydrographs in terms of three physically-based parameters, namely alpha*, K*, and P* representing the basin and rainfall characteristics; and, 4) The synthetic triangular hydrograph proposed in this paper predicts the peak discharge, the time of occurrence of the peak discharge and the volume of runoff before and after the hydrograph peak as accurately as a mathematical model founded on the kinematic overland and the Green-Ampt infiltration equations. (Lantz-PTT)
W86-05239

FLOOD FREQUENCY ANALYSIS USING THE COX REGRESSION MODEL,

Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and A. F. Karr.
Water Resources Research WRERAO, Vol. 22, No. 6, p 890-896, June 1986. 2 fig, 3 tab, 22 ref, append.

Descriptors: *Flood frequency, *Frequency analysis, *Cox regression model, Flood forecasting, Water resources, Mathematical studies, Mathematical models, Appalachian Plateau, Snowpack, Flood control, Reservoirs, Soil moisture.

The Cox regression model provides a flexible tool for incorporating time-varying exogenous information pertaining to processes such as soil moisture storage, snow pack, and frozen ground into flood frequency analyses. The flood frequency model developed was based on the Cox regression model and simultaneously generalizes partial duration series models and mixture distribution models. Two applications of the model are illustrated. The model can be used in a hypothesis testing framework to assess the importance of specific processes on flood frequency at a site. Specifically, some estimation procedures are presented and a partial likelihood ratio test is developed for assessing the significance of 'covariates.' Inference procedures are applied to a 240 square mile catchment on the Appalachian Plateau. In this example, the covariate processes are snow pack and soil moisture storage. The Cox regression model can also be used to provide time-varying flood frequency estimates for water resource management problems. A formulation for a 'flood warning problem' is presented, based on the Cox regression model. In this example, operation of flood control storage of a reservoir is tied to time-varying estimates of flood risk. (Lantz-PTT)
W86-05248

EFFECT OF SERIAL CORRELATION ON RESERVOIR SIZE,

Monash Univ., Clayton (Australia).
For primary bibliographic entry see Field 2H.
W86-05253

RESISTANCE TO FLOW AND VELOCITY DISTRIBUTION IN RIGID BOUNDARY CHANNELS CARRYING SEDIMENT-LADEN FLOW,

M.B.M. Coll. of Engineering, Jodhpur (India).
A. K. Arora, K. G. R. Raju, and R. J. Garde.
Water Resources Research WRERAO, Vol. 22, No. 6, p 943-951, June 1986. 10 fig, 1 tab, 17 ref.

Descriptors: *Flow resistance, *Open channel flow, *Flow profiles, *Flow velocity, *Channel flow, *Sediment transport, Mathematical analysis, Boundary channels, Velocity distribution.

An experimental study on the characteristics of sediment-laden flow in rigid boundary open channels is reported. The data indicate that the friction factor for sediment-laden flows may be larger or smaller than that for clear water flow under the same conditions. The conditions leading to a decrease or increase in the friction factor have been identified, and a predictor was developed for the friction factor when it is greater than that for clear water flow. A velocity defect law has been obtained; the maximum velocity, in turn, is related to the average velocity in the cross section, the friction factor, and the aspect ratio. The results from the proposed law of velocity distribution are better than those from the existing laws for sediment-laden flow in rigid boundary channels. (Lantz-PTT)
W86-05255

2F. Groundwater

SPECIFIC HYDROMETRY OF KARST REGIONS,

Split Univ. (Yugoslavia). Faculty of Engineering.
O. Bonacci.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 321-333, 6 fig, 9 ref.

Descriptors: *Karst, *Hydrometry, *Ponors, *Poljes, *Hydrologic data collections, Piezometers, Water level, Boreholes, Borehole geophysics, Mathematicl studies, Rivers, Water loss, Sinks, Discharge measurements, Mathematicl models, Geohydrology, Groundwater, Remote sensing, Tracers, Springs.

Hydrologic data gathering methods in karst are presented. Measurement methods for water phenomena in karst can be classified as follows: piezometric boreholes in karst; tracers, speleological investigations; remote sensing; geophysical measurement methods; measurement of chemical composition of water and suspended and mineral substances in water; measurement of water temperature; and classical and specific hydrometric measurements in karst. Spring discharge curves can be obtained using water levels measured in piezometric boreholes in karst. Methods for organizing discharge measurements and establishing water losses along river channels in karst, whether in stationary and stagnant conditions or in non-steady flows are described. Some experiences with measuring and defining the ponor swallow capacity in the poljes subsystems of karst are examined. (See also W86-04785) (Geiger - PTT)
W86-04812

GROUNDWATER MOVEMENT STUDIED,

D. Senet, and B. Solomon.
Agricultural Research, Vol. 34, No. 1, p 12-13, January 1986. 2 fig.

Descriptors: *Irrigation, *Soil water movement, *Groundwater movement, *Groundwater pollution, *Soil water, Potassium bromide, Pasture, Agricultural Research Service.

Agricultural Research Service scientists have been studying preferential flow of irrigation water through the soil beneath fields. Previously, preferential flow of water through soil had been thought to be mainly associated with cracks, root holes, and worm holes. Such a flow can occur without large, obvious pores. Apparently added water was passing old water in the soil, and thus moving much faster than expected. In other studies, potassium bromide was applied to pastureland. The peak concentration was found 21 to 24 months later in water samples collected from springs supplied by the test watershed, and there was no significant decrease in concentration after 4 years. (Rochester-PTT)
W86-04983

MONITORING WELL SCREEN INFLUENCES ON DIRECT FLOWMETER MEASUREMENTS,

K-V Associates, Inc., Falmouth, MA.
For primary bibliographic entry see Field 7B.
W86-05026

VOLATILE ORGANIC CHEMICAL CONTAMINATION OF GROUNDWATER RESOURCES IN THE U.S.,

For primary bibliographic entry see Field 5B.
W86-05028

EVOLVING CONCEPTS OF SUBSURFACE CONTAMINANT TRANSPORT,

Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W86-05029

BROMOFORM FORMATION IN OZONATED GROUNDWATER CONTAINING BROMIDE AND HUMIC SUBSTANCES,

Florida International Univ., Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5F.
W86-05043

FIELD VALIDATION OF THE GEOHYDROLOGY SIMULATION MODEL, FEWA,

Miami Univ., Coral Gables, FL. Coll. of Engineering.
For primary bibliographic entry see Field 5B.
W86-05071

TWO-DIMENSIONAL POLLUTANT MIGRATION IN SOILS OF FINITE DEPTH,

University of Western Ontario, London. Geotechnical Research Centre.
For primary bibliographic entry see Field 5B.
W86-05102

ANALYTICAL SOLUTIONS FOR STRIP BASIN RECHARGE TO AQUIFERS WITH CAUCHY BOUNDARY CONDITIONS,

Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.

Journal of Hydrology, Vol. 83, No. 3/4, p 197-206, March 1986. 3 fig, 13 ref, append.

Descriptors: *Artificial recharge, *Aquifer characteristics, *Aquifers, *Recharge basins, *Groundwater recharge, Boundary conditions, Clogged stream bed, Basins, Mathematical models, Unconfined aquifers.

Analytical solutions for groundwater recharge from strip basins to finite aquifers are presented. The analysis comprises two cases of recharge regime: continuous (constant rate) and period recharge (seasonal variation). The solutions can be useful for assessing response as well as for calibrating numerical computer models. (Peters-PTT)
W86-05108

IN-SITU STUDY OF THE OCCURRENCE AND RATE OF DENITRIFICATION IN A SHALLOW UNCONFINED SAND AQUIFER,

Research Council of Alberta, Edmonton. Terrain Sciences Dept.
For primary bibliographic entry see Field 5B.
W86-05112

MODELLING OF RIVER WATER INFILTRATION USING OXYGEN-18 DATA,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
W. Stichler, P. Maloszewski, and H. Moser.
Journal of Hydrology, Vol. 83, No. 3/4, p 355-365, March 1986. 3 tab, 8 fig, 3 ref.

Descriptors: *Mathematical models, *Infiltration, *Rivers, *Groundwater, Danube River, Passau, Environmental tracers, Observation wells, Model studies, Isotopic tracers, Flow, Stream banks.

Measurements of (18)O-content were used to determine the portion of bank infiltrated river water making up the groundwater of a 0.3 sq km island in the Danube River near Passau (F.R.G). Values of 77 and 96% were found for different measuring points. Applying mathematical flow models to the environmental tracer data, mean transit times of 48-120 days for the bank infiltrated water and a dispersion parameter of about 0.12 have been calculated. These estimates permitted prediction of the migration of possible pollution from the river to the observation and production wells. The successful use of this method for such bank filtration studies depends on a proper determination of input and output functions, and a significant isotopic difference between river water and groundwater. In this study the input function was measured directly in the river water. The sampling frequency of two samples per week of river water and of the water in the observation and production wells was high enough for calculating the mean monthly (18)O-content with sufficient accuracy. The (18)O-content of groundwater not influenced by bank filtrated river water was practically constant with time and clearly different from that of the river water. (Peters-PTT)
W86-05118

DECAY OF A DISTURBED FREE SURFACE IN AN ANISOTROPIC POROUS MEDIUM,

Norges Landbrukshoegskole, Aas. Dept. of Physics and Meteorology.
P. A. Tyvand.
Journal of Hydrology, Vol. 83, No. 3/4, p 367-371, March 1986. 4 ref.

Descriptors: *Anisotropy, *Groundwater movement, Porous media, Mathematical studies.

A two-dimensional linear theory of the decay of a disturbed free surface in an anisotropic porous layer is given. The porous medium is homogeneous and has an arbitrary two-dimensional anisotropy. The tilt of the streamlines is studied, and a formula for the decay rate is found. The decay of a disturbed free surface is an exceptionally simple mathematical problem: It allows an exact analytical solution also for the case where the principal axes are oblique to the coordinate axes. (Peters-PTT)
W86-05119

DETERMINATION OF SATURATED HYDRAULIC CONDUCTIVITY FROM SOIL PERCOLATION TEST RESULTS,

Oxford Univ. (England).
For primary bibliographic entry see Field 2G.
W86-05124

ANALYSIS OF GROUNDWATER QUALITY DATA OBTAINED FROM PRIVATE INDIVIDUAL WATER SYSTEMS IN PENNSYLVANIA,

Pennsylvania State Univ., University Park. School of Forest Resources.
W. E. Sharp, D. W. Mooney, and R. S. Adams.
Northeastern Environmental Science, Vol. 4, No. 3-4, p 155-159, 1985. 3 tab, 5 ref.

Descriptors: *Groundwater pollution, *Water quality, *Monitoring, *Hydrologic data collections, *Coliforms, Wells, Nitrates, Sulfates, Drinking water, Groundwater, Geohydrology, Geology, Sodium, Acidity, Alkalinity, Turbidity.

Groundwater quality data were collected from all regions of Pennsylvania from 1874 to 1983 as a public service by the Soil and Forage Testing Laboratory, the Pennsylvania State University. The samples represented sources in which there was a perceived water quality problem. These data are summarized by origin or source water and region. Spring water supply sources were more frequently contaminated with bacteria than well water sources and 40% of all private individual water supplies sampled were contaminated by coliform bacteria. Computations of Ryznar Stability Index indicated that 59% of all individual water supplies had corrosive water. There were no statistically valid differences in the quality of water from wells under 80 ft deep as opposed to wells over 80 ft deep for any of the parameters measured except sodium which was greater in the deeper wells. Regional groundwater quality differences apparent in the data and seemed to be influenced by regional geology and groundwater pollution activities. The intensively farmed, carbonate areas of the Southeast and Southcentral regions had the highest median nitrate levels while the resistant rocks of the Northcentral region had the highest median Ryznar Stability Index value. Springs had significantly higher Ryznar Stability Index values than wells, indicating a possible atmospheric deposition influence for groundwaters with shorter residence times. Sulfates were highest in the Southwest where groundwater pollution from coal mining was prevalent. A substantial number of the private individual drinking water supplies did not meet drinking water standards. (Author's abstract-PTT)
W86-05140

GROUNDWATER RECHARGE ESTIMATE BY NUMERICAL MODELING: A CASE STUDY,

Port Harcourt Univ. (Nigeria). Dept. of Civil Engineering.
I. L. Nwaogazie.
Aqua AQUAAA, No. 2, p 77-80, 1986. 4 fig, 14 ref, 1 append.

Descriptors: *Groundwater recharge, *Mathematical modeling, *Case studies, Equilibrium, Irrigation water, Pumping, Water use, Model studies, Finite difference methods, Flow pattern, Groundwater movement, Groundwater availability.

The groundwater recharge parameter estimate of Pawnee Alluvial Valley, Kansas, prior to 1945, was performed under assumed conditions of steady state dynamic equilibrium. Pumpage for irrigation was very low, so the water table configuration was only minimally disturbed. A two-dimensional finite difference model was applied to a selected cross-section of the aquifer, generating head distribution for the development of equipotential lines and flow gradients. Simulation was geared toward the generation of a realistic flow pattern from a combination of anisotropic factors and layered cross-sections. An average recharge value of 1.30 in/yr was computed with corrections for both anisotropy and vertical exaggeration. (Lantz-PTT)
W86-05146

CURVILINEAR FINITE ELEMENT MODEL FOR SIMULATING TWO-WELL TRACER TESTS AND TRANSPORT IN STRATIFIED AQUIFERS,

GeoTrans, Inc., Reston, VA.
P. S. Huyakorn, P. F. Anderson, O. Guven, and F. J. Molz.
Water Resources Research WRERAO, Vol. 22, No. 5, p 663-678, May 1986. 13 fig, 1 tab, 27 ref. EPA Agreement CR 810704-01-0.

Descriptors: *Path of pollutants, *Injection wells, *Finite element method, *Model studies, *Simulation analysis, *Tracers, *Stratified flow, *Aquifers, *Groundwater movement, Solute transport, Mathematical models, Mathematical studies, Streamflow, Flow profile.

The problem of solute transport in steady nonuniform flow created by a recharging and discharging well pair was investigated. Numerical difficulties encountered with the standard Galerkin formulation in Cartesian coordinates are illustrated. An improved finite element solution strategy is presented to overcome the numerical problem, with the strategy based on a formulation performed in three-dimensional curvilinear coordinates. The formulation is developed especially for the simulation of two-well injection-withdrawal tracer tests conducted in homogeneous or stratified aquifers. The formulation can also be applied to other types of problems involving transport in homogeneous and stratified aquifers. A three-dimensional finite element approximation is derived by two successive applications of upstream weighted-residual and subdomain collocation procedures. First, the weighted residual procedure is formulated in the horizontal flow plane using curvilinear coordinates along normal streamlines. upstream weighting is included, but automatically controlled and limited to one dimension along the main flow direction. Second, the subdomain collocation procedure is formulated in the vertical dimension. Spatial discretization of the three-dimensional flow region is performed using a curvilinear finite element mesh that is point-centered in the horizontal plane and block-centered in the vertical direction. General algorithms are developed for mesh generation, time stepping and matrix reduction. The solution algorithm is designed to accomodate several thousand nodal unknowns with a minimal core storage and CPU time requirement. Two simulation examples are presented to verify and validate the numerical model in two dimensions using an analytical solution and experimental laboratory and field data. A comparative study shows that the proposed formulation is superior to the standard Galerkin formulation in Cartesian coordinates both in terms of accuracy and computational efficiency. The field simulation example indicates the need to conduct a more elaborate three-dimensional simulation study allowing for vertical variation in hydraulic conductivity. (Lantz-PTT)
W86-05213

GROUNDWATER FLOW AND SAND BODY INTERCONNECTEDNESS IN A THICK, MULTIPLE-AQUIFER SYSTEM,

Texas Univ. at Austin. Bureau of Economic Geology.
G. E. Fogg.
Water Resources Research WRERAO, Vol. 22, No. 5, p 679-694, May 1986. 15 fig, 1 tab, 38 ref. DOE Contract No. DE-AC97-80EV46617.

Descriptors: *Groundwater movement, *Aquifer systems, *Sand aquifers, Permeability, Conductivity, Geohydrology, Wilcox aquifer, Texas, Continuity, Mathematical studies, Model studies, Solute transport, Hydraulic head.

Many sandstone aquifers are actually multiple-aquifer systems, consisting of discontinuous sand bodies distributed complexly in a matrix of lower-permeability silts and clays. The arrangement and interconnectedness of these various lithofacies strongly influence spatial patterns of hydraulic conductivity (K) and, in turn, groundwater flow and mass transport. A promising technique for estimating such patterns of K involves careful analysis of both subsurface geologic and hydrologic data. In this study, the three-dimensional distribu-

tion of K was estimated for a numerical flow model of part of the Wilcox aquifer system in Texas, using K data from core samples and pumping tests, and more than 100 geophysical logs. The aquifer system, which is up to 320 m thick, consists of multiple, elongate sand bodies, and silts and clays deposited in a fluvial environment, and is similar to many other systems found in the Gulf Coast and other sedimentary basins. The resulting deterministic-conceptual flow model demonstrates the importance and methods of incorporating geologic information in groundwater models. Flow in the aquifer is shown to be controlled not so much by K of the sands as by their continuity and interconnectedness. Much of the aquifer system consists of large zones in which the fluvial channel-fill sands are sparse and apparently disconnected, resulting in groundwater flow rates lower by a factor of 100 to 10,000, than in adjacent, well-interconnected belts of fluvial channel-fill sand belts. Because the model is three-dimensional, sensitivity of hydraulic head to heterogeneity or interconnectedness is much less than normally observed in two-dimensional models, and therefore heads computed by the model give little to no indication of the location of well-interconnected zones. Thus such zones can easily go undetected, even in carefully calibrated models which yield reasonably accurate hydraulic heads. This is a significant point for the modeling of solute transport. (Lantz-PTT)
W86-05214

STOCHASTIC ANALYSIS OF THREE-DIMENSIONAL FLOW IN A BOUNDED DOMAIN,

Geological Survey, Denver, CO.
R. L. Naff, and A. V. Vecchia.
Water Resources Research WRERAO, Vol. 22, No. 5, p 695-704, May 1986. 7 fig, 13 ref.

Descriptors: *Stochastic processes, *Flow profiles, *Bound water, *Groundwater movement, Poisson ratio, Mathematical studies, Hydraulic head, Hydraulic conductivity, Aquifers, Model studies.

A commonly accepted first-order approximation of the equation for steady state flow in a fully saturated, spatially random medium has the form of Poisson's equation. This form allows for the advantageous use of Green's functions to solve for the random output (hydraulic heads) in terms of a convolution over the random input (the logarithm of hydraulic conductivity). A solution for steady state three-dimensional flow in an aquifer bounded above and below is presented; consideration of these boundaries is made possible by the use of Green's functions to solve Poisson's equation. Within the bounded domain, the medium hydraulic conductivity is assumed to be a second-order, stationary, random process as represented by a simple three-dimensional covariance function. Upper and lower boundaries are taken to be no-flow boundaries, with the mean flow vector lying entirely in the horizontal dimensions. This study indicates that as the flow path of a particle is restricted from three dimensions to two, the relative variance of the heads increases. If the flow path were further restricted so that one-dimensional flow perpendicular to layering occurred, then the head variance should increase yet more. However, if the restriction is such that flow is forced to parallel layering, then the head variances decrease. Head correlation increases with the transition from a three- to a two-dimensional flow system and then to one dimension with flow parallel to layering. The head correlation for one-dimensional flow perpendicular to layering, relative to two-dimensional flow, remains uninvestigated; intuitively, one would suppose that this one-dimensional flow case would have less head correlation than the two-dimensional case. (Lantz-PTT)
W86-05215

COMPARISON OF SEVERAL METHODS FOR THE SOLUTION OF THE INVERSE PROBLEM IN TWO-DIMENSIONAL STEADY STATE GROUNDWATER FLOW MODELING,

Geological Survey, Austin, TX. Water Resources Div.
L. K. Kuiper.
Water Resources Research WRERAO, Vol. 22, No. 5, p 705-714, May 1986. 1 tab, 8 ref.

Descriptors: *Groundwater movement, *Mathematical models, *Mathematical equations, *Statistical methods, Mathematical studies, Hydraulic conductivity, Hydraulic head, Kriging, Aquifers.

Two geostatistical approaches for the estimation of hydraulic conductivity and hydraulic head from hydraulic conductivity and hydraulic head measurements are developed for a two-dimensional steady flow with sinks. The first approach uses linearization of the discretized flow equations to allow the construction of a joint covariance matrix of the hydraulic head and log-conductivity measurements as functions of six possible parameters. It then uses maximum likelihood estimation to obtain these parameters and also a parameter associated with log-conductivity measurement error. Having found values for the parameters, it then uses kriging to form predictors for log-conductivity and hydraulic head from measured values of hydraulic conductivity and hydraulic head. The second approach uses kriging to form a parameter-dependent predictor for log-conductivity from measured hydraulic conductivity, and then uses this predicted log-conductivity placed into the discretized flow equations to compute hydraulic head. The parameters are determined by the minimization of the sum of the squares of the difference between the measured and computed hydraulic heads. A third approach simply allows the hydraulic conductivity field to be a step function with a different value for hydraulic conductivity assigned to each of several chosen regions in the two-dimensional aquifer. The assigned hydraulic conductivities are determined by the minimization of the sum of the squares of the difference between the measured and computer hydraulic heads. The three approaches are tested for hydraulic head prediction accuracy on two generated test problems, one of which is statistically generated, and also on a field problem. Results indicate that the third approach, despite its simplicity, performs as well or better than the other approaches. (Lantz-PTT)
W86-05216

COMPARATIVE STUDY OF THE GREEN AND AMPT ANALYSIS FOR A FALLING WATER TABLE IN A STRATIFIED PROFILE,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and S. A. Awadalla.
Water Resources Research WRERAO, Vol. 22, No. 5, p 723-730, May 1986. 13 fig, 6 ref.

Descriptors: *Groundwater movement, *Mathematical analysis, *Water table decline, *Stratified flow, Water table profile, Mathematical studies, Gravity flow, Porous media, Mathematical equations, Sands, Soil porosity.

General equations are developed for a Green and Ampt type analysis of gravity drainage for falling water table conditions in an initially saturated stratified profile of porous material, both with and without the presence of an applied surface flux. The particular type of stratification system considered is one in which a coarse sequence of porous material overlies a fine sequence. Two profiles are used in the analysis: 1) a medium-textured sand overlying a slightly finer sand; and 2) the same medium-textured sand overlying a sandy loam. The results obtained by analyzing these cases using algebraic equations, are compared with results obtained from a computer-based numerical analysis of the differential equation describing water movement in unsaturated porous media. The results of the numerical simulations are given in terms of pressure head profiles and water content profiles. From these data, detailed comparisons are made with the Green and Ampt results in terms of the discharge-time relationship and the position of the draining from with time. For the systems considered, the simplified sharp-front analysis gives results of reasonable accuracy suggesting that the model would be satisfactory for certain types of field studies. (Lantz-PTT)
W86-05218

SOIL WATER MOVEMENT AND RECHARGE THROUGH SAND AT A SEMIARID SITE IN NEW MEXICO,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W86-05247

VELOCITY EFFECTS ON DISPERSION IN POROUS MEDIA WITH A SINGLE HETEROGENEITY,

Purdue Univ., Lafayette, IN. School of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W86-05252

ORTHOGONAL-UPSTREAM FINITE ELEMENT APPROACH TO MODELING AQUIFER CONTAMINANT TRANSPORT,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W86-05256

HELIUM ACCUMULATION IN GROUNDWATER. II: A MODEL FOR THE ACCUMULATION OF THE CRUSTAL 4HE DEGASSING FLUX,

Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, and G. N. Ivey.
Geochimica et Cosmochimica Acta, Vol. 49, No. 11, p 2445-2452, November 1985. 7 fig, 23 ref.

Descriptors: *Groundwater, *Helium, *Accumulation, Confined aquifers, Aquifers, Confined Groundwater, Degassing, Model Studies, Fluctuations, Mathematical studies, Australia, Namibia.

A model of helium accumulation in a confined aquifer is presented which includes in situ production and a crustal degassing flux of helium into the bottom of a confined aquifer. The in situ production, crustal degassing flux, vertical diffusion coefficient, aquifer thickness, groundwater velocity and a impermeable upper aquiclude were identified as the primary parameters determining the concentration of helium in confined aquifers as a function of vertical and horizontal position (age). The model developed from these parameters was consistent with the measurements of helium concentration in the Great Artesian Basin, Australia and also with that concentration in the Auob Sandstone of Namibia. The measured value of the crustal degassing flux of helium from these two areas is comparable to that calculated from the atmospheric budget of helium. It is concluded that crustal degassing of helium may be a common and widespread phenomenon. (Master-PTT)
W86-05291

MEASUREMENT OF IMPORTANT PARAMETERS DETERMINING AQUEOUS PHASE DIFFUSION RATES THROUGH CRYSTALLINE ROCK MATRICES,

UKAEA Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
For primary bibliographic entry see Field 5B.
W86-05297

UNCONFINED GROUNDWATER FLOW CALCULATION INTO A TUNNEL,

Tahal Consulting Engineers Ltd., Tel-Aviv (Israel). Hydrology Div.
D. Meiri.
Journal of Hydrology, Vol. 82, No. 1/2, p 69-75, November 1985. 5 fig, 1 tab, 4 ref.

Descriptors: *Groundwater movement, *Mathematical analysis, *Tunnels, Numerical model, Water inflow.

A numerical model based on the finite element method for the solution of nonsteady groundwater flow with a free surface is used to analyze the unconfined flow of groundwater into a tunnel. Numerical results are of the same order of magnitude as analytical approximations. Results can be used to estimate the rate of water inflows during tunnel construction, but cannot be used during operation after the tunnel is completed and lined. (McFarlane-PTT)

W86-05298

SINKING CITIES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 4B.
W86-05321

MULTI-LAYER SAMPLER FOR THE STUDY OF DETAILED HYDROCHEMICAL PROFILES IN GROUNDWATER,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 5G.
W86-05336

USE OF RAIN AND DRY DEPOSITION COMPOSITIONS FOR INTERPRETING GROUNDWATER CHEMISTRY,
Arkansas Univ., Fayetteville. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-05394

2G. Water In Soils

RELATION BETWEEN L-BAND SOIL EMITTANCE AND SOIL WATER CONTENT,
Agricultural Univ., Wageningen (Netherlands).
For primary bibliographic entry see Field 7B.
W86-04688

PREDICTIONS OF SOIL-WATER POTENTIALS IN THE NORTH-WESTERN SONORAN DESERT,
California Univ., Los Angeles. Dept. of Biology.
D. R. Young, and P. S. Nobel.
Journal of Ecology, Vol. 74, No. 1, p 143-154, March 1986. 2 tab, 6 fig, 38 ref.

Descriptors: *Soil water potential, *Deserts, California, Sonora Desert, Succulents, Computer models, Precipitation, Evaporation, Permeability coefficient.

A computer model was developed to predict soil water potential at a Sonora Desert site near Palm Desert, California, in the southwest United States. The variability of precipitation there, coupled with the low water holding capacity of the sandy soil, resulted in large temporal and spatial variations in soil water potential. The predicted soil water potentials for depths of 5, 10, and 20 cm were in close agreement with measured values as the soil dried after an application of water. Predicted values at a depth of 10 cm, the mean rooting depth of Agave deserti and other succulents common at the study site, also agreed with soil water potentials measured in the field throughout one year. Both soil water potential and evaporation from the soil surface were very sensitive to simulated changes in the hydraulic conductivity of the soil. The annual duration of soil moisture adequate for succulents was dependent on the rainfall as well as on the spacing and amount of individual rainfalls. The portion of annual precipitation evaporated from the soil surface varied from 73 percent in a dry year (77 mm precipitation) to 59 percent in a wet year (597 mm). Simulations were also performed, using the figures for total monthly precipitation. Based on the average number of rainfalls for a particular month, the rainfall was distributed throughout the month in the model. Predictions using both daily and monthly inputs were in close agreement, especially for the number of days during a year when the soil water potential was sufficient for water absorption by the succulent plants. (Peters-PTT)
W86-04695

USING SOIL SURVEY INFORMATION TO CHARACTERIZE THE SOIL-WATER STATE,
Stichting voor Bodemkartering, Wageningen (Netherlands).
J. Bouma.
Journal of Soil Science, Vol. 37, No. 1, p 1-7, March 1986. 3 fig, 24 ref.

Descriptors: *Soil water, *Land evaluation, *Soil survey, *Simulation, *Soil morphology, Bimodal pore systems, Flow subsystems, Hydraulic conductivity, Moisture retention.

The manner in which the soil-water state is characterized in the context of land evaluation is discussed. Current and future developments in land evaluation are discussed, emphasizing the input of soil survey when using computer simulation models for soil water regime. Computer simulation of the soil-water regime can define the potential conditions that professional users of soil information require. Soil morphology, as part of soil survey information, can provide important indications of physical soil properties, but these indications should be treated as hypotheses, not as the final truth. Soil morphology can be used to define representative sample dimensions and sampling locations. Of particular interest are simulation models of soils that have bimodal pore systems where soil morphology is used to define sub-systems of flow, each characterized by the standard flow theory. Pedological differences do not always correspond to functional differences. 'Conversion' of pedological distinctions into functional criteria should be encouraged. This refers to physical measurements of hydraulic conductivity and moisture retention in major soil horizons and use of interpolation techniques such as kriging. (Rochester-PTT)
W86-04713

SORPTION OF TRACE METALS BY HUMIC MATERIALS IN SOILS AND NATURAL WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W86-04715

POSSIBILITY OF MELIORATION AND AGRICULTURAL USE OF LIMAN AND MARINE SEDIMENTS,
Odessa Agricultural Inst. (USSR).
For primary bibliographic entry see Field 5G.
W86-04729

HEIGHT AND SPEED OF CAPILLARY RISE OF WATER IN MEDIUM LOAM SOILS,
Volga Inst. of Hydraulic Engineering and Melioration, Engel's (USSR).
A. D. Man'ko, L. V. Galibina, and A. S. Fal'kovich.
Soviet Soil Science, Vol. 17, No. 5, p 101-106, September-October, 1985. 2 fig, 2 tab, 8 ref. Translated from Pochvovedeniye, No. 9, p 93-97, 1985.

Descriptors: *Soil water, *Capillarity, *Power functions, *Groundwater discharge, *Medium loam soil, *Aeration, Crop yield, Waterlogging, Salinization, Capillary zone.

Data are presented on the height and speed of the capillary rise of water in lysimeters with 2- and 3-m high monoliths of medium loam soil with a low initial content. Empirical relations in the form of power functions are obtained for the height of the capillary rise of water and the function of time. The 150-cm layer above the water table is the zone of maximum water exchange in medium loam soils. In the presence of mineralized groundwater at this depth, its evaporation in the period between irrigations would lead to the accumulation of salts in the plow layer. The presence of fresh groundwater at this depth would lead to the deterioration of aeration conditions in the soil and reduce crop yield. The height of the capillary rise in soils with a low initial moisture content is directly proportional to the fourth root of time. To prevent the waterlogging and salinization of the soil one must not allow the groundwater to rise above 2.5-3 m. (Rochester-PTT)
W86-04730

DETERMINATION OF THE SOIL WATER BUDGET FROM SUCTION PRESSURE CURVES,
Akademiya Nauk SSSR, Moscow. Pochvennyi Inst.
E. T. Pyagay.
Soviet Soil Science, Vol. 17, No. 5, p 114-120, September-October 1985. 2 fig, 2 tab, 3 ref. Translated from Pochvovedeniye, No. 6, p 131-136.

Descriptors: *Soil water, *Soil water suction, *Infiltration, *Recharge, *Evaporation, *Tensiometers, Irrigation, Rainfall.

Infiltration recharge and evaporation of soil moisture may be determined from suction pressure curves obtained in the field with tensiometers. The proposed method allows rapid determination of the soil saturation by water and makes it possible to calculate the amount of moisture consumed by groundwater during short periods of time under nonstationary moisture transfer conditions. Trials of the method showed that its chief advantage over the moisture-content method is that the data can be obtained quickly for the budget calculations needed to study the water regime of soils in a zone of excessive (or adequate) wetting, where it rains very often in some periods as well as in areas irrigated every 5-10 days. (Rochester-PTT)
W86-04731

DETERMINATION OF THE PARAMETERS OF WATER INTAKE BY SOIL WITH THE ENERGY CHARACTERISTICS OF RAIN TAKEN INTO ACCOUNT,
Moscow Inst. of Agricultural Engineers (USSR).
A. M. Abramov.
Soviet Soil Science, Vol. 17, No. 5, p 121-128, September-October 1985. 2 fig, 3 tab, 9 ref. Translated from Pochvovedeniye, No. 6, p 137-143.

Descriptors: *Irrigation, *Infiltration, *Soil water, *Rainfall impact, *Sprinklers, Soil type, Sandy loam, Chernozems, Alluvial meadow, Bog, Medium clay loam, Soviet soil.

The parameters of water intake by soil may be determined in relation to the energy characteristics of artificial rain. Erosion-permissible irrigation rates for different sprinklers are calculated from the specific power of the rain they produce. The dependency of the erosion-permissible irrigation rate on the specific power of rain is shown for sod on weakly podzolic, medium clay loam; alluvial meadow-bog sandy loam (a soil with a crust); alluvial meadow-bog sandy loam (standard plot); and leached sandy loam chernozem. The disruptive effect of raindrops from sprinkling is considerably decreased in soils that have first been leveled and soaked by rain, in which case a protective layer quickly forms on the soil surface. Erosion-permissible rates of irrigation vary for chernozems in different regions of the Soviet Union. (Rochester-PTT)
W86-04732

EFFECT OF SOIL CHARACTERISTICS ON EROSION AND NUTRIENT LOSS,
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 2J.
W86-04908

NEW METHOD FOR OBTAINING A SPATIALLY AVERAGED INFILTRATION RATE FROM RAINFALL AND RUNOFF RATES,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
S. Y. Campbell, W. H. Van Der Molen, C. W. Rose, and J. Y. Parlange.
Journal of Hydrology, Vol. 82, No. 1/2, p 57-68, November 30, 1985. 2 fig, 14 ref.

Descriptors: *Infiltration rate, *Rainfall rate, *Runoff rate, Rainfall infiltration, Precipitation, Flow rates, Rainfall-runoff relationships, Mathematical analysis.

This paper describes a new method of obtaining a spatial average value for infiltration from rainfall and runoff rates. The theory is developed from the general analytic solution to the kinematic flow approximation of overland flow on a plane surface. Application of the method is illustrated both with analytic examples and field experimental data. The

field data is based on rainfall and runoff measurements from a small catchment on the Walnut Gulch Experimental Watershed in Arizona. Difficulties which appear to have arisen from relative time errors between separate mechanical clocks for rainfall and runoff rates were investigated and overcome using this method. (Khumbatta-PTT)
W86-05074

GEOLOGIC CONTROL ON SOIL COMPOSITION AND PROPERTIES, LAKE OJIBWAY CLAY PLAIN, MATAGAMI, QUEBEC,

McGill Univ., Montreal (Quebec). Geotechnical Research Centre.
Canadian Geotechnical Journal CGJOAH, Vol. 22, No. 4, p 491-500, November 1985. 1 tab, 15 fig, 20 ref.

Descriptors: *Quebec, *Soil physical properties, *Geological control clays, Lake Ojibway, Matagami, Carbonate, Turbidity currents, Glacial geology.

The soft, freshwater varved clays comprising the Ojibway clay plain in the James Bay region of Quebec form the foundation soils for increasing numbers of transportation routes and water retaining structures associated with James Bay hydroelectric development. A knowledge of their behavior over both the short and long term, especially with respect to leaching, is of considerable consequence. Varved clays deposited in proglacial Lake Ojibway at Matagami, Quebec, were derived from two source areas: carbonate-deficient, Precambrian crystalline igneous rocks from New Quebec to the east and carbonate-rich Paleozoic rocks from the James Bay lowlands in Ontario to the west. About 50% of the 12-15 m thick clay section consists of varved clays containing less than 3% carbonate, reflecting the New Quebec source. The remaining 50% of the section consists of two pulses of carbonate-enriched varves (15-30% carbonate) derived from rock flour in two glacial advances known as Cochrane I and Cochrane II, which advanced to within 20 km of Matagami. The clays are preconsolidated at the site by a combination of desiccation, groundwater level drawdown, and bonding. High in situ water contents correlate with thinner, low-carbonate, distal varves of high activity. The best correlations are obtained for relative activity. Carbonate seems to have effectively neutralized smectite in the Cochrane proximal varves, rendering the distal varves (of New Quebec source) the most active clays at the site. (Peters-PTT)
W86-05103

DETERMINATION OF SATURATED HYDRAULIC CONDUCTIVITY FROM SOIL PERCOLATION TEST RESULTS,

Oxford Univ. (England).
D. D. Fritton, T. T. Ratvasky, and G. W. Petersen.
Soil Science Society of America Journal, Vol. 50, No. 2, p 273-276, March/April 1986.

Descriptors: *Hydrology, *Soil water, *Percolation, *Permeability coefficient, Infiltration rate, Pennsylvania, Linear regression analysis, Hydraulic permeability, Soil types.

Percolation times and saturated hydraulic conductivity rates from 28 test holes were used with data from the literature to relate saturated hydraulic conductivity, K, to percolation time, P. Sites were chosen to represent seven central and western Pennsylvania soils developed in shale and sandstone colluvium, alluvium, glacial outwash, or residual limestone parent materials. The sites used included Murrill, Hagerstown, Lindside, Morrison, Clarksburg, and Cosotton. Saturated hydraulic conductivity was determined by the shallow well pump-in method, an in situ test that measured three dimensional water flow into the soil. Percolation time was determined using a modification of approved procedures of the EPA and the Pennsylvania Department of Environmental Resources. Linear regression analysis performed on the base 10 logarithm of the 28 pairs of data resulted in the equation: log K= -0.309 log P-4.296 (with P in units of s/m and K in units of m/s). This equation was compared to one from literature data and to a steady state three dimensional infiltration equation derived from soil water flow theory. The literature data and the theoretical equation were different from that generated in this study due to the use of a saturated hydraulic conductivity technique that was sensitive to the layered nature of the soils used. (Peters-PTT)
W86-05124

LEACHING OF HERBICIDES THROUGH UNDISTURBED CORES OF A STRUCTURED CLAY SOIL,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W86-05125

EVAPORITE MINERALOGY ASSOCIATED WITH SALINE SEEPS IN SOUTHWESTERN NORTH DAKOTA,

University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 3C.
W86-05128

WATER TABLE OF ALDER AND NEIGHBOURING ELM STANDS IN A SMALL TRIBUTARY BASIN,

Tohoku Univ., Sendai (Japan). Biological Inst.
For primary bibliographic entry see Field 2I.
W86-05188

EFFECTS OF MOISTURE ON SOIL MICROORGANISMS AND NEMATODES: A FIELD EXPERIMENT,

Sveriges Lantbruksuniversitet, Uppsala. Institutionen foer Mikrobiologi.
J. Schnurer, M. Clarholm, S. Bostrom, and T. Rosswall.
Microbial Ecology MCBEBU, Vol. 12, No. 2, p 217-230, June 1986. 10 fig, 1 tab, 28 ref.

Descriptors: *Soil moisture, *Rainfall impact, *Nematodes, Irrigation, Agriculture, Biomass, Protozoa, Oxygen consumption, Bacteria, Cultivated lands, Soil fungi, Soil bacteria, Fungi.

The short-term dynamics of various soil organisms under two different moisture regimes were compared. Agricultural soil was examined for the effects of a single rainfall event and subsequent drying, and was compared to a soil kept moist by daily irrigation. Numbers and biomass of bacteria, numbers of protozoa and nematodes, length of FDA-active hyphae, and total hyphal lengths were determined at daily intervals. Oxygen consumption was determined to obtain an integrated measure of biological activity. Total hyphal length was not affected by one rainfall but increased from 700 m/gm dry weight soil, to more than 1,600 m in less than ten days in the irrigated plot. In the rain plot, bacterial numbers doubled within 3 days and declined during the following period of drought. In the irrigated plot, numbers increased by 50% and then remained constant over the duration of the study. Only small changes in protozoan numbers were observed, with the exceptions of the last sampling date in the irrigated plot when large numbers of naked amoebae were recorded 2 days after a large natural rainfall. Nematode numbers, especially obligate root feeders, increased in both treatments. The increases were caused by decoiling rather than growth. The results indicate that fungal respiration was dominating, while bacteria, lacking a suitable source of energy, were less active, except for the first days. (Peters-PTT)
W86-05203

SECOND-ORDER APPROACH FOR THE MODELING OF DISPERSIVE TRANSPORT IN POROUS MEDIA: 1. THEORETICAL DEVELOPMENT,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-05205

SECOND-ORDER APPROACH FOR THE MODELING OF DISPERSIVE TRANSPORT IN POROUS MEDIA: 2. APPLICATION TO SOLUTE MOTION IN PIPES AND CAPILLARY TUBES,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-05206

DRAINAGE FROM A UNIFORM SOIL LAYER ON A HILLSLOPE,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2E.
W86-05209

INVESTIGATION OF WATER MOVEMENT IN THE UNSATURATED ZONE UNDER AN IRRIGATED AREA USING ENVIRONMENTAL TRITIUM,

Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
H. Gvirtzman, and M. Magaritz.
Water Resources Research WRERAO, Vol. 22, No. 5, p 635-642, May 1986. 4 fig, 4 tab, 49 ref.

Descriptors: *Unsaturated flow, *Soilwater movement, *Soil water, *Aeration zone, *Tritium, Groundwater movement, Irrigation water, Convection, Percolation, Precipitation, Flow rates, Flow profile, Loess, Negev, Israel, Radioisotopes.

A 14-year record of convective-dispersive flow in the unsaturated zone was reconstructed using the difference between the environmental tritium content of rain, and that of irrigation water. Samples were taken from a loess profile in the northern Negev, Israel, in an area where precipitation is 200 mm/winter and irrigation is 650 mm/summer. The difference between the measured tritium profile and the input tritium profile was interpreted in terms of mobile and immobile water domains. The percentage of the total water which remained immobile was estimated to be about 40% at the surface and 55% at 8.5 m depth. This leads to the estimate that 8 + 1% of the rain and irrigation water percolated downward, with a velocity of 0.66 + 0.03 m/yr, and a maximal effective dispersion coefficient of 5 times 10 to the -11 sq m/s. Using these values, the limits of dispersivity (0.5-1.5mm) and of tortuosity (0.05-0.11) were determined, in the medium studied. (Lantz-PTT)
W86-05210

FIELD STUDY OF NAPROPAMIDE MOVEMENT THROUGH UNSATURATED SOIL,

California Univ., Riverside. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-05221

PREDICTION OF SURFACE SATURATION ZONES IN NATURAL CATCHMENTS BY TOPOGRAPHIC ANALYSIS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2E.
W86-05226

DIFFERENTIAL BARE FIELD DRAINAGE PROPERTIES FROM AIRBORNE MICROWAVE OBSERVATIONS,

Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
R. Bernard, J. V. Soares, and D. Vidal-Madjar.
Water Resources Research WRERAO, Vol. 22, No. 6, p 869-875, June 1986. 5 fig, 3 tab, 26 ref.

Descriptors: *Drainage patterns, *Microwaves, *Aerial photography, Remote sensing, Soil moisture, Measuring instruments, Model studies, Evaporation, Mathematical analysis.

Time variations of surface soil moisture can be monitored using active microwave remote sensing. With the existence of airborne systems, it is now

possible to estimate this variable on a regional scale. Data from a helicopter-borne scatterometer show that surface water content reductions during a 9-day period are quite different from one field to another. A simple model describing the water budget of the soil surface layer due to evaporation and drainage is applied. From this model, a pseudodiffusivity can be calculated for each field using only the remotely sensed data. This new parameter gives a quantitative estimate of the observed drying heterogeneities. (Lantz-PTT)
W86-05245

SOIL WATER EXTRACTOR THAT MINIMIZES CO2 DEGASSING AND PH ERRORS,

D. L. Suarez.
Water Resources Research WRERAO, Vol. 22, No. 6, p 876-880, June 1986. 5 fig, 1 tab, 6 ref.

Descriptors: *Soil water, *Sampling, *Water extractors, *Carbon dioxide, *Hydrogen ion concentration, Measuring instruments, Minerals, Chemical precipitation.

Soil water extractors that are presently used to sample the unsaturated zone cause substantial CO2 degassing within the sampler, resulting in pH errors that are sufficiently large to create measured pH values that are unacceptable for determining specific mineralogic controls on solution composition. The pH increases can also result in oxide and carbonate precipitation within the extractor thereby altering solution composition. The soil water samplers described here reduce CO2 degassing by minimizing the gas-liquid ratio in the extractor and by flushing several volumes of solution through the liquid-filled sampling container before a sample is removed. The construction of both shallow and deep samplers is described. (Lantz-PTT)
W86-05246

SOIL WATER MOVEMENT AND RECHARGE THROUGH SAND AT A SEMIARID SITE IN NEW MEXICO,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and R. Knowlton, Jr.
Water Resources Research WRERAO, Vol. 22, No. 6, p 881-889, June 1986. 7 fig, 4 tab, 29 ref.
New Mexico Water Resources Research Institute Grant Program Project 1345679.

Descriptors: *Soil water, *Recharge, *Sand, *Semiarid lands, *New Mexico, Socorro, Groundwater recharge, Groundwater movement, Seasonal variations, Vertical flow, Hydraulic conductivity, Pressure head.

A semiarid site near Socorro, New Mexico, has been instrumented with tensiometers and a neutron probe access tube to study soil water movement which may contribute to areal groundwater recharge under natural conditions. During the period of record which extends from November 1982 through May 1984, annual precipitation was approximately 17.9 cm/yr. Below a depth of about 30 cm, pressure head ranged from about -129 to -35 cm and moisture content varied between about 0.05 to 0.09 cu cm/cu cm. The vertical hydraulic gradient was slightly greater than unity and indicated downward soil water movement. Unsaturated hydraulic conductivity was determined in the field by the instantaneous profile method. Recharge was calculated from Darcy's equation using in situ pressure head data below the root zone, calculated hydraulic gradient, and in situ hydraulic conductivity. Recharge was also calculated as being equal to the unsaturated hydraulic conductivity corresponding to in situ water content. Average annual recharge calculated over a 19 month period from pressure head measurements may range from 0.7 cm/yr to as much as 3.7 cm/yr. Recharge estimated from moisture-content data, assuming a unit hydraulic gradient, is about 3.7 cm/yr. During the period of record, monthly average recharge varies by more than 3 orders of magnitude. Both the winter frontal storms and intense summer thunderstorms lead to deep infiltration, and presumably, groundwater recharge. (Lantz-PTT)
W86-05247

EQUIVALENT FORMULATIONS FOR SOLUTE AND WATER MOVEMENT IN SOILS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
C. J. Barnes.
Water Resources Research WRERAO, Vol. 22, No. 6, p 913-918, June 1986. 7 fig, 1 tab, 15 ref.

Descriptors: *Mathematical equations, *Solute transport, *Path of pollutants, *Soil water, Saturated soils, Unsaturated flow, Saturated flow, Mathematical models.

The equivalence between certain formulations of equations describing solute movement through saturated soils and water movement in unsaturated soils, is used to infer results about solute movement from known results concerning saturated water movement, and vice versa. This equivalence is shown to extend to multidimensional solute movement. By analogy with a quasi-analytical theory of water movement in unsaturated soils, the concept of the solute flux-concentration relation is introduced. The examples of the usefulness of the equivalence between the two sets of equations are instructive, but by no means exhaust the possibilities. In particular, the restrictive conditions of a constant convective velocity and uniform water content for solute movement can be removed. (Lantz-PTT)
W86-05251

SEASONAL AND DIURNAL VARIATION OF ENERGY BUDGET COMPONENTS IN CONIFEROUS FORESTS,

Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
For primary bibliographic entry see Field 2D.
W86-05296

2H. Lakes

RAISED BOGS OF SOUTH-EASTERN LABRADOR, CANADA: CLASSIFICATION, DISTRIBUTION, VEGETATION AND RECENT DYNAMICS,

Harvard Univ., Petersham, MA. Harvard Forest.
D. R. Foster, and P. H. Glaser.
Journal of Ecology, Vol. 74, No. 1, p 47-71, March 1986. 3 tab, 15 fig, 75 ref.

Descriptors: *Bogs, *Canada, Labrador, Mires, Hummock vegetation, Peatland zonation, Precipitation.

A general classification of the mire types and vegetation in southeastern Labrador was provided and the factors responsible for the zonal distribution were investigated. The mires of Labrador form a distinct geographical zonation: concentric raised bogs occur at low altitudes along the southern coast, excentric and plateau bogs extend inland to slightly greater altitudes and higher latitudes, and patterned fens occupy most of the interior north to the tundra. Labrador belongs politically to the Province of Newfoundland and, geographically, occupies a portion of the Labrador-Ungava Peninsula, which it shares with the Province of Quebec. The zone boundaries parallel contours and climatic isopleths, and the zonation is explained in terms of the effects of moisture surplus, soligenous water flow and physiography on mire development. The raised bogs are similar to oceanic mires, with an extensive ground cover of Cladonia spp., absence of trees on the mire expanse, and pronounced surface patterns of broad peat hummocks and open water pools. The recent history of the hummock vegetation involves the alteration of Cladonia stellaris and Sphagnum fuscum, as documented by the presence of recurrence surfaces in short cores, peat monoliths, and long cores. Local factors, including fire and the lowering of the water table through pool drainage, are frequently responsible for changes in the ground cover and the degree of peat humification, and they may confound the stratigraphic interpretation of climatic change. (Peters-PTT)
W86-04693

GERMINATION OF TEN SHORELINE PLANTS IN RELATION TO SEED SIZE, SOIL PARTICLE SIZE AND WATER LEVEL: AN EXPERIMENTAL STUDY,

Ottawa Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2I.
W86-04694

DISTRIBUTION OF EPIPHYTIC BACTERIA ON FRESHWATER PLANTS,

Freshwater Biological Association, Wareham (England). River Lab.
J. H. Baker, and D. R. Orr.
Journal of Ecology, Vol. 74, No. 1, p 155-165, March 1986. 2 tab, 3 fig, 28 ref.

Descriptors: *Aquatic plants, *Epiphytic bacteria, Leaf surface community.

The population densities of bacteria on the leaves of a range of aquatic plant species were determined, including differences both within and between leaves of the same plant. The spatial distribution of epiphytic bacteria was determined on Apium nodiflorum (L.) Lag., Elodea canadensi Michx., Glyceria maxima (Hartm.) Holmberg, Glyceria Maxima (Hartm.) Holmberg, Nasturtium officinale R. Br., and Veronica beccabunga L. The proportion of the total variance due to the variance between leaves ranged widely (0.04 to 0.82). Two species (Nasturtium officinale and Veronica beccabunga) had significantly larger populations on the abaxial surfaces of their submerged leaves than on the adaxial surfaces of the same leaves. The older the leaf, the greater was the bacterial density. The aerial parts of floating and emergent plants had substantially lower bacterial densities than the submerged parts. No significant seasonal differences were discernible between leaves of the same age, but significant short term changes were detected on Ranunculus penicillatus var. calcareus. (Peters-PTT)
W86-04696

FROM SWAMP TO LAKE: RECENT CHANGES IN A LOWLAND TROPICAL SWAMP,

Papua New Guinea Univ., Port Moresby. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-04697

NITROGEN CYCLING IN A FRESHWATER MARSH OF PANICUM HEMITOMON ON THE DELTAIC PLAIN OF THE MISSISSIPPI RIVER,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, C. J. Smith, and M. N. Sarafyan.
Journal of Ecology, Vol. 74, No. 1, p 249-256, March 1986. 2 fig, 1 tab, 26 ref.

Descriptors: *Marshes, *Freshwater marshes, *Nitrogen Cycle, Mississippi River, *Deltaic plain, Louisiana, Nitrogen fixation.

The response of Panicum hemitomon to added nitrogen was determined and the major nitrogen fluxes including fixation and losses from a P. hemitomon freshwater marsh were measured. The marsh bordered Lac des Allemandes, a 65 sq km freshwater lake in the northern part of Barataria Basin located along the deltaic plain of the Mississippi River. P. hemitomon is the predominant freshwater plant in these marshes, a large percentage of which are floating marsh or flotant and contain a mat of roots and plant remains overlying an unconsolidated peat layer 0-35 cm thick, underlain by 1-5 m of organic ooze which grades with depth to clay. Nitrogen is apparently a limiting nutrient since supplemental nitrogen increased above ground biomass by 40 percent. There is apparently little loss of internal nitrogen from the system since 80 percent of the nitrogen added at the rate of 3 grams per sq m was recovered in the soil plant system at the end of the growing season. Nitrogen fixation was the principal source of nitrogen to this vast freshwater system with 6.7 grams per sq m per year being added. These marshes are apparently serving as large nitrogen sinks, with 12 grams per sq m per year being retained as organic

nitrogen as a result of accretion as determined by 137Cs dating. The results suggest that these freshwater marshes may improve water quality by removing nutrients from inflowing water. (Peters-PTT)
W86-04698

USE OF LAMINATED LAKE SEDIMENTS IN THE ESTIMATION AND CALIBRATION OF EROSION RATES,

Plymouth Polytechnic (England). Dept. of Environmental Sciences.
P. E. O'Sullivan, M. A. Coard, and D. A. Pickering.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 385-396, 3 fig, 3 tab, 34 ref.

Descriptors: *Erosion rates, *Lake sediments, *Drainage area, *Deposition, Erosion, Laminated sediments, England, Cores, Sedimentation, Lagoons, Cornwall, Loe Pool, Cober River.

The value of lake sediments as a potential source of information for the study of the ontogeny of drainage basins is considered, and the importance of this information to geologists and geomorphologists is discussed. In particular, the laminated sediments known as clastic varves, which are composed mainly of allochthonous material, afford an excellent opportunity for the study of erosion rates. The clastic varves of Loe Pool, a coastal lagoon in Cornwall (United Kingdom), have been used to study erosion rates in the basin for the River Cover in the period from approximately 1860 to the present. Multiple coring of the most recent sediments was used to calculate volume, mass and influx of dry matter and ash to the pool during periods of intensive mining, and the subsequent post-mining period. Erosion rates were found to be approximately 174 t/km/yr in the late nineteenth century, between 360 and 420 t/km/yr during the early twentieth century, and approximately 12 t/km/yr at present. (See also W86-04896) (Halterman - PTT)
W86-04933

HYDROTHERMAL-BIOLOGICAL COUPLING OF LAKE EUTROPHICATION MODELS,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5C.
W86-04938

LAKE RESTORATION: A FIVE-YEAR EVALUATION OF THE MIRROR AND SHADOW LAKE PROJECT WAUPACA, WISCONSIN,

Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5G.
W86-04939

NATURAL FLOW VISUALIZATION IN LAKE EYRE, SOUTH AUSTRALIA,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
J. A. T. Bye, R. A. D. Byron-Scott, T. Maxworthy, and R. A. Nunes.
EOS, Transactions, American Geophysical Union, Vol. 67, No. 5, p 58-59, February 4, 1986. 3 fig, 1 tab, 6 ref.

Descriptors: *Flood, *Flow pattern, *Water currents, *Waves, *Aerial reconnaissance, Flow around objects, Lake Eyre, South Australia, Fine silt, Dissolved salt.

A rare flooding event occurring in Lake Eyre, South Australia, permitted visualization of flow patterns. This is possible because a sharp boundary persists between dissolved gypseous salt (from the bottom of the lake when dry) and fine silt, which is suspended from elsewhere in the lake. Aerial observations were conducted of the following phenomena: (1) a series of nearly two-dimensional rollers or breaking waves, which occurs on the southern interface between and the silty water in the lee of the sand islands and the clear water that is flowing along the coastal channel; (2) an injection of clear water over a low sand bar into silty water, a distance of 600 m, which shows a series of fine entrainment features and an asymmetric head; and (3) a family of quasi-horizontal intrusions, through which the silty water was interleaving with the clear water across the northern interface in the lee of the islands. (Rochester-PTT)
W86-04981

DECLINING LAKE SEDIMENT PHOSPHORUS RELEASE AND OXYGEN DEFICIT FOLLOWING WASTEWATER DIVERSION,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W86-05025

MONITORING SEBAGO LAKE WATER QUALITY BELOW THE THERMOCLINE,

Portland Water District, ME.
For primary bibliographic entry see Field 5F.
W86-05027

STUDIES OF DIURNAL ACID FLUCTUATIONS IN BRITISH ISOETID-TYPE SUBMERGED AQUATIC MACROPHYTES,

Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
For primary bibliographic entry see Field 5C.
W86-05064

SUCCESSION OF COMMUNITIES IN THE GOCZALKOWICE DAM RESERVOIR IN THE PERIOD 1955-1982,

Polish Academy of Sciences, Goczalkowice. Hydrobiological Station.
E. Krzyzanek, H. Kasza, W. Krzanowski, T. Kuflikowski, and G. Pajak.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 1, p 21-43, 1986. 7 fig, 3 tab, 49 ref.

Descriptors: *Reservoirs, *Ecosystems, *Goczalkowice Dam, Poland, Lake morphology, Aquatic plants, Aquatic animals, Aquatic life, Aquatic environment.

The dam reservoir at Goczalkowice was constructed in the years 1950-1955, as a water intake for community supply and for retention. Thanks to the hydrological investigations carried out continuously from the filling of the reservoir, the process of biocenotic formation and the succession of plant and animal organisms could be examined against the background of changes in the chemical composition of the water. In the 28 years of the reservoir's existence five stages of biocenotic formation were differentiated against the background of changes in the chemical constituents of the water. In the first stage, just after damming, riverine and land biocenoses were destroyed. Three months after the filling of the reservoir the second stage began, taking about two months; the period of initial formation of biocenoses in the reservoir. The third period, dating from 1956 to the early sixties, was still characterized by a poor chemical and biological stabilization. The dynamic development of plankton, benthos, and mycrophytes was noted. The fourth stage, from the early sixties to the beginning of the seventies, can be termed 'oligotrophication' period in the development of the reservoir. The biocenoses were finally formed, while their quantitative composition deteriorated. The fifth stage, started at the beginning of the seventies and still continues. The fertility of the reservoir, the concentration of calcium, magnesium, chlorides, and sulfates, and of nutrients increased. This was manifested by the more intensive development of plants and animals, especially of phytoplankton with blooms of Microcystis aeruginosa. (Lantz-PTT)
W86-05084

SIGNIFICANCE AND DEGREE OF ABIOSESTON CONSUMPTION IN THE FILTER-FEEDER DAPHNIA GALEATA SARS AM. RICHARD (CLADOCERA) IN LAKE BALATON,

Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 5B.
W86-05085

INVESTIGATIONS ABOUT THE FATE OF HEAVY METALS IN LAKES: II. THE ROLE OF IRON AND MANGANESE REMOBILIZATION TO THE HYPOLIMNIC ENRICHMENT OF HEAVY METALS (UNTERSUCHUNGEN ZUM VERHALTEN VON SCHWERMETALLEN IN GEWASSERN: II. DIE BEDEUTUNG DER EISEN- UND MANGAN-REMOBILISIERUNG FUER DIE HYPOLIMNISCHE ANREICHERUNG VON SCHWERMETALLEN),

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
For primary bibliographic entry see Field 5B.
W86-05088

DIAGNOSTIC STUDY ON THE VERTICAL CIRCULATION AND THE MAINTENANCE MECHANISMS OF THE CYCLONIC GYRE IN LAKE BIWA,

Shiga Univ., Otsu (Japan). Dept. of Earth Science.
S. Endoh.
Journal of Geophysical Research, Vol. 91, No. C1, p869-876, January 15, 1986. 1 tab, 8 fig, 27 ref.

Descriptors: *Cyclonic gyre, *Limnology, *Vertical circulation, *Lake Biwa, Thermal stratification, Downwelling, Upwelling, Differential heating, Seasonal variation, Mathematical models, Japan, Lakes.

The physical significance of vertical circulation and evidence for its existence in Lake Biwa, Japan, are shown, and some maintenance mechanisms of the gyre are discussed on the basis of a previously developed diagnostic model and observed water temperature distributions. Lake Biwa, the largest lake in Japan has a stable cyclonic gyre during seasons of thermal stratification. A vertical circulation consisting of downwelling in the central area and upwelling near the rim of the gyre is calculated by the diagnostic model. The energetics in the model indicate that this vertical circulation corresponds to the decay process of the gyre. Tracking of drifters in summer supports the presence of a vertical circulation, though its magnitude is about 50% less than that estimated by the diagnostic model. This is explained from the ratio of kinetic energy and available potential energy of the gyre. The realistic value of the vertical eddy viscosity is estimated to be 0.8-2.1 sq cm/s in summer. Monthly variations of the horizontal and vertical circulations are calculated by the diagnostic model using the monthly mean density fields. The gyre and the vertical circulation are maximal in September. The characteristic decay time scale of the gyre is estimated to be about 10 days. The effect of topographic differential heating is one of the maintenance mechanisms of the gyre in early summer, and from late summer to late fall. (Peters-PTT)
W86-05094

MODEL OF GAS TRANSFER ACROSS AIR-WATER INTERFACES WITH CAPILLARY WAVES,

Aix-Marseille-1 Univ. (France). Inst. de Mecanique Statistique de la Turbulence.
M. Coantic.
Journal of Geophysical Research, Vol. 91, No. C3, p 3925-3943, March 15, 1986. 2 tab, 10 fig, 70 ref.

Descriptors: *Capillary waves, *Air-water interfaces, *Mathematical models, Gas transfer, Wind velocity, Schmidt number, Lakes, Eddy diffusion, Hydrodynamics.

The transfer of weakly soluble gases between the atmosphere and seas or lakes is controlled by liquid-phase molecular and turbulent diffusion mechanisms, which depend on wind velocity and gas Schmidt number. A distinct change in regime is observed around 2-3 m/s, when capillary waves appear, which present models cannot explain. It is suggested that turbulent diffusivity be related with

(1) possible motions close to a free liquid-gas interface, (2) mean current distribution in that region, and (3) capillary wave spectra. Resulting transfer velocities explain laboratory and field data at low and moderate wind speeds. A mathematical model was developed that led to a prediction of gas exchange coefficient as a function of interfacial friction, in the wind speed range where wave breaking is not important. This was done from purely hydrodynamical considerations and data, without recourse to any adjustment of a constant from gas exchange data. The predicted exchange rates, however, are in quantitative agreement with the best available experimental results. The present approach provides a satisfactory qualitative explanation for the important amount of scatter shown by observations. (Peters-PTT)
W86-05099

CLIMATOLOGY OF INTERNAL WAVES IN A DEEP TEMPERATE LAKE,

National Water Research Inst., Vancouver (British Columbia).
R. C. Wiegand, and E. C. Carmack.
Journal of Geophysical Research, Vol. 91, No. C3, p 3951-3958, March 15, 1986. 14 fig, 34 ref.

Descriptors: *Seiches, *Internal waves, *Climatology, *Lakes, Kootenay Lake, British Columbia, Thermistor chains, Wind, Seasonal variation, Thermal stratification, Hydrodynamics, Waves.

The internal motions in a large temperate lake are examined from the viewpoint of wave climatology. Kootenay Lake is a long (100 km), deep (140 m), dimictic lake in southeastern British Columbia. Internal waves were observed over an 18-month period using three thermistor chains moored along the major axis of the lake. To characterize their seasonal aspects, four types of oscillations are recognized: classical seiches with amplitudes of 10-30 m and periods of 1-2 weeks, intrabasin waves with periods of 2-4 days, large-amplitude waves resembling nonlinear surges, and high-frequency waves associated with both the internal surge and large-amplitude internal seiche motions. The periods of the major components of the internal wave field are determined mainly by morphometry but vary seasonally with stratification. Thus the wind, which not only forces internal waves but can also modify stratification, is important. In large lakes like Kootenay, the thermal structure may vary not only spatially but also temporally at periods comparable to those of the internal waves themselves. Hence the shape and frequency of these waves may be altered as they pass through the lake. Large amplitudes occur during spring and late autumn when stratification is weak. (Peters-PTT)
W86-05100

CATASTROPHIC LAKE DRAINAGE WITHIN THE HOMATHKO RIVER BASIN, BRITISH COLUMBIA,

British Columbia Hydro and Power Authority, Vancouver. Geotechnical Dept.
I. Blown, and M. Church.
Canadian Geotechnical Journal CGJOAH, Vol. 22, No. 4, p 551-563, November 1985. 1 tab, 12 fig, 20 ref.

Descriptors: *Lakes, *British Columbia, *Drainage, Homathko River, Dam break, Debris flow, Hazard evaluation, Jokulhlaup, Floods, Lake ice, Moraines.

Three examples of sudden lake drainage and some potentially dangerous situations, encountered in the Homathko River basin within the Coast Mountains of British Columbia, Canada are presented. Some simple reconnaissance methods used to assess potential hazard presented by a lake are evaluated. To understand the mechanism of failure and gain information about the probability of further catastrophic drainages, ground reconnaissance was necessary at each site. The three phenomena related to sudden lake drainage include: moraine breaching by solitary wave action following an icefall into a lake; failure of a glacier ice dam by flotation and melting to produce a glacier outburst flood or jokulhlaup; and debris torrent following a moraine breach. The possibility of a fourth phenomenon, moraine failure by piping, is discussed. A first attempt to develop practical hazard evaluation methods before the event, which relies on simple scale relations or index relations developed from experience of events elsewhere, is presented. (Peters-PTT)
W86-05104

EUTROPHICATION IN NORTHERN TUNISIA,

Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H., Eschborn (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-05150

CLEARANCE RATES OF CRUSTACEAN MACROFILTRATORS: THE NATURE OF IN SITU RATE DEPRESSIONS IN A FERTILIZED OLIGOTROPHIC LAKE IN THE KUOKKEL AREA, NORTHERN SWEDEN,

Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W86-05154

AVAILABILITY OF PHOSPHORUS AND THE SPECIES COMPOSITION OF THE SPRING PHYTOPLANKTON IN LAKE ERKEN,

Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W86-05156

PRIMARY PRODUCTION AND EFFECTS OF ENRICHMENT WITH NITRATE AND PHOSPHATE ON PHYTOPLANKTON IN THE BARRA BONITA RESERVOIR (STATE OF SAO PAULO, BRAZIL),

Universidade Federal de Sao Carlos (Brazil). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-05157

EPIPELIC ALGAL FLORA OF THE RIVER WYE SYSTEM, WALES, UK. 1. PRODUCTIVITY AND TOTAL BIOMASS DYNAMICS,

University Coll., Cardiff (Wales). Dept. of Plant Science.
S. E. Antoine, and K. Bensen-Evans.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 4, p 575-589, 1985. 3 tab, 6 fig, 31 ref.

Descriptors: *Biomass, *River Wye, *Algal growth, *Productivity, *Wales, Chlorophyll, Algae, River Elan, River Iteron, River Lugg, Temperature effects, Seasonal variation, Benthos.

The spatial and temporal distribution of the epipelic algal flora of the non-tidal sections of the River Wye and its tributaries, the Rivers Elan, Ithon and Lugg were investigated. Chlorophyll-alpha and productivity values showed a downstream increase, which was much less obvious for the total biomass. Phaeophytin-alpha values followed almost similar spatial and temporal fluctuations to those of chlorophyll-alpha. High chlorophyll-alpha productivity and total biomass values were recorded during warmer months due to favorable environmental conditions for algal growth. These parameters had lower values during unfavorable winter and flood periods. A drop in the numbers of epipelic algae seen during early autumn after a period of high standing crop and low water levels may be due to a high level of metabolic activity or to grazing by the zoobenthos during the warmer months. The decreased algal population during the winter months is attributed to the short day length, lower temperature and higher flow rates.)
W86-05158

ANALYSIS OF THE BIOTIC COMMUNITY IN A KUMAUN HIMALAYAN LAKE, NAINITAL (U.P.), INDIA,

Kumaun Univ., Naini Tal (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-05159

MEASURE OF PLANKTON COMMUNITY SIMILARITY UTILIZING VARIABLE WEIGHTING OF TOTAL DENSITY AND TAXONOMIC PROPORTIONALITY,

Ontario Ministry of the Environment, Rexdale.
K. H. Nicholls.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 5, p 621-632, 1985. 8 tab, 4 fig, 17 ref.

Descriptors: *Ecosystems, *Plankton, *Mathematical analysis, Taxonomy, Gravenhurst Bay, Ontario, Phosphorus removal, Limnology, Algae, Species diversity, Phytoplankton, Phosphorus removal.

Four commonly used formulae for measuring percentage similarity (PS) of biological communities were tested for their usefulness in relating to two plankton community properties, species proportional differences and total density differences. The method was applied to phytoplankton data from Gravenhurst Bay, Ontario, where phosphorus loading reductions have resulted in significant changes in the phytoplankton community. The new expression involves a seven step procedure for organizing and arithmetically manipulating plankton data for calculations of PS. Any desired weighting factor may be applied to emphasize either the proportionality of species content or the total density properties of the plankton assemblages. The expression, as applied to the phytoplankton data from Gravenhurst Bay, used equal weighting of the taxonomic and total density properties. The phytoplankton data were organized as ice-free period average biomass values for the dominant algal classes and functional groups (i.e., blue-green bloom formers, blue-green nonbloom formers, and five other algal classes). The new expression of PS clearly showed a better distinction between phytoplankton communities pre- and post phosphorus control, than could be shown with another measure of PS measuring only similarity of taxonomic structure. (Peters-PTT)
W86-05160

CHEMICAL AND MICROBIOLOGICAL PROCESSES AS REGULATORS OF THE EXCHANGE OF SUBSTANCES BETWEEN SEDIMENTS AND WATER IN SHALLOW EUTROPHIC LAKES,

Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5C.
W86-05161

JUVENILE ANADROMOUS ATLANTIC SALMON OF THREE LAKES OF NEWFOUNDLAND,

Department of Fisheries and Oceans, St. John's (Newfoundland). Fisheries Research Branch.
V. A. Pepper, N. P. Oliver, and R. Blundon.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 5, p 733-753, 1985. 4 tab, 8 fig, 55 ref.

Descriptors: *Lakes, *Salmon, Lentic environment, Gander River, Newfoundland, Bonavista Bay, Deep water, Shallow water.

Anadromous Atlantic salmon parr (Salmo salar) were captured from these Newfoundland lakes: Salmon Pond on the Gander River system, Indian Pond on the Indian Brook system, and Butts Pond on the Middle Brook system. The first two systems empty into Notre Dame Bay on the northeast coast of Newfoundland. Middle Brook empties into Bonavista Bay in the vicinity of the community of Gambo. The lakes were examined to determine the extent to which lentic habitats are used as nursery areas for natural populations of these salmon. The observed standing stock of juvenile salmon in the lakes studied, varied inversely with mean lake depth. Growth rate of parr in lacustrine habitat was > or = that of parr in riverine habitats in the same watersheds. Yearling and 2 year parr were captures most often in shallow water <2 meters deep around the lake perimeters and were not abundant at greater depths. The 3+ and 4+ parr age groups were rarely found inshore but were captured in deeper offshore areas. No under year-

lings were found in lake habitats. It is concluded that some shallow lakes of Newfoundland provide major rearing areas for juvenile anadromous Atlantic salmon. (Peters-PTT)
W86-05163

COMPARATIVE LIMNOLOGY OF SEVERAL RESERVOIRS IN CENTRAL INDIA,

Government Post Graduate Coll., Chhindwara (India). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W86-05164

LIMNOLOGICAL OBSERVATIONS ON RIHAND RESERVOIR (UTTAR PRADESH) WITH REFERENCE TO THE PHYSICAL AND CHEMICAL PARAMETERS OF ITS WATER,

Central Inland Fisheries Research Inst., Merzapur (India). All-India Coordinated Research Project on Ecology and Fisheries of Freshwater Reservoirs.
R. K. Singh.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 6, p 857-875, 1985. 12 tab, 12 fig, 24 ref.

Descriptors: *Reservoirs, *Thermocline, *Limnology, *Nutrients, *Rihand Reservoir, Phytoplankton, River Rihand, Uttar Pradesh, River Stone, Ganges River, Monsoon, Catchment areas, Limnology, Evaporation, Temperature effects, Rainfall, Hydrogen ion concentration, Dissolved oxygen, Transparency, Seasonal variation, Carbon dioxide, Calcium, Magnesium, Iron, Nitrates.

Observations on the Rihand Reservoir, based on monsoon inflow, reservoir level, evaporation loss, air and water temperature, rainfall and wind velocity are discussed in relation to the physical and chemical parameters of this body of water. Rihand Reservoir formed as the result of constructing a dam across River Rihand, is a tributary of the River Stone, which belongs to the Ganges System. A weak thermocline was observed, and the water showed a biogenic chemical stratification during the warmer months. Rihand is a monomictic tropical lake with a moderate nutrient supply, but is not very productive from the limnological point of view. The nutrient content of this lake declined from 1972 to 1974, but improved in 1975 and 1976 with the increase in rain and inflow of water. The productivity of the reservoir depends greatly on the nutrient level of the inflowing water from the catchment area, so that the monsoon inflow largely influences the water quality of the reservoir. The phytoplankton population is directly related to the inflow of water from the catchment area. (Peters-PTT)
W86-05165

FOOD SIZE SPECTRA AND SPECIES REPLACEMENT WITHIN HERBIVOROUS ZOOPLANKTON,

Oslo Univ. (Norway). Biologisk Inst.
D. O. Hessen, J. P. Nilssen, and T. O. Eriksen.
Internationale Revue der Gesamten Hydrobiologie, Vol. 71, No. 1, p 1-10, 1986. 1 tab, 5 fig, 42 ref.

Descriptors: *Zooplankton, *Algae, *Copepods, *Limnology, Lake Gjersjon, Norway, Seasonal variation, Predation, Bacteria, Daphnia, Phytoplankton, Rotifers, Nutrients.

The numerical relationship between Eudiaptomus gracilis and Bosmina longirostris was investigated in eight polyethylene enclosures in Lake Gjersjoen in S.E. Norway, during one month in early summer when both species are common. At the start of the experiment, the numerical relationship between Bosmina and Eudiaptomus was <1:10, but during the experimental period, a strong increase in Bosmina and a corresponding decrease in Eudiaptomus and medium-sized algae was observed. The shift from Eudiaptomus to Bosmina was probably due to strong competition on medium-sized algae while Bosmina in addition may utilize smaller algae and bacteria, not available to selective fish predation, suppressing Bosmina. (Peters-PTT)
W86-05168

FATTY ACIDS IN LIPIDS FROM PARTICULATE ORGANIC MATTER IN A EUTROPHIC LAKE, LAKE NAKANUMA, JAPAN,

Tsukuba Univ. (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-05171

ANALYSIS OF THE INSHORE MACROZOOBENTHIC COMMUNITY IN LAKE NAINI TAL, UP, INDIA,

Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. K. Gupta, and M. C. Pant.
International Revue der Gesamten Hydrobiologie, Vol. 71, No. 1, 115-125, 1986. 3 tab, 8 fig, 15 ref.

Descriptors: *Benthos, *Eutrophic lakes, *Pollution load, *Temperature effects, Lake Naini Tal, India, Sediments, Population density, Species diversity, Lakes, Seasonal variation, Life cycles.

Population density, species richness, diversity, dominance and similarity indices were examined in the inshore area (0 to 1 meter stratum) of Lake Naini Tal during 1978-1979. Significant changes in the zoobenthos community structures were found both in space and time. A classification based on similarity index values of the data from different sampling times showed two clusters of species: winter and summer. Similar analysis of the sample data from different sites suggested three clusters of species for polluted water, clean water and intermediate sites. The variation in the benthos community structure over the season is primarily related to temperature, availability of food and life cycle pattern, while its variation in space is related to sediment texture and degree of pollution. (Peters-PTT)
W86-05172

FIELD AND LABORATORY STUDIES ON NILE PHYTOPLANKTON IN EGYPT. I. SOME PHYSICAL AND CHEMICAL CHARACTERISTICS,

Assiut Univ. (Egypt). Dept. of Botany.
A. M. Ahmed, M. H. Haikal, A. A. Mohammed, and M. A. Zidan.
International Revue der Gesamten Hydrobiologie, Vol. 71, No. 1, p 127-138, 1986. 1 tab, 4 fig, 57 ref.

Descriptors: *Rivers, *Chemical composition, *Phytoplankton, *Physical properties, *Nile River, Egypt, Temperature effects, Dissolved oxygen, Nitrates, Phosphate Silicates, Chlorides, Photosynthesis, Seasonal variations, Monthly distributions, Hydrogen ion concentration, Sodium, Potassium, Calcium, Magnesium.

Monthly variations of some physical and chemical characteristics of Nile waters at Assiut (375 km south of Cairo, Egypt) during the period September 1980 to September 1982 were analyzed. The maximum temperature was recorded in summer and the minimum in winter. The highest concentrations of dissolved oxygen were always associated with increased phytoplankton populations, which result in greater photosynthetic activity and, accordingly, higher oxygen production. The pH values of Nile waters were in the vicinity of 8.0 The highest oxygen concentrations were recorded in the summer months. The total soluble salts and the total alkalinity exhibited almost identical trends. Nitrate, phosphate, silicate and chloride concentrations showed no major trends. (Peters-PTT)
W86-05173

COMPATIBILITY OF CARBON UPTAKE RATES CALCULATED FROM STABLE AND RADIOACTIVE ISOTOPE DATA: IMPLICATIONS FOR THE DESIGN OF EXPERIMENTAL PROTOCOLS IN AQUATIC PRIMARY PRODUCTIVITY,

Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
Y. Collos, and G. Slawyk.
Journal of Plankton Research JPLRD9, Vol. 7, No. 5, p 595-603, September 1985. 1 tab, 3 fig, 26 ref.

Descriptors: *Phytoplankton, *Carbon radioisotopes, *Isotope studies, Primary productivity, Tracers, Mathematical studies.

Basic differences between the (13)C and the (14)C techniques of measuring carbon uptake by phytoplankton exist at the level of the isotopic analysis. With the first method, a ratio of isotopic abundances is measured on the sample, whereas an absolute amount of isotope is estimated with the second method. If a carbon source other than the labeled one is utilized by the phytoplankton during incubation, the stable isotope method may be biased. Specific uptake values will be underestimated by this effect. It is, however, possible to obtain unbiased estimates of the (13)C-labeled carbon uptake by using an equation containing a term describing the final particulate carbon concentration. Under this condition, carbon uptake rates derived from (13)C isotope data will always be compatible with the (14)C method of measuring primary production. These theoretical considerations have led to a redesign of experimental procedures for field work, as well as a modification of the analytical instrumentation used for both (13)C and (15)N tracer work. (Peters-PTT)
W86-05174

IN SITU PULSE LIGHT FLUOROMETER FOR CHLOROPHYLL DETERMINATION AS A MONITOR FOR VERTICAL AND HORIZONTAL PHYTOPLANKTON DISTRIBUTION IN LAKES,

Aarhus Univ. (Denmark). Botanical Inst.
U. Uehlinger.
Journal of Plankton Research JPLRD9, Vol. 7, No. 5, p 605-615, September 1985. 10 fig, 21 ref.

Descriptors: *Monitoring, *Chlorophyll A, *Mesotrophic lakes, *Algae, *Vertical distribution, *Fluorometry, *Phytoplankton, Lake Lucerne, Lakes, Epilimnion.

Methodological problems with in vivo fluorescence (IVF) measurement using an in situ pulse light fluorometer were investigated in order to validate this method for monitoring the vertical and horizontal chlorophyll A distribution in lakes. Field data were collected at two stations in the mesotrophic Lake Lucerne (Kreuztrichter, Kastanienbaum), and some measurements were performed in limnocorrals suspended in the same lake. The correlation between chlorophyll A and IVF was poor in the upper epilimnion of a mesotrophic lake. The IVF of algal cultures and natural phytoplankton is very sensitive to changes in the light environment. The response of the IVF to rapid light fluctuations depends on the amplitude of the light intensity and the light conditions to which the algae were exposed before the onset of light fluctuations. The variability of the ratio IVF:chlorophyll A concentration makes a permanent calibration of the IVF against chlorophyll A necessary. (Peters-PTT)
W86-05175

14C-LABELLING PATTERNS OF PHYTOPLANKTON: SPECIFIC ACTIVITY OF DIFFERENT PRODUCT POOLS,

Michigan State Univ., East Lansing. Pesticide Research Center.
For primary bibliographic entry see Field 5A.
W86-05176

PHYTOPLANKTON PRODUCTIVITY IN TURBID WATERS,

Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W86-05177

COMPARISON OF CARBON-SPECIFIC GROWTH RATES AND RATES OF CELLULAR INCREASE OF PHYTOPLANKTON IN LARGE LIMNETIC ENCLOSURES,

Freshwater Biological Association, Windermere (England).
C. S. Reynolds, G. P. Harris, and D. N. Gouldney.
Journal of Plankton Research JPLRD9, Vol. 7,

No. 6, p 791-820, November 1985. 19 fig, 1 tab, 58 ref. Natural Environment Research Council Contract No. DGR/410/380.

Descriptors: *Phytoplankton, *Photosynthesis, *Growth rates, Lund tubes, Chlorophyll growth rates, Respiration, Excretion, Carbon radioisotopes, Lake morphology, Carbon cycle, Mathematical analysis.

Potential carbon-specific growth rates of phytoplankton were estimated from a series of measurements of photosynthetic radio-carbon uptake over 4- and 24-hour exposure periods in the light fields of three large limnetic enclosures (Lund Tubes), each providing different limnological and trophic conditions. Photosynthetic behavior and short-term, chlorophyll-specific carbon-fixation rates conformed to well established criteria but, over 24 hr, the net retention represented 23-82% of the carbon fixed during the daylight hours. Potential mean growth rates of the photo-autotrophic community were calculated as the net exponential rates of daily carbon-accumulation relative to derived, instantaneous estimates of the cell carbon content. Apparent actual community growth rates were calculated as the sum of the exponential rates of change of each of the major species present, corrected for probable rates of in situ grazing and sinking, and expressed relative to the fraction of total biomass for which they accounted. The corresponding values were only occasionally similar. It is suggested that the measured carbon fixation rates represent a capacity for cellular increase which, owing to other likely limitations upon growth, is seldom realized. Apparent rates of loss of whole cells do not account for the loss of carbon. The unaccounted loss is best explained by physiological voiding of excess carbon (by respiration, photorespiration, excretion, for example) prior to the formation of new cells. (Peters-PTT)
W86-05178

SEASONAL DYNAMICS OF SKISTODIAPTOMUS PALLIDUS HERRICK AND OTHER ZOOPLANKTON POPULATIONS IN DEER LAKE, S. W. BRITISH COLUMBIA,

Waikato Univ., Hamilton (New Zealand). School of Science.

M. A. Chapman, J. D. L Green, and T. G. Northcote.

Journal of Plankton Research JPLRD9, Vol. 7, No. 6, p 867-876, November 1985. 6 fig, 28 ref.

Descriptors: *Daphnia, *Deer Lake, *Population dynamics, *British Columbia, Turbidity, Burnaby, Eutrophic lakes, Algae, Seasonal variation.

Seasonal environmental conditions and dynamics of a Skistodiaptomus pallidus population are given for a 2-year period in eutrophic Deer Lake, Burnaby, British Columbia. The lake is small and relatively shallow, surrounded by parkland and agricultural fields. Much of its watershed is under urban and industrial use. The lake is heavily used for recreation, but with increasing concern, because of high water turbidity resulting at times from algae. One major inlet and a number of small inlets carry water which is often nutrient-rich into the lake, creating a eutrophic environment. Characteristics of S. pallidus in the lake appear similar to those in more southerly habitats. Breeding occurs between March and November with about five generations produced per year. The annual cycles of Daphnia rosea, D. pulicaria, Diacyclops bicuspidatus thomasi, Bosmina longirostris, rotifers and Chaoborus flavicans are described. (Peters-PTT)
W86-05180

PRACTICAL GUIDELINES FOR THE USE OF ZOOPLANKTON LENGTH-WEIGHT REGRESSION EQUATIONS,

McGill Univ., Montreal (Quebec). Dept. of Biology.

D. F. Bird, and Y. T. -Prairie.

Journal of Plankton Research JPLRD9, Vol. 7, No. 6, p 955-960, November 1985. 1 fig, 9 ref, append.

Descriptors: *Zooplankton, *Statistical methods, *Regression analysis, Biomass, Ecosystems, Daphnia, Mathematical equations, Water analysis.

Guidelines are presented for the use of length-weight equations, relating to four potential pitfalls in the measurement of planktonic biomass, an important component for the analysis of aquatic systems. The first pitfall to be avoided is the grouping of length measurements prior to the estimation of a common weight. To avoid miscalculation, log weights should be estimated individually from each long-transformed length, retransformed to original units. The mean weight per organism can then be taken. The second issue to be considered is bias due to transformation. The magnitude of the bias is a function of the scatter about the regression line, but does not depend in any practical way on variables other than the residual mean square. The third issue is the question of precision of length measurements. Excessive error in length measurement can affect equation coefficients. Unreasonably large measurement errors are needed to effect a change in the most sensitive predictions. Little benefit can be derived from overly fastidious length measurements. Maximum practical measurement intervals are recommended at 0.05 mm for daphnids and Diaphanosoma, 0.03 mm for the smaller Ceriodaphnia and Bosmina, and 0.015 mm for the special case of Holopedium gibberum where only abdomen length is measured. The final issue involves confidence limits around the overall predicted mean weight. Confidence limits should be provided whenever possible to help the reader decide on the reliability of the data, and to allow quantitative tests of hypotheses involving measures of standing crop. The fact that the data are log-transformed complicates matters because confidence limits are ot symmetrical around an individual predicted weight, and because confidence limits are larger around larger organisms. A simple nonparametric technique called the bootstrap can be used to provide reliable confidence limits around the estimate. (Peters-PTT)
W86-05182

ASPECTS OF THE FEEDING ECOLOGY OF TURBIN WATER ZOOPLANKTON. IN SITU STUDIES OF COMMUNITY FILTRATION RATES IN SILT-LADEN LAKE LE ROUX, ORANGE RIVER, SOUTH AFRICA,

Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.

R. C. Hart.

Journal of Plankton Research JPLRD9, Vol. 8, No. 3, p 401-426, May 1986. 8 fig, 3 tab, 78 ref.

Descriptors: *Limnology, *Ecology, *Turbidity, *Silt, *Lake le Roux, *Orange River, *South Africa, *Zooplankton, Filtration, Oligotrophic Lakes, Reservoirs, Lake Verwoerd, Copepods, Daphnia, Biomass, Temperature effects, Algae, Regression analysis, Statistical analysis.

Diel vertical studies of zooplankton community filtration rates (CFR) were undertaken in situ over two annual cycles in a sheltered bay of Lake le Roux, a large silt-laden oligotrophic reservoir in the arid subtropics of South Africa. Lake le Roux was formed in September 1976 by the impoundment of the Orange River by the P. K. le Roux Dam. Water transparency varies considerably and depends largely upon the hydrological manipulation of this reservoir and its larger upstream sister, Lake Verwoerd. The grazer community is dominated by a copepod, Metadiaptomus meridianus, while Daphnia gibba, D. barbata and Moina brachiata account for the balance. Spot estimates of CFR varied from 0.1 to 75%/day in the upper 10 meters, while depth-integrated values ranged seasonally from 0.1 to 15%/day. Most variations in CFR were attributable to seasonal changes in grazer biomass and temperature. There variables are used to construct multiple linear regression models for the prediction of CFR in this system. Some higher CFR values were measured in warmer waters with an unusually rich zooplankton. No significant diel vertical changes in CFR or grazer biomass were observed. Both variables declined sharply with depth. Inorganic turbidity dominated the seston, with algal carbon accounting for less than about 20% of the total POC (particulate organic carbon) available. Feeding responses of this turbid-water community were generally consistent with observations made of other assemblages, apart from the seemingly high specific filtration rates which, atypically, were inversely related to temperature. (Peters-PTT)
W86-05183

SOME CHARACTERISTICS OF THE CARBON COMPOUNDS RELEASED BY DAPHNIA,

Norges Tekniske Hoegskole, Trondheim. Inst. of Marine Biochemistry.

Y. Olsen, K. M. Varum, and A. Jensen.

Journal of Plankton Research JPLRD9, Vol. 8, No. 3, p 505-517, May 1986. 4 fig, 7 tab, 18 ref.

Descriptors: *Daphnia, *Carbon compounds, *Algae, Organic carbon, Particle size, Chlorophyll A, Water pollution sources, Plankton.

A rough characterization of the organic carbon released by some species of Daphnia grazing on algae is presented. The daphnia species studied released 18 to 100% of the algal carbon ingested as dissolved and particulate carbon compounds, presumably as feces. The particulate fraction constituted on average 79% of the total released compounds, leaving 21% as dissolved compounds. The particles released were very small, transparent, and not visible by light microscopy. They contained significant amounts of chlorophyll derivatives. The dissolved compounds consisted mainly of small molecules which are utilized by planktonic bacteria. Particulate organic carbon and chlorophyll A should not be used as measures for algal carbon in grazing experiments with daphnia. Both parameters are influenced by the animals' fecal particles, yielding lowered clearance rates when compared with those obtained by using cell numbers as a measure for algal carbon. (Peters-PTT)
W86-05185

REGULATION OF BACTERIAL SECONDARY PRODUCTION IN TWO EUTROPHIC LAKES AND IN EXPERIMENTAL ENCLOSURES,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.

For primary bibliographic entry see Field 5C.
W86-05186

DETRITUS IN THE LITTORAL OF SEVERAL MASURIAN LAKES (SOURCES AND FATES),

Warsaw Univ. (Poland). Dept. of Hydrobiology.

For primary bibliographic entry see Field 5B.
W86-05189

OCCURRENCE OF GASTROPODA IN THE LAKE LITTORAL AND THEIR ROLE IN THE PRODUCTION AND TRANSFORMATION OF DETRITUS I. SNAILS IN THE LITTORAL OF MIKOLAJSKIE LAKE - GENERAL CHARACTERISTICS OF OCCURRENCE,

Warsaw Univ. (Poland). Dept. of Hydrobiology.

A. Kolodziejczyk.

Ekologia Polska, Vol. 32, No. 3., p 441-468, 1984. 9 fig, 3 tab, 80 ref.

Descriptors: *Snails, *Limnology, *Littoral environment, *Mikolajskie Lake, Detritus, Periphyton, Seasonal variation, Aquatic plants, Biomass, Lake morphology, Poland.

Various aspects of the occurrence of snails in the littoral of the Mikolajskie Lake were studied. The variation in numbers, biomass, and dominance structure of the snails living on the most numerous littoral substratex were studied. In many cases snails were a clearly dominant group among the invertebrate macrofauna, especially with regard to biomass. This dominance is particularly conspicuous on plants. Snails utilize lake macrophytes in different ways. Emergent plants are inhabited throughout the year. On plants with annual aboveground shoots, a marked growth in numbers could be seen and in biomass as well, in the successive months. On plants with perennial aboveground shoots, used by animals as a substrate throughout the year, changes in numbers of the snails in successive months are irregular. For both these plant

groups, great differences have been found also in the species composition and dominance structure of the snails inhabiting them. In summer, the largest numbers of snails per 1 sq m of the littoral are found on submerged vegetation and on plants with floating leaves, as well as on the stony bottom. In sediments, and on the annual P. australis, both the average numbers of snails and their biomass are many times greater than in the habitats mentioned earlier. It has been estimated that in the ice-free period, submerged plants, and those with floating leaves hold up to 63% of numbers, and up to 79% of biomass of all the snails in the Mikolajskie Lake. On account of its very small surface area, the stony bottom of this lake, as a substrate, plays a very small role. In spite of its considerable colonizable surface area, P. australis harbors a small number and low biomass of snails. In spring, the main environment where most snails in the Mikolajskie Lake live is the sediment zone. (see also W86-05191)(Lantz-PTT)
W86-05190

OCCURRENCE OF GASTROPODA IN THE LAKE LITTORAL AND THEIR ROLE IN THE PRODUCTION AND TRANSFORMATION OF DETRITUS II. ECOLOGICAL ACTIVITY OF SNAILS,

Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Kolodziejczyk.
Ekologia Polska, Vol. 32, No. 3., p 469-492, 1984.
12 tab, 76 ref.

Descriptors: *Snails, *Limnology, *Littoral environment, *Feces, Gastropoda, Detritus, Mikolajskie Lake, Periphyton, Seasonal variation, Aquatic plants, Lake morphology, Poland.

Various signs were studied of the activity of snails connected with the production and transformation of detritus by these animals. Most of the snail taxa under study have been found to prefer plant detritus and periphyton as their food, with L. stagnalis the only species that readily ate living plants with delicate tissues. A comparison of the quantities consumed during 24 hours of preferred and avoided foot items, demonstrate that the former were eaten in much larger amounts. The organic matter contained in them also was better assimilated, with about 30-80% of the organic matter ingested being returned to the environment in the form of fecal detritus. Calculated per individual, the circadian production of feces by the particular species is very different, ranging on an average from 0.5 mg dry wt. in Theodoxus fluviatilis to 40.8 mg in Planorbarius corneus. If calculated per 1 g dry wt of animal, the respective values appear to be closer, amounting on an average to about 30-65 mg for most of the taxa analyzed. For snails of the same species the amount of feces excreted clearly depends on the kind of food, but little on the body-size of an animal, over a fairly wide range of this parameter. In T. fluviatilis a lack of correlation has been found, over a fairly wide range of temperature values, between it, and the number of fecal pellets excreted. In all experiments a great variation in the amount of feces excreted was observed among individuals of the same species, as well as in the same individuals between successive days. It was found that snail also excreted small amounts of feces underneath the ice cover in winter. Based on this study, the quantity of feces produced by different snail taxa has been estimated. Snails inhabiting submerged macrophytes excrete as much as 90% of the total amount of 88 tons of dry weight of snail fecal detritus input to Mikolajskie Lake in summer. Snails living on emergent macrophytes produce as little as 2% of the total snail feces. Very small amounts of feces are excreted by stony-bottom-dwelling snails. This results from the fact that this environment represents a small part of the surface area of the lake, and that the dominant species in this lake is T. fluviatilis which excretes the smallest amount of feces among the snail taxa studied. (see also W86-05190)(Lantz-PTT)
W86-05191

LIFE CYCLE AND THE ZONES OF OCCURRENCE OF MESOCYCLOPS LEUCKARTI CLAUS (CYCLOPOIDA, COPEPODA),

Warsaw Univ. (Poland). Dept. of Hydrobiology.
K. Papinska.
Ekologia Polska, Vol. 32, No. 3., p 493-531, 1984.
21 fig, 4 tab, 53 ref.

Descriptors: *Copepods, *Sediments, *Limnology, *Water depth, Masurian lakes, Eutrophication, Mikolajskie Lake, Daphnia, Nutrient availability, Seasonal variation, Lake morphology, Poland.

Research studies were conducted which covered 37 lakes in the Masurian lakeland region of Poland, the most intensive of which were conducted in Mikolajskie Lake. Seasonal variations in numbers, zone of occurrence, and age structure of the Mesocyclops leuckarti population were analyzed for 3 consecutive years against thermal conditions, oxygen content, and composition and total abundance of the whole crustacean community. The life cycle of M. leuckarti can follow one of three patterns: with a diapause lasting about 9 months, without a diapause, and with a diapause lasting about 5 months. A comparison was also made of the course of the life cycles of M. leuckarti and M. (Th.) oithonoides, a closely related species with similar requirements. It was found that M. leukarti is present in the near-bottom water layer and in the bottom sediments, as well as the pelagic zones. This distribution varied however, dependent upon the location of available nutrients, which in turn varied depending upon seasonal distributions of oxygen, and the bottom sediment chemistry. In the bottom sediments, both resting stages and active individuals of M. leukarti were found. An analysis of the data from 35 lakes, collected during the summer stagnation, has demonstrated that the presence of M. leukarti in the bottom sediments in summer depends also on the composition and numbers of the cyclopoid copepods found in the pelagial zone, and that not in all lakes does the life cycle of M. leuckarti include a diapause lasting about 9 months. It seems that both the occurrence above the bottom, and the passing of M. leuckarti into the bottom sediments to diapause, there are to a large extent, controlled by the conditions of the biotic environment, which make it possible for the species to outlast adverse food conditions. (Lantz-PTT)
W86-05192

ZONATION IN PERIPHYTON COLONIZING CONCRETE BLOCKS ON THE SHORE OF LAKE ZEGRZYNSKIE,

Warsaw Univ. (Poland). Dept. of Hydrobiology.
E. Pieczynska, and D. Banas.
Ekologia Polska, Vol. 32, No. 3., p 533-552, 1984.
11 fig, 33 ref.

Descriptors: *Algae, *Concretes, *Artificial lakes, *Lake Zegrzynskie, *Periphyton, Nematodes, Algal growth, Water level fluctuations, Cyanophyta, Chlorophyta.

The qualitative and quantitative composition of periphyton colonizing the concrete embankments of Lake Zegrzynskie were analyzed. The effect of water level fluctuations on the number and composition of periphytic animals was investigated, including the colonization rate of periphyton-free substrates. On the emergent parts of the concrete blocks, the crustaceous type of periphyton is formed, mainly by blue-green algae. On the submerged parts, filamentous periphyton grow, with green algae being the dominant species. Along the shoreline, there is a narrow belt of periphyton which varies in composition. The number of animal species present, and the density of individuals, are greater with filamentous periphyton (Nematoda spp. dominated). The decreasing water level caused drying, resulting in a distinct reduction of periphytic organisms. Field experiments on colonization of bare substrates show that the new periphyton structure in concrete blocks is dependent on water level fluctuations. (Lantz-PTT)
W86-05193

THERMAL AND OXYGEN CONDITIONS AND THE CHEMICAL COMPOSITION OF THE WATER IN THE GREAT MASURIAN LAKES,

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 5C.
W86-05194

SOME OBSERVATIONS ON HOCHSTETTER'S FROG IN THE CATCHMENT OF THE MOTU RIVER, EAST CAPE,

Department of Scientific and Industrial Research, Havelock North (New Zealand). Ecology Div.
J. A. McLennan.
New Zealand Journal of Ecology, Vol. 8, p1-4, 1985. 3 fig, 1 tab, 6 ref.

Descriptors: *Frogs, *Rivers, *Catchment areas, Motu River, New Zealand, Silting, Ecological effects, Environmental effects, Stream degradation.

The distribution and abundance of Hochstetter's frog (Leiopelma hochstetteri Fitzinger) in part of the catchment of the Motu River was assessed during two short surveys in 1981 and 1983. The Motu River rises in the Ruakumara Range and flows northwest through steep, heavily forested hill country before entering the Bay of Plenty and Haupoto, East Cape, New Zealand. Specimens were found in most tributaries examined and on banks of the main river, above extreme flood level. The highest counts were obtained in areas with stable, moss covered substrates, shaded by overhanging vegetation. Frogs in the Upper Motu River were significantly further away from the edge of streams than those in the catchment of the Takaputahi River. Geologically, the catchment of the Motu River is inherently unstable and some silting and degradation of stream occurs naturally. Since the Hochstsetter's frog is vulnerable, to any disturbance that affects the stability of streams, the added burden of high numbers of browsing animals may increase erosion in the catchment to levels which adversely affect the frog population. (Peters-PTT)
W86-05197

UNUSUAL MICROORGANISMS OBSERVED IN NEW ZEALAND HOT SPRINGS,

Waikato Univ., Hamilton (New Zealand). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W86-05200

METHOD FOR ENUMERATING PROTOZOA IN A VARIETY OF FRESHWATER HABITATS,

Southampton Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W86-05201

RELATIONSHIP BETWEEN MICROBIAL ACTIVITY OF STREAM SEDIMENTS, DETERMINED BY THREE DIFFERENT METHODS, AND ABIOTIC VARIABLES,

Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 5A.
W86-05202

ENTERIC LUMINOUS MICROFLORA OF THE POND-CULTURED MILK FISH CHANOS CHANOS (FORSKAL),

Annamalai Univ., Annamalainagar (India). Centre of Advanced Study in Marine Biology.
A. Ramesh, R. Nandakumar, and V. K. Venugopalan.
Microbial Ecology MCBEBU, Vol. 12, No. 2, p 231-236, June 1986. 3 fig, 1 tab, 8 ref.

Descriptors: *Enteric bacteria, *Fish farming, *Ponds, Milkfish, Sediment, Salinity, Biomass, Vibrio harveyi, Vibrio fischeri, Brackish water, Luminous bacteria.

The types, densities, and distribution of the bacteria found in the gut of farmed milkfish was investigated. The fish were collected from a brackish water culture pond adjacent to the Vellar estuary from which water was pumped to the pond. Significant differences in luminous bacterial numbers were found between gut and pond water and between gut and pond sediment, but not between pond water and sediment. No significant variation in luminous bacterial population among the gut

regions was observed. The quantity of ingesta in the fish gut does not appear to influence the biomass of luminous bacteria. Apart from salinity, environmental parameters did not appear to control luminous bacterial populations of the gut. V. harveyi and V. Fischeri were the two most commonly encountered species, and of the two luminous species, V. harveyi was predominant. (Peters-PTT)
W86-05204

SOURCES AND SINKS OF IONS IN A SOFT WATER, ACIDIC LAKE IN FLORIDA,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W86-05217

EFFECT OF SERIAL CORRELATION ON RESERVOIR SIZE,

Monash Univ., Clayton (Australia).
R. M. Phatarfod.
Water Resources Research WRERAO, Vol. 22, No. 6, p 927-934, June 1986. 5 tab, 21 ref.

Descriptors: *Correlation analysis, *Reservoir capacity, Correlation coefficient, Mathematical analysis, Model studies, Inflows, Seasonal variation, Flow profiles.

The effect of the serial correlation coefficient of the inflows, on reservoir size, when large reservoirs are involved, is investigated. Specifically, reservoir size ratios, i.e., the ratio of the reservoir size when the serial correlations are present to the size when they are neglected, assuming reliability and draft to be the same, are calculated. When the reservoir is operated on an annual basis, it is shown that for low drafts the ratio is dependent on the inflow model, whereas for the limiting case when the draft ratio approaches the value 1, the ratio is approximately (1 + p)/(1 - p), irrespective of the inflow model, where p is the annual serial coefficient. For the case when the reservoir is operated on a seasonal basis, the ratio considered is that of the reservoir size when all the serial correlations are present to the size when the year-end seasonal correlation is neglected. It is shown that for large reservoirs this ratio is mainly dependent on the annual flow parameters irrespective of the within-year pattern of inflows. (Lantz-PTT)
W86-05253

KINETICS OF MICROBIAL MANGANESE OXIDATION AND TRACE METAL BINDING IN SEDIMENTS: RESULTS FROM AN IN SITU DIALYSIS TECHNIQUE,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
P. E. Kepkay.
Limnology and Oceanography, Vol. 30, No. 4, p 713-726, July 1985. 10 fig, 2 tab, 33 ref.

Descriptors: *Kinetics, *Microbial Manganese Oxidation, Trace Metals, Sediments, Ferromanganese, Nickel, Cobalt, Copper, Lake Charlotte, Nova Scotia.

Sediments associated with freshwater ferromanganese concretions in Lake Charlotte, Nova Scotia, contained microscopic precipitates of managanese and iron were dispersed throughout the sediment. They were as rich in nickel, cobalt, and copper as deep sea concretions. In addition, the development of the precipitates appeared to be associated with the microbial oxidation of manganese. Results from the deployment of poisoned and unpoisoned dialysis probes or 'peepers' demonstrated that microbial manganese oxidation and nickel binding were closely associated, causing a fivefold enhancement of abiotic processes such as adsorption. The microbial enhancement of copper binding was far less pronounced, due to organic-metal interactions in competition with manganese oxidation. Organic-metal interactions and oxidation may both have been in effect during iron binding, but the relative importance of the two processes could not be determined from the kinetic data. (Lantz-PTT)
W86-05278

WIND-FORCED MOTIONS IN STRATIFIED LAKES AND THEIR EFFECT ON MIXED-LAYER SHEAR,

Western Australia Univ., Nedlands. Centre for Water Research.
S. G. Monismith.
Limnology and Oceanography, Vol. 30, No. 4, p 771-783, July 1985. 8 fig, 1 tab, 17 ref.

Descriptors: *Wind-forced motions, *Stratified lakes, *Mixed layers, *Shear, Model studies.

The solution for the response of a rectangular, n-layered, stratified lake to an arbitrarily varying (in time) wind stress is presented. The case n = 3 is considered in detail. For a three-layered lake the response is made up of the individual responses of one external and two internal modes. When the upper layer is shallow relative to the other two layers, the mixed-layer shear is due almost entirely to the slower, second-mode response. Moreover, the upper interface can tilt quite severely while the lower interface remains nearly flat. Calculations based on the three-layer model are compared with measurements made in Wellington Reservoir, Western Australia. (Author's abstract)
W86-05279

PHOSPHORUS DEPOSITION FROM THE EPILIMNION OF ONONDAGA LAKE,

Upstate Freshwater Inst., Inc., Syracuse, NY.
M. C. Wodka, S. W. Effler, and C. T. Driscoll.
Limnology and Oceanography,Vol. 30, No. 4, p 833-843, July, 1985. 3 fig, 3 tab, 51 ref.

Descriptors: *Phosphorus, *Deposition, *Epilimnion, *Limnology, *Onondaga Lake, Fluctuations, Sediment traps, Cycling nutrients, Organic carbon, Inorganic compounds, Sedimentation, Vertical flow.

The downward flux of inorganic and organic fractions of phosphorus from the epilimnion of calcium-rich, hypereutrophic, Onondaga Lake was determined over 7 months in the water and in sediment traps. Material was collected in sediment traps for short and long periods (average of 4 and 14 days) throughout the study. A linear relationship between overlying concentrations of particulate phosphorus and downward flux (mg P/sq m/day) of phosphorus was only weakly supported (significant at 99.5% confidence level, r to the (2) power = 0.156). About 30% of the phosphorus was in inorganic form. The time average flux of particulate phosphorus (45.4 mg P/sq m/day) was greater than any values in the literature for other systems. The substantial contribution of inorganic phosphorus to total phosphorus deposition and the large magnitude of the overall downward flux may be attributed to oversaturation with respect to the solubility of calcite in the epilimnion of the lake. This then facilitates the sedimentation of phosphorus with calcite and may also enhance the settling of phytoplankton cells. A comparison of the sediment trap data with annual mass balance calculations suggest that phosphorus settling across the metalimnion cycles vertically, on the average about three times, before it is exported from the lake or incorporated into the sediments. (Lantz-PTT)
W86-05280

TEMPORAL AND SPATIAL TRENDS IN METAL LOADINGS TO SEDIMENTS OF THE TURKEY LAKES, ONTARIO,

Department of Fisheries and Oceans, Owen Sound (Ontario). Great Lakes Fisheries Research Branch.
For primary bibliographic entry see Field 5B.
W86-05346

ENVIRONMENTAL PH INFLUENCES GROWTH AND TISSUE CHEMISTRY OF THE SUBMERSED MACROPHYTE VALLISNERIA AMERICANA,

State Univ. of New York at Binghamton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-05347

OVERVIEW OF THE HYDROLOGIC CONCERNS RELATED TO WETLANDS IN THE UNITED STATES,

Connecticut Univ., Storrs. Ecology Section.
V. Carter.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 2, p 364-374, February 1986. 1 fig, 123 ref.

Descriptors: *Wetlands, *Hydrologic aspects, Vegetation, Ecosystems, Surface-groundwater relationships, Hydrologic budget, Floods, Recharge, Base flow, Estuarine environment, Water quality.

Regional, geologic, topographic, and climatic differences create a tremendous diversity in wetland types and wetland vegetation in the United States. Wetland hydrology, a primary driving force influencing wetland ecology, development, and persistence, is as yet poorly understood. The interaction between groundwater and surface water and the discharge-recharge relationships in wetlands affect water quality and nutrient budgets as well as vegetative composition. Hydrologic considerations necessary for an improved understanding of wetland ecology include detailed water budgets, water chemistry, water regime, and boundary conditions. Wetland values are often based on perceived wetland functions. These hydrologic functions include (1) flood storage and flood-peak desynchronization, (2) recharge and discharge, (3) base flow and estuarine water balance, and (4) water-quality regulation. Expanded research and basic data collection focused on wetland hydrology and its relation to wetland ecology are needed to identify and quantify the hydrologic functions of wetlands. (Lantz-PTT)
W86-05349

HYDROLOGY, DEVELOPMENT, AND BIOGEOCHEMISTRY OF OMBROGENOUS PEAT BOGS WITH SPECIAL REFERENCE TO NUTRIENT RELOCATION IN A WESTERN NEWFOUNDLAND BOG,

Connecticut Univ., Storrs. Ecology Section.
A. W. H. Damman.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 2, p 384-394, February 1986. 12 fig, 1 tab, 63 ref. NSF Grant Nos. GS-0744 and DEB-7905195.

Descriptors: *Peat bogs, *Hydrologic aspects, *Geochemistry, *Nutrients, *Newfoundland, Water supply, Sodium, Potassium, Magnesium, Calcium, Seasonal variation, Vegetation, Precipitation, Ombrogenous bogs.

Ombrogenous bogs differ fundamentally from other peatlands in their hydrology, and this affects peat accumulation and bog development as well as the elemental concentrations in peat and water. In oceanic and northern parts of the raised bog zone, the surface of the bog center remains below the critical profile of the water mound because factors other than moisture supply limit its maximum height. In the surface peat, Na and K decrease with depth, whereas other elements increase to a greater or smaller extent. Most elements occur in surprisingly low concentrations below the anaerobic level. In an ombrotrophic bog in western Newfoundland, Na, Mg, and Ca concentrations of bog water were 5, 4.5, and 0.5 times higher, respectively, than in precipitation. K and Mg increased downslope, especially in spring, but not during the vegetation season. In July and August, 20-30% of the Mg, 75-80% of the K, and 93% of the Ca are removed from the precipitation while the water seeps over the bog. Uptake by vegetation is primarily responsible, but Ca is mostly adsorbed on the peat. Increased water flow, rather than higher nutrient concentration, appears to account for the occurrence of more nutrient-demanding species. (Lantz-PTT)
W86-05350

PRAIRIE MARSHES IN WESTERN CANADA, WITH SPECIFIC REFERENCE TO THE ECOLOGY OF FIVE EMERGENT MACROPHYTES,

Manitoba Univ., Winnipeg. Dept. of Botany.
J. M. Shay, and C. T. Shay.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 2, p 443-454, February 1986. 3 fig, 3 tab, 75 ref.

Descriptors: *Marshes, *Marsh plants, *Canada, *Macrophytes, Ecology, Manitoba, Saskatchewan, Alberta, Water level, Chemical analysis, Salinity, Plant growth, Saline water, Precipitation, Standing crops, Wetlands.

Prairie marshes in western Canada occur in the Manitoba, Saskatchewan, and Alberta plains. They are dynamic habitats characterized by fluctuations in water levels and water chemistry. Marsh habitats form an east-west gradient that involves a decrease in precipitation (525-350 mm/yr) and an increase in its variability. Within the region, water salinity ranges from fresh to hypersaline. Water levels and chemistry coupled with life history features influence the distribution and successional role of emergent macrophytes. Five dominant emergents have aboveground standing crops of between 425 (Scirpus lacustris ssp. glaucus) and 1750 g/sq m (Typha latifolia). They vary in reproductive strategy and tolerance to water levels and salinity. S. Lacustris ssp. glaucus grows in deep water with conductivities < 15 mS/cm, and spreads vegetatively. T. latifolia, tolerant of water fluctuations and salinity < 10 mS/cm, spreads both vegetatively and by seed, particularly under drawdown. Phragmites australis tolerates a wide range of moisture conditions and salinities (< 20 mS/cm). It propagates primarily by rhizomes and runners. S. lacustris ssp. validus thrives under unstable water regimes but is saline intolerant (<2 mS/cm). It is short lived (+ 3 years) and reproduces primarily by seed. S. martimus var. paludosus, which dominates western wetlands, tolerates hypersaline conditions (+ 45 mS/cm), prefers changing water levels, and spreads both vegetatively and by seed. (Lantz-PTT)
W86-05351

PHOTOCHEMICAL AND MICROBIAL DEGRADATION OF 2,4,5-TRICHLOROANILINE IN A FRESHWATER LAKE,

Georgia Univ., Athens. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W86-05392

ECOLOGICALLY DERIVED GUIDELINES FOR MANAGING TWO NEW ZEALAND LAKES,

Otago Univ., Dunedin (New Zealand). Dept. of Botany.
For primary bibliographic entry see Field 6E.
W86-05399

QUANTITATIVE TECHNIQUE FOR ESTIMATING THE BOUNDARIES OF WETLANDS FROM VEGETATION DATA,

Landplan Collaborative Ltd., Guelph (Ontario).
For primary bibliographic entry see Field 2I.
W86-05411

2I. Water In Plants

GERMINATION OF TEN SHORELINE PLANTS IN RELATION TO SEED SIZE, SOIL PARTICLE SIZE AND WATER LEVEL: AN EXPERIMENTAL STUDY,

Ottawa Univ. (Ontario). Dept. of Biology.
P. A. Keddy, and P. Constabel.
Journal of Ecology, Vol. 74, No. 1, p 133-141, March 1986. 6 fig, 30 ref.

Descriptors: Descriptors *Water level, *Shoreline, *Plants, Ontario, Canada, Seed size, Soil particle size, Wetland plants.

The zonation of plants along environmental gradients is particularly pronounced on lakeshores where species are distributed along the two gradients of water depth and exposure to waves. Soil particle sizes vary and may influence germination and early establishment. The effect of position along a particle-sized gradient on germination of different sized seeds was studied. Seeds of ten wetland plants (Acorus calamus, Alisma plantago-aquatica, Bidens cernua, B. vulgata, Cyperus aristatus, Lythrum salicaria, Polygonum punctatum, Sagittaria latifolia, Scirpus americanus, and Typha angustifolia) were vernalized and then sown along a particle size gradient with seven stages ranging from 0.125 to 0.250 to 8 to 16 mm. The seeds were collected from several wetlands in Lanark County and the adjacent Regional Municipality of Ottawa-Carleton, Ontario, Canada. Two water levels, 1 cm and 4 cm below the soil surface, were provided. The proportion of seeds producing established seedlings was determined for each particle size and each species. In the drier treatment nine out of ten species germinated differentially along the gradient. In the wetter treatment, only three out of ten species so responded. In both wet and dry treatments, those species which did respond significantly to the gradient had a shared preference for the fine soil. The single exception was Acorus calamus in the dry treatment. The species with the smallest seeds generally showed the greatest response to the gradient. Large seeded species had the broadest tolerances for variation in soil particle sizes. On lakeshores, the fine particles associated with sheltered bays would allow the highest recruitment. These effects would be most pronounced during periods of low water. The zonation of adult plants is apparently not produced by species with different sized seeds requiring different soil particle sizes for maximum germination. (Peters-PTT)
W86-04694

EFFECT OF WATER STRESS UPON POLYAMINE LEVELS IN BARLEY (HORDEUM VULGARE L.) LEAVES,

Birkbeck Coll., London (England). Dept. of Botany.
L. B. Turner, and G. R. Stewart.
Journal of Experimental Botany, Vol. 37, No. 175, p 170-177, February 1986. 3 fig, 1 tab, 21 ref.

Descriptors: *Water stress, *Barley, *Leaves, Water potentials, Polyamines, Plant Physiology, Drought, Turgidity.

Changes are described in the levels of putrescine, spermidine and spermine in intact plants during the gradual development of water stress, using varieties of barley which differ in their tolerance to drought primarily as a consequence of their inherent water requirements. After 6 days without water Alger/Ceres, Palmella Blue and Rihane had accumulated putrescine, although only in concentrations up to twice those found in the controls, but Roho had a decreased putrescine content. One common response was identified; the accumulation and subsequent loss of putrescine was dependent upon the maintenance and loss of leaf turgor respectively. Varietal differences in putrescine accumulation were related to water consumption rates and the extent of osmotic adjustment. Spermine behaved in a similar manner to putrescine but spermidine levels always decreased. Proline levels were 150 fold higher and glycine-betaine levels 50-fold higher than polyamines in stressed plants. Proline and glycine-betaine accumulation occurred once a threshold turgor was reached, which in Roho appeared to be a reduction by 0.2-0.25 MPa or 30-40 percent. The importance of polyamine accumulation during water stress is discussed. (Peters-PTT)
W86-04700

WATER RELATIONS OF CHROMIUM VI TREATED BUSH BEAN PLANTS (PHASEOLUS VULGARIS) L. CV. CONTENDER) UNDER BOTH NORMAL AND WATER STRESS CONDITIONS,

Universidad Autonoma de Barcelona (Spain). Faculty of Sciences.
For primary bibliographic entry see Field 5C.
W86-04701

WATER TABLE OF ALDER AND NEIGHBOURING ELM STANDS IN A SMALL TRIBUTARY BASIN,

Tohoku Univ., Sendai (Japan). Biological Inst.
H. Fujita, and T. Kikuchi.
Japanese Journal of Ecology, Vol. 34, No. 4, p 473-475, December 1984. 2 fig, 9 ref.

Descriptors: *Water table, *Groundwater availability, *Trees, Japan, Alder trees, Elm trees, Tributaries, Basins, Seasonal variation, Rainfall.

Because water conditions are an important factor in the establishment of alder and elm forests in Japan, the water table in alder and elm forests at the bottom of a small tributary valley is studied. The area is at the base of a small tributary valley dissecting a hilly area near the northwestern end of Miyagi Prefecture, Japan. A thick gravel bed is under the fine surface deposits at the upper end of the study area and elm stands are prominent there, although alder stands sometimes occur the moister areas. The lower end consists mainly of clay and silt with a thin gravel bed, except for the stream side where coarse and fine sands are deposited. This area is usually covered by alder stands, although the stream side is sometimes occupied by elm stands. The seasonal change of groundwater level is related to a number of factors, including rainfall, evapotranspiration and the nature of water movement. Fluctuations recorded in this study depended greatly upon rainfall and excess water from melted snow in late April. Alder stands occurred both at wet sites where the water table was high, regardless of the range of its fluctuation, and where the water table was low and stable. The limit for elm stands could not be determined because only two stands were examined. These stands occupied well-drained sites where the water table was lower than 40 cm. (Peters-PTT)
W86-05188

CONIDIAL FUNGI FROM FRESH-WATER FOAM,

Osmania Univ., Hyderabad (India). Dept. of Botany.
C. Manoharachary, and D. Bhairavanath.
Indian Journal of Botany, Vol. 8, No. 1, p 67-68, June 1985. 1 tab, 2 ref.

Descriptors: *Conidial fungi, *Foaming, Andra Pradesh, India, Anguilloosopora crassa, Dactylella aquatica, Freshwater, Streams, Lunulospora curvula, Triscelophorus monosporus.

Foam formed in aquatic ecosystems acts as a trap for many fungal spores and in particular of aquatic Hyphomycetes. Therefore foam samples collected were scanned for a period of one year. Foam samples were collected from some streams of Mancheppa forest locality and of Nizamabad District, Andhra Pradesh, India during 1980-81. Fresh foam and foam samples fixed with a few drops of formalin-alcohol (1 : 5) were scanned under the microscope and identified besides recording their abundance following standard methods. This survey revealed the presence of Anguillospora crassa and Dactylella aquatica with rare occurence, Lunulospora curvula and Triscelophorus monosporus which are more abundant; and clavariopsis aquatica of frequent appearance. However, spores of Beltrania, Curvularia, Drechslera and Tetrapolos were also observed. A survey of literature revealed that A. crassa, C. aquatica and D. aquatica are the new additions to the Fungi of India. (Lantz-PTT)
W86-05396

MYCO-ECOLOGICAL STUDIES OF TWO WATER-BODIES FROM ANDHRA PRADESH, INDIA,

Osmania Univ., Hyderabad (India). Dept. of Botany.
D. Bhairavanath and, and C. Manoharachary.
Indian Journal of Botany, Vol. 8, No. 1, p 69-78, June 1985. 4 fig, 5 tab, 21 ref.

Descriptors: *Mycoflora, *Water tanks, *Andhra Pradesh, India, Seasonal distribution, Fungi, Monsoons, Rainfall intensity, Hydrogen ion concentration, Organic loading, Achlya, Aphanomyces, Blastocladia, Pythium.

The mycoflora, quantitative information, seasonal variation, distribution and systematics of aquatic Phycomycetes in two freshwater tanks and influence of certain physico-chemical factors on these fungi have been studied. Water samples were collected (March 1980 to February 1981) from two fresh water tanks of Nizamabad District of Andhra Pradesh, India, selected for the present study were designated as Tank A and Tank B, respectively. These were located at 1250 ft and 1500 ft above mean sea level. The sampling sites have experi-

enced monsoon (June to September), Winter (October to January) and summer (February to May) with an average rainfall of 176.46 mm for the year 1980-81 and with a maximum of 377.80 mm in June 1980. Tank water A harbored more fungal population and species than B. Mycoflora was maximum in late monsoon and winter, being least in summer. Achlyas, Pythiums and Phycomycetes other than Saprolegnia were more frequent. Low temperature and high organic contents besides the oxygen contents favored the occurrence, distribution and phenology of aquatic Phycomycetes. A range of pH 8.0 to 8.5 supported good mycoflora than 8.5 to 9.0. Fungel species representing Achlya, Aphanomyces, Blastocladia, and Pythium besides the Allomyces have been isolated. Some species were restricted to a particular tank water and a month/season, while other showed irregular distribution. Fungi have been classified as 'indwellers' and 'transients' as per their completion of life cycles and arrival. (Lantz-PTT)
W86-05397

QUANTITATIVE TECHNIQUE FOR ESTIMATING THE BOUNDARIES OF WETLANDS FROM VEGETATION DATA,

Landplan Collaborative Ltd., Guelph (Ontario).
M. J. Sharp, and P. A. Keddy.
Environmental Management, Vol. 10, No. 1, p 107-112, January 1986. 2 fig, 2 tab, 50 ref.

Descriptors: *Wetlands, *Vegetation, *Surveys, *Boundaries, Marshes, Hydrophytes, St. Lawrence River, Canada, Botanical studies.

A method is proposed for the accurate delineation of the wetlands for planning and conservation purposes. The three-step method is based on vegetation zonation. The first step is to examine transects crossing the transition zone from marsh to upland. In each transect the uppermost occurrence of each plant species is locatedrelative to a fixed survey point. The second step is to determine which of these species are hydrophytes (wetland plants). This is assessed using the presence or absence of morphological and physiological adaptions for growing in wet environments. Alternatively, a literature search using botanical manuals may suffice. The third step determines the upper limit of the wetland by finding the upper limit of the uppermost hydrophyte in each transect, and taking the mean value of these over all transects. This mean defines the boundary of the wetland. The method is illustrated using two marshes (Weston Island and Gray's Creek) along the north shore of the St. Lawrence River in Ontario. It is concluded that this technique fills the need for a low-cost method for delineating wetlands that is scientifically defensible and can be employed on relatively small wetlands. (Peters-PTT)
W86-05411

2J. Erosion and Sedimentation

MORPHOLOGY OF A DELTA PROGRADING BY BULK SEDIMENT TRANSPORT,

Cornell Univ., Ithaca, NY. Dept. of Geological Sciences.
P. M. Kenyon, and D. L. Turcotte.
Geological Society of America Bulletin BUGMA, Vol. 96, No. 11, p 1457-1465, November 1985. 14 fig, 2 tab, 42 ref. NSF EAR 81-21053.

Descriptors: *Deltas, *Sediment transport, *Geomorphology, *Mathematical models, *Progradation, Mississippi River, Fraser River, Rhine River, Lake Constance, United States, Canada, Creep, Landslides, Lake Sediments.

A theoretical geomorphic model is developed for the propagation of a river delta in which the patterns of deposition and movement of sediment on the delta front slope are dominated by bulk-transport processes, such as creep and landsliding. The model predicts an exponential delta front profile, in which the maximum slope is controlled by the sediment supply to the delta, the rate of sediment transport on the delta front slope, and the depth of the receiving basin. Applications of the model to the Fraser and Mississippi River deltas and to the Rhine River delta in Lake Constance give good agreement with the progradation and morphology of these deltas. A difference in transport coefficient between the Mississippi River and the other deltas is attributed to the differences in sediment composition and/or rate of sediment supply between this and the other deltas. The derived sediment-transport coefficients are found to be much higher than those for subaerial hillslopes. The results suggest that deltas prograding by the processes considered in this paper will adjust quickly in sediment supply. (Author's abstract-PTT)
W86-04702

ANALYSIS OF STRATIGRAPHIC CONTROL ON RIVER BANK FAILURE,

Nigeria Univ., Nsukka. Dept. of Geology.
For primary bibliographic entry see Field 4D.
W86-04748

RIVER MECHANICS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
R. D. Hey.
Institution of Water Engineers and Scientists, Journal, Vol. 40, No. 2, p 139-158, April 1986. 10 fig, 1 tab, 44 ref.

Descriptors: *River mechanics, *River beds, *River engineering, Mathematical models, Secondary flows, Shear stress, Flow resistance, Bed load, Bank erosion, Bank protection, River channels, Channel capacity, Dredging, Channelization, Outfalls, Intakes, Natural channel design, Mountains, Sediment transport, Meanders.

A review of recent research on river mechanics and its application to river engineering practice includes: dynamic process-response models of gravel-bed river development, secondary flows, boundary shear stress, flow resistance bedload transport, bank erosion, meander mechanisms, regime dimensions of gravel-bed rivers, dominant discharge, dynamic modeling of river channels, channel capacity, dredging, widening/narrowing, and straightening, flood banks and two-stage channels, bank protection, river outfalls and intakes, natural channel design, and river response to changes in discharge and sediment load. In mountainous areas, or proglacial zones, where gravel bed rivers are inherently unstable, particular care has to be exercised in the design and construction of river engineering works in order to minimize their impact on channel stability. Stable gravel-bed rivers are more tolerant of such changes. In contrast, stable sand-bed rivers are highly vulnerable because of high transport rates and the absence of armoring. (Rochester-PTT)
W86-04750

EROSION AND SEDIMENT TRANSPORT MEASUREMENT: SYMPOSIUM.

Institute of Hydrology, Wallingford (England).
Available from IAHS, 2000 Florida Ave., NW, Washington, DC. 20009, Price: $40.00. IAHS-AISH Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. 527 p.

Descriptors: *Sediment transport, *Erosion, Sampling, Measuring instruments, Suspended sediments, Bed load, Rivers, Rainfall, Runoff, Sediment yield, Landslides, Soil mechanics, Bank erosion, Soil loss, Soil erosion, Monitoring, Model studies, Sediment load.

This symposium concerns two main topics: measurement of sediment transport and measurement of erosion. Papers on sediment transport measurement are grouped into several categories: bed load transport, continuous monitoring of suspended sediment concentrations, suspended sediment sampling apparatus, suspended sediment sampling techniques, debris flows and landslides, and design of data collection programs. Papers on erosion measurement include rainfall erosivity and splash erosion, rainfall simulators, erosion plot studies, and field measurement or erosion. (See W86-04844 thru W86-04894) (Cassar-PTT)
W86-04843

MEASUREMENT OF BED LOAD IN RIVERS,

Oregon State Univ., Corvallis. School of Forestry.
W. W. Emmett.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 3-15, 3 fig, 4 tab, 4 ref.

Descriptors: *Sediment transport, *Bed load, *Sampling, *Rivers, Erosion, Particle size, Helley-Smith sampler, Sediment load, Sedimentation.

The Helley-Smith bed load sampler is a direct measuring, pressure differential sampler designed for use with sediment ranging in size from coarse sand to medium gravel. For sediment particle sizes between 0.50 and 16 mm, the Helley-Smith bed load sampler has a near-perfect sediment trapping efficiency. For particle sizes smaller than 0.50 mm or larger than about 16 mm, inadequate sampling procedure for many rivers consists of sampling bed load at about 20 equally-spaced transverse locations on each of two transverse across the river. This procedure enables determination of mean bed load transport rate as well as providing insight to spatial and temporal variations in transport rate. (See also W86-04843) (Author's abstract)
W86-04844

INCREASED BAG SIZE IMPROVES HELLEY-SMITH BED LOAD SAMPLER FOR USE IN STREAMS WITH HIGH SAND AND ORGANIC MATTER TRANSPORT,

R. L. Beschta.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 17-25, 3 fig, 1 tab, 12 ref.

Descriptors: *Sediment transport, *Bed load, *Sampling, *Rivers, Erosion, Particle size, Helley-Smith sampler, Sediment load, Sedimentation, Sand, Organic matter, Flumes.

Flume measurements showed that the sampling efficiency of the Helley-Smith bed load sampler rapidly decreased as sands clogged the 0.2 mm mesh of a standard bag (surface area = 1950 sq cm). Sampled transport rates were consistently low in relation to ambient rates of sediment transport. For sampling intervals of 4 and 145 min, sampling efficiencies averaged 20 and 14%, respectively. Because the change in efficiency was nonlinear with time, transport rates computed from samples collected over a variety of sampling times should not be compared directly. A three-fold increase in bag surface area prevented the rapid decline in sampling efficiences, and calculated transport rates were within a few percentage points of ambient rates. Instream measurements further indicated that organic matter decreases the sampling efficiency of the standard bag, another problem minimized by the use of a larger bag. (See also W86-04843) (Author's abstract)
W86-04845

EFFICIENCY OF BASKET TYPE BED LOAD SAMPLERS,

National Water Research Inst., Burlington (Ontario).
P. Engel, and Y. L. Lau.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 27-34, 4 fig, 2 tab, 12 ref.

Descriptors: *Sediment transport, *Bed load, *Sampling, *Rivers, Erosion, Particle size, Sediment load, Sedimentation, Basket samplers, Flumes.

The sampling efficiencies of three models of basket samplers were studied in a sediment flume. Dimensions of the samplers (in cm) were 3.8 x 8.8 x 11.5, 5.0 x 11.7 x 15.3, and 7.6 x 17.6 x 23.6. Results, together with analysis of data from the literature, indicate that the sampling efficiency of basket samplers is not constant but may be a function of two dimensionless variables. The hydraulic efficiency, which should be constant for accurate sampling, decreased as the basket sampler filled with sedi-

ment. Therefore, calibration curves are necessary to obtain bed load transport using basket samplers. (See also W86-04843) (Cassar-PTT)
W86-04846

DEVELOPMENT OF A SAND BED LOAD SAMPLER FOR THE YANGTZE RIVER,

Yangtze River Planning Office, Hankou (China).
Z. Dejia, L. Daorong, and G. Haochuan.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of teh Florence Symposium, June 22-26, 1981. p 35-46, 11 fig, 2 tab.

Descriptors: *Sediment transport, *Bed load, *Sampling, *Rivers, Erosion, Particle size, Sediment load, Sedimentation, Sand, Yangtze River, Polyakov bed load sampler, Netherlands bed load sampler, Don bed load sampler, Flow velocity, China.

Several bed load samplers used in the Yangtze River during the 1950's are described. The Polyakov sampler, which has a collecting trap, leading plate, and tail vane, has an efficiency of 19.9% under slower stream velocities. The Netherlands (or Dutch sampler) has a mesh bag with much resistance to flow and an efficiency of 17.5%. It also produces a large scour hole. The Don sampler, a pressure-difference type, has a trapping efficiency of 46.5%. The contact plate loses contact with the bed in a few seconds and produces scour holes in front. Criteria for a satisfactory bed load sampler include a good fit between the lower edge of the sampler entrance and the stream bed without causing erosion or deposition, a 1.0 ratio of intake velocity to natural stream velocity, and high trapping efficiency. Two samplers were designed, based on these desirable characteristics. The ratio of intake to stream velocity and the trapping efficiency were 86.1 and 43.5%, respectively, for the Yangtze 73 sampler and 1.05 and 61.4% for the Yangtze 78 sampler. Both have a 100 x 100 mm entrance, protective plates to maintain contact with the stream bed, and are designed to reduce flow velocity within the sampler to allow representative sampling. (See also W86-04843) (Cassar - PTT)
W86-04847

EXPERIMENTAL INVESTIGATIONS ON THE INITIATION OF BED LOAD TRANSPORT IN GRAVEL RIVERS,

Pisa Univ. (Italy). Facolta di Ingegneria.
S. Cavazza.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 53-61, 3 fig, 1 tab.

Descriptors: *Sediment transport, *Bed load, *Rivers, Gravel, Floods, Tracers, Flow velocity, Turbulent flow, Shields curve.

This report presents the results of research carried out on gravel river beds, composed of fractions of up to 350 mm, and the conditions of initial bed load transport. The method employed is applicable to rivers with short duration floods and significant periods of low water. It comprises the following elements: topographical survey of the geometry of the river bed; granulometric analysis of the bed material; selection of round pepple tracers, the measurement of orthogonal circumferences, weight and volume; coloring and numbering of tracers; placing of tracers moved after every flood and, where possible, measurement of displacement. This report presents the results of experiments carried out on six marked sections. The data obtained have permitted the testing of theoretical formulae for bed load transport at these sites and the verification of the Shields curve in cases of extreme turbulence. (See also W86-004843) (Author's abstract)
W86-04848

NUCLEAR TECHNIQUES FOR MEASURING SEDIMENT TRANSPORT IN NATURAL STREAMS, EXAMPLES FROM INSTRUMENTED BASINS,

Naples Univ. (Italy). Ist. di Geologia e Geofisica.
G. S. Taziolo.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 63-81, 16 fig, 25 ref.

Descriptors: *Isotopic tracus, *Measuring instruments, *Sediment transport, *Streams, Radioactive tracers, Nuclear gages, Gages, Erosion, Floods, Suspended sediments, X-ray, Gamma radiation.

Nuclear gages are useful for measuring bed load transport in torrential streams with very high suspended sediment concentrations (1 to 200-300 g per liter). These instruments use the absorption or diffusion of x-ray or gamma radiation by an artificial radiation source, or alternatively, on the measurement of natural gamma radioactivity emitted by the suspended sediment. Nuclear techniques cause minimum disturbance of water flow. Factors which influence measurements are temperature, chemical composition of the sediments, and electronic drift. Nuclear gages (Am241 and Cs137) were used in two instrumented basins in southern Italy, where floods are common in the short rainy season. Data indicated a reasonable degree of correlation between discharge and suspended sediment loads for 15 flood events. Tracers for studying sediment movement are described. In general, Au198 is used for preliminary experiments and longer-lived Cr51, Ir192, Sc46, and Ta182 for later stages. Activities vary from a few millicuries to 150 Ci. The mass of radioactive sediment emplaced varies from a few dozen for pebble-sized material to several kilograms for pelitic sediment and sand. Particles are labeled by coating the surface or, in larger materials, depositing the tracer in drilled holes. (See also W86-04843) (Cassar - PTT)
W86-04849

DEVELOPMENT OF NUCLEAR SEDIMENT CONCENTRATION GAUGES FOR USE ON THE YELLOW RIVER,

Yellow River Conservancy Commission, Zhengzhou (China). Inst. of Hydraulic Research.
L. Zhi, L. Yuren, S. Leling, X. Xianglin, and Y. Yujing.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 83-90, 7 fig, 4 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Rivers, *Suspended sediment, Yellow River, China, Nuclear gages, Gages, Isotopic tracers.

Three types of nuclear sediment concentration gages were developed for use on the Yellow River, China. The instrument designed for measuring hyperconcentrations was based on the principle of gamma scattering, using a Geiger counter with a tungsten cathode and a transistorized quench circuit. Radioactive sources were Cs137, and for accuracy at lower concentrations, Am241. Results of horizontal sampling and the radioisotope method agreed closely for sediment concentrations between 15 and 500 kg per cu m. Lower sediment concentrations were measured with two types of probes: scintillation detector and proportional counter detector. (See also W86-04843) (Cassar - PTT)
W86-04850

LATEST ACHIEVEMENTS IN THE DEVELOPMENT OF NUCLEAR SUSPENDED SEDIMENT GAUGES,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
B. Berke, and L. Rakoczi.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 91-96, 2 fig, 2 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Rivers, *Suspended sediments, Nuclear gages, Gages, Hungary, Floods.

In situ measurement of suspended sediment concentrations is especially important at higher concentrations, i.e., during floods or in countries where streams have very high sediment transport capacity. The new Hungarian nuclear gage for measuring suspended sediment includes previously developed features like the horizontal arrangement, the capability of taking measurements close to the bed, and an adjustable distance between the radiation source and the detector. In addition, it has the following new features: (a) a semiconductor detector instead of a scintillation detector, enabling a lower supply voltage to be used, and having tolerance of voltage fluctuations; (b) a built-in programmable pocket calculator which directly converts measured radiation intensity into sediment concentration. The range of measurement of the gage is about 500-12000 mg per liter, high enough for most semiarid or tropical streamflow conditions. Because it is battery-powered and portable, the gage can be rushed to the site of a sudden flood. (See also W86-04843) (Author's abstract)
W86-04851

CONTINUOUS MEASUREMENT OF SUSPENDED SEDIMENT IN RIVERS BY MEANS OF A DOUBLE BEAM TURBIDITY METER,

Hydrological Research Inst., Pretoria (South Africa).
D. C. Grobler, and A. V. B. Weaver.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 97-103, 4 fig, 1 tab, 8 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Suspended sediments, *Turbidity, Rivers, Double beam turbidity meter, Monitoring.

A turbidity meter for continuous monitoriong of suspended sediment concentrations in rivers is described. The measuring principle automatically compensates for detector and light source aging as well as for the accumulation of dirt and algae on the sensor windows. Data are recorded on a Read Only Memory (ROM) device which plugs into the instrument. After a ROM is full, it is replaced and the ROM with the data is connected to a computer. The data are read directly onto a disc file. The ROM is cleared by passing it under an ultraviolet light after which it is ready for reuse. The instrument has an intelligent receiver unit which can be programmed to vary integration times, measuring frequencies and recording frequencies as a function of information received from the turbidity sensor or other sensor connected to it. Initial laboratory and field tests indicate that the instrument is accurate and measures over a wide sediment concentration range (0-8 g per liter). This combination of features makes this a highly suitable instrument for monitoring sediment concentrations for the purpose of calculating sediment discharge in rivers. (See also W86-04843) (Author's abstract)
W86-04852

USE OF TURBIDITY MONITORS TO ASSESS SEDIMENT YIELD IN EAST JAVA, INDONESIA,

Hydraulics Research Station, Wallingford (England).
T. E. Brabben.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 105-113, 4 fig, 3 tab, 10 ref.

Descriptors: *Sediment transport, *Suspended sediments, *Turbidity, *Sediment yield, Rivers, Monitoring, Reservoirs, Silting, Reservoir silting, Karangkates Reservoir, Selorejo Reservoir, Java, Indonesia, Brantas River, Partech turbidity monitor, Erosion.

Sediment loss from the drainage basins of two reservoirs, Karangkates and Selorejo, in the River Brantas basin, East Java were studied. Since 1977 up to eight Partech turbidity monitors have been used to record continuous output of suspended sediment concentration at river flow measuring points within the drainage basins. Measurements of rainfall intensity and streamflow were made at the same time. Surveys of the reservoirs were undertaken to determine the quantity and distribution of

the sediment deposits. Turbidity monitors had a high mechanical failure rate (30% of records lost) due to high temperatures, humidity, and slow maintenance. Sediment yields calculated from turbidity monitoring data were much lower than those estimated from reservoir surveys. The discrepancy is caused by lack of data collected in the severe flood stages and lack of bed loads. (See also W86-04843) (Cassar - PTT)
W86-04853

ANALYSIS OF A SIMPLE SUSPENDED LOAD INTEGRATING SAMPLER,

Florence Univ. (Italy). Dept. of Civil Engineering.
I. Becchi, P. Billi, and P. Tacconi.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 115-122, 10 fig, 2 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Suspended sediments, *Sampling, Filtering bag integrating sampler, Filters.

The filtering bag integrating sampler for suspended sediment comprises a perforated metal cage, a tea bag paper filtering bag, and a molded polyethylene nozzle. Filtering efficiency results with two weights of nonwoven filter paper were widely scattered. Further testing showed that type T paper, weight 17 g/sq m, produced more scattered data than type B paper, weight 25 g/sq m. Slight variations in nozzle shape produced large changes in the behavior of the sampler. Relationships were developed between the filtering efficiency and the diameter of the sediment. (See also W86-04843)(Cassar - PTT)
W86-04854

RECENT DEVELOPMENTS IN PUMP SAMPLERS FOR THE MEASUREMENT OF SAND TRANSPORT,

Hydraulics Research Station, Wallingford (England).
M. J. Crickmore, and C. J. Teal.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 123-130, 3 fig, 3 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Sand, *Sampling, Suspended sediments, Pump samplers, Sand fluctuations.

It continues to be the practice of the Hydraulics Research Station to compute suspended sand fluxes in rivers and estuaries from depth profiles of sediment concentration and velocity. The profiles are defined by point measurements using pump samplers and current meters. Special bed frames are described that have been designed to allow reliable positioning of the sampling intake and the current meter with reference to the bed surface. On-site extraction of the sediment is obtained by filtration or by hydrocyclone. The flux of individual size fractions is computer by combining the best-fit profiles of velocity and concentration. Specimen results for river and tidal flow are given. (See also W86-04843) (Author's abstract)
W86-04855

FIELD MEASUREMENTS OF SUSPENDED SEDIMENT CONCENTRATION IN THE SURF ZONE,

Polish Academy of Sciences, Gdansk. Inst. Budownictwa Wodnego.
T. Basinski.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 137-143, 3 fig, 1 tab, 4 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Suspended sediments, *Sampling, Surf, Sand, Sand trap, Suction sampler, Radioisotope probe.

Three methods of measuring suspended sand concentrations were compared in field tests. These include a sand trap, a suction sampler, and a radioisotope probe. Among the sources of measurement error are distortion of the flow pattern by the device; temporal variations in salinity and other water quality parameters; composition, size distribution, and shape of sand grains; organic matter, air bubbles; variations in sea level and shifting sea bed; equipment faults; insufficient calibration; and unappropriate and insufficient measuring points. A list of requirements for measurement methods is given. Evaluation of the three samplers is presented in table. Although all of them can be used in practice, the cost, sensitivity, ease of calibration, and integration time must be considered for each situation. (See also W86-04843) (Cassar - PTT)
W86-04856

IN SITU MEASUREMENTS OF PARTICULATE MATTER TRANSPORT IN RIVERS,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
B. Doll, H. H. Hahn, and F. Kaser.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 145-150, 2 fig, 2 tab, 3 ref.

Descriptors: *Sediment transport, *Rivers, *Particulate matter, *Suspended sediment, *Sampling, Mixing, Neckar River, Federal Republic of Germany, Ecograph.

In order to apply models describing mixing and transport phenomena in natural systems, data of a very specific nature are required. The program of an investigation undertaken for more than two years in the River Neckar has been determined to a large extent by the concept of a model developed in parallel. Prerequisites for the collection of in situ data include a specially equipped boat, which permits the collection of data by means of various electrodes as well as by sampling. The continuous measuring equipment as well as the sampling device are suppled by a continuous flow of water pumped into the laboratory installed on the boat. Samples are either analyzed there, in an accompanying field laboratory ashore, or in the central laboratory of the research institute. The overall geometry of river cross sections was recorded by an echograph. (See also W86-04843) (Author's abstract)
W86-04857

SEDIMENT MEASUREMENT TECHNIQUES USED BY THE SOIL CONSERVATION SERVICE OF NEW SOUTH WALES, AUSTRALIA,

Soil Conservation Service of New South Wales, Sydney (Australia).
K. T. Ryan.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 151-157, 12 ref.

Descriptors: *Sediment transport, *Measuring instruments, *Sampling, Runoff, Geib sampler, Flow splitting, Wheel sampler, Pomerene sampler, Pumping samplers, Gamet water sampler, Flow control, Pumping sampler, New South Wales, Australia, Crump weirs, H flumes.

The Soil Conservation Service of New South Wales uses two sediment sampler systems. The first uses a sediment sampler to provide an estimate of both sediment concentration and total runoff. The second system uses a sediment sampler to give an estimate of sediment concentration and a supplementary instrument to give the total runoff estimate. Criteria for choosing a sampler for a particular application are capacity, sample size and type, accuracy, reliability, cost, and hydraulic head. Geib multislot divisors and storage tanks are used to estimate total sediment yield, on an event basis, from small plots. Pomerene wheels and H flumes are used in small basins. When discrete samples are required for soil erosion process research, or from medium to large basins, pumping sediment samplers are used. The sampler intake point is located downstream of a turbulent section of flow or a depth integrating tube is used to obtain representative samples. The flow measuring structures used with pumping samplers are either sloping crest Crump weirs or H flumes with 14% sloping drop boxes. (See also W86-04843) (Cassar - PTT)
W86-04858

SEDIMENT TRANSPORT SAMPLING FOR ENVIRONMENTAL DATA COLLECTION,

Water and Power Resources Service, Denver, CO.
For primary bibliographic entry see Field 7B.
W86-04859

SEDIMENT SAMPLING IN RIVERS AND CANALS,

Uttar Pradesh Irrigation Research Inst. Roorkee (India).
For primary bibliographic entry see Field 7B.
W86-04860

RELIABILITY OF SUSPENDED SEDIMENT LOAD DATA,

Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7C.
W86-04861

ACCURACY AND PRECISION OF SUSPENDED SEDIMENT LOADS,

Guelph Univ. (Ontario). School of Engineering.
For primary bibliographic entry see Field 7C.
W86-04862

STUDY OF THE VARIABILITY OF SUSPENDED SEDIMENT MEASUREMENTS,

Agricultural Research Service, Chickasha, OK.
For primary bibliographic entry see Field 7B.
W86-04863

ACCURACY OF ESTIMATING BASIN DENUDATION PROCESSES FROM SUSPENDED SEDIMENT MEASUREMENTS,

Institute of Meteorology and Water Management, Warsaw (Poland).
J. Branski.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 213-218, 5 ref.

Descriptors: *Sediment transport, *Erosion, *Sediment yield, *Suspende sediments, *River basins, Denudation, Poland, Statistical analysis.

It is obvious that estimations of denudation rate have a systematic (negative) error resulting from not having taken into account (a) bed and dissolved load, and (b) that part of the denudation product which does not reach rivers but remains in storage in the landscape. These estimations have random errors which depend on the method used to measure suspended load, the method of calculating sediment concentration, the method of calculating sediment yield, etc. By establishing the elementary random errors by statistical analysis it is possible to calculate the accuracy of denudation indices. An assessment is presented using data from Polish rivers, both for simple basins (source to measuring point) and incremental basins (between measuring points); errors are 4 times larger for the latter calculation. (See also W86-04843) (Author's abstract)
W86-04864

TECHNIQUES APPLIED IN DETERMINING SEDIMENT LOADS IN SOUTH AFRICAN RIVERS,

Pretoria Univ. (South Africa). Dept. of Civil Engineering.
A. Rooseboom, and G. W. Annandale.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 219-224, 3 fig, 10 ref.

Descriptors: *Sediment transport, *Sediment yield, *Erosion, *South Africa, Rivers, Reservoirs, Sediment load, Mathematical studies.

Since 1920 sediment loads in southern African rivers have been measured with daily bottle sam-

pling and measurement of sediment deposit volumes. Bottle samples usually yield results about 25% lower than those obtained with more sophisticated methods. Limited bed load sampling indicated that most of the sediment load in these rivers is suspended. Sediment yield was successfully depicted by applying the double mass curve of cumulative sediment discharge against cumulative water discharge. Reservoir sediments were calculated from the measured volume, assuming all deposits were 50 years old with a density of 1350 kg/cu m. A sediment yield map of South Africa was prepared. (Cassar - PTT)
W86-04865

MEASUREMENT OF DEBRIS FLOW AND SEDIMENT-LADEN FLOW USING A CONVEYOR-BELT FLUME IN A LABORATORY,

Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W86-04866

SOME PROBLEMS RELATED TO SEDIMENT TRANSPORT MEASUREMENT IN STEEP MOUNTAIN STREAMS,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
F. Raemy, and M. Jaeggi.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p. 231-239, 6 fig, 5 ref.

Descriptors: *Sediment transport, *Streams, *Mountains, Flumes, Sediment load, Sediment scale, Sediment-water interfaces.

A sediment-scale was developed to record continuously the variation of a sediment load with time, as applied to steep mountain streams with very high sediment concentrations and unsteady phenomena in bed erosion processes. The scale measures the forces exerted by the water-sediment mixture on a steel slab inserted in the flume bottom. Knowing the weight of the mixture, worked out from calibrated extensiometers supporting the slab, the height of the water table over the flume bottom and the mean velocity of the sediment, the instantaneous sediment transport rate can be found. Tests were conducted with a flow discharge of 7.4 liters/sec, a slope of 2%, and masses of 2 and 4 kg of widely graded sediment introduced at the upstream end of the flume. Introducing the sediment disturbed the flow by causing the water surface level to fall for the first 5 sec. The sediment velocity was almost constant throughout the passage of sediment, i.e., it did not change significantly with sediment concentration. (See also W86-04843) (Cassar - PTT)
W86-04867

INTEGRATED DEBRIS FLOW OBSERVATIONS,

Kyoto Univ. (Japan). Disaster Prevention Research Inst.
S. Okuda, T. Aoki, and M. Okamoto.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 241-244.

Descriptors: *Sediment transport, *Soil mechanics, *Erosion, *Landslides, Mountains, Mt. Yakedake, Kamikamihori Valley, Japan, Debris flows, Photography, Rainfall, Rain gages, Flow meters.

Debris flows in the Kamikamihori Valley east of Mt. Yakedake (2455 m), Japan, have been studied using rain gates, directional rain gages, and groundwater level meters in the debris source areas; investigation of the flow mechanism with fluid speed meters, impact force recording devices, soil samplers, seismographs, 8 mm movie cameras, and video cameras in the fan area. Automatic sensors turn on the equipment when the debris flows start, usually from rainfall. Photography conditions are extremely difficult because most rainfall and debris flows occur at night or in heavy fog. Fifty-three flows have been observed in the past 10 years. (See also W86-04843) (Cassar - PTT)
W86-04868

STUDIES OF SEDIMENT PRODUCTION ON MOUNTAIN SLOPES,

Kyoto Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 4D.
W86-04869

NEW METHODS OF MEASUREMENT OF SLOW PARTICULATE PROCESSES ON HILLSIDE SLOPES,

London School of Economics and Political Science (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04870

SEDIMENT MEASUREMENT IN THE YELLOW RIVER,

Yellow River Conservancy Commission, Zhengzhou (China).
L. Yuqian, and X. Guishu.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 275-285, 7 fig, 4 tab, 5 ref.

Descriptors: *Sediment transport, *Erosion, *Rivers, Sediment deposition, Deposition, Sediment yield, Yellow River, China, Networks, Reservoirs, Reservoir silting, Silting, Floods, Sediment concentration, Soil loss, Alluvial rivers.

The development of sediment measurement networks on the Yellow River, China, are reviewed. This river is characterized by a very high sediment load and a relatively limited volume of water. Long-term data collection has revealed the main source area of sediment yield and the quantity of sediment transported, deposited, and diverted. Some records date to the third century AD. Although only 33 hydrometric stations existed in 1949, 456 stations operate today. The river is studied in four sections, based on channel pattern - wandering, transition, meandering, and estuary. Thirty-six percent of the total sediment is >50 microns in diameter; 3/4 of it originates from an area of 100,000 sq km (total basin area is 752,000 sq km). About 50-90% of the total sediment is delivered within 10 days of floods. Only 24% of the silt passes through the system into the sea, leaving 43% in the delta. Geomorphological changes in the lower river during floods are drastic, making hydrometric measurements difficult. Reservoir sedimentation is a severe problem in the 140 reservoirs on the river. This is being controlled by removing sediment-laden water for irrigation and regulating flow so that the muddy water is kept moving through the system. Accuracy of methods for measuring sediment transport is described, considering the hyperconcentrations of sediment and the wide temporal variations in the river system. (See also W86-04843) (Cassar - PTT)
W86-04871

MEASUREMENT OF SEDIMENT YIELD AND TRANSPORT IN MOUNTAIN TORRENTS IN JAPAN,

Public Works Research Inst., Tsukuba (Japan).
T. Mizuyama, and M. Watanabe.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 287-294, 8 fig.

Descriptors: *Sediment transport, *Rivers, *Sediment yield, *Sampling, Mountains, Dams, Sedimentation, Sabo dams, Japan, Bed load, Erosion, Particle size, Erosion control.

Sabo (erosion control) dams and reservoirs are used in Japan as large bed load traps to measure sediment yield in mountainous streams where customary methods are ineffective. Types of measurements for this system include rainfall, flow discharge, sediment concentration of wash load and suspended load, river bed elevation changes, sediment production caused by erosion and landslides (from serial photographs), sediment yield from experimental plots (bare and vegetated), and grain size distribution. Equations are given for the relationship of sediment concentration of wash load to flow discharge. Studies of grain size distribution show that the finest particles, often not detected, are vital for successful completion of sediment mass balances. Reservoir sedimentation data must consider the variations in the trapping efficiency of each site and the density of sediments. (See also W86-04843) (Cassar - PTT)
W86-04872

MEASUREMENT OF SUSPENDED SEDIMENT AND BED LOAD IN SAND BED CHANNELS AND THE ASSOCIATED PROBLEMS,

Illinois State Water Survey Div., Champaign.
N. G. Bhowmik.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 295-303, 5 fig, 6 ref.

Descriptors: *Sediment transport, *Erosion, *Bed load, *Suspended sediments, *Sampling, *Erosion rates, Sand, Kankakee River, Illinois, Bank erosion, Illinois River, Navigation, Barges.

Problems faced in the measurement of erosion and sediment transport are described for four case studies. (1) Sediment transport in the Kanakee River was measured with a Helley-Smith bed load sampler, used with caution because it could easily sink in the sandy bottom and because the sampler was designed to measure much larger particles. Maximum water discharge and maximum sediment load correlated well in some cases, but not in others, showing that isolated samples may not be reliable. The relationship between sediment yield and water yield varied considerably with the season. Although the suspended sediment was sand in the spring flood, silt, clay, and very fine sand was carried in late summer and fall. (2) Bank erosion in the Illinois River was successfully documented by measuring the bank slopes at a few cross sections and surveying the bank along the selected reaches. (3) Lateral movement of suspended sediment in the presence of barge traffic in the Illinois River was studied at a shore station and barge track station. Concentrations of suspended sediment (mg/liter) increased from 60 (background) to 500 when the first barges passed and back to 90 after 4 barges had passed. (4) A sampling schedule for suspended sediment concentrations in the Kanakee River was devised, considering that 70-90% of the annual suspended sediment load passed during the 60-90 day flood season. (See also W86-04843) (Cassar - PTT)
W86-04873

SIGNIFICANCE, MEASUREMENT, AND ANALYSIS OF SEDIMENT DISCHARGES OF FLASHY STREAMS,

Irrigation and Power Research Station, Amritsar (India).
G. S. Dhillon, V. S. Sakhuja, and T. C. Paul.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 305-313, 5 fig, 22 ref.

Descriptors: *Sediment transport, *Streams, *Suspended sediments, *Bed load, *Sampling, India, Flashy streams, Sediment load, DuBoys-Straub formula, Sediment load, Bed load samplers, Acoustic instruments, Ultrasonic method, Punjan bottle sampler, Mathematical studies.

Standard methods for measuring sediment loads are limited when applied to flashy streams carrying very large suspended sediment loads. Mean sediment concentrations may vary up to 70% in a vertical. Some other problems are as follows: ultrasonic scattering method -- severely disturbed by air bubbles and restrictions on the upper limit of sediment concentration; bed load samplers -- do not stay in place in the raging torrents; acoustic instruments -- measure only the relative bed load transport in the cross section and relative variations with time in streams having coarse bed material; ultrasonic method -- relies on questionable assump-

tions. A complete trench across a river appears to be reliable for measuring bed load. Five flashy streams were sampled from overhanging cableways or bridges, using the Punjab bottle sampler fitted with appropriate weights. Suspended sediment samples were taken in three verticals at 1/6, 1/2, and 5/6 of surface width; at the surface in high flood stages. A Russian type sampler with an efficiency of 73% was used for bed load sampling. Of five sediment discharge formulae (DuBoys-Straub, Shields, Colby, Laursen, and Engelund-Hansen), the DuBoys-Straub formula had the least standard error. (See also W86-04843) (Cassar - PTT)
W86-04874

NATIONAL EROSION INVENTORY OF THE SOIL CONSERVATION SERVICE, US DEPARTMENT OF AGRICULTURE, 1977-1979,

Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 7C.
W86-04875

DATA REQUIREMENTS FOR SEDIMENT, EROSION AND TRANSPORT SIMULATION,

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W86-04876

UPLAND EROSION: EVALUATION AND MEASUREMENT,

Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
G. Chisci.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 332-349, 1 fig, 4 tab, 58 ref.

Descriptors: *Erosion, *Soil erosion, *Model studies, *Sediment transport, Mathematical models, Soil loss, Hill erosion, Rainfall, Runoff, Rainfall simulators, Universal Soil Loss Equation, Microscale measurements.

The connection between experimental research and mathematical models in assessing and forecasting upslope soil erosion are described. Although erosion occurs on macro- and mesoscales, this paper is confined to microscale measurements (hill slopes, soil depth loss vs. different erosion type, and soil fertility). Soil erosion depends basically on the power of the rain to cause erosion (erosivity) and the ability of the soil to withstand the rain (erodibility). Subsidiary factors are soil morphology, vegetation cover, and land management. Erosion, erosivity, and erodibility can be separated into components. From these, a basic conceptual model is derived. The Universal Soil Loss equation was developed to express annual soil loss in terms of the components. Modifications in the factors can fit this equation for use in other countries. Newer models such as CREAMS and the gross erosion sediment delivery method provide more accurate predictions. Experimental plots are used to measure erosion and collect rainfall-runoff data. These studies involve techniques and equipment such as flow shear stress, splash cups, bounded runoff plots, surface level measuring devices, and rainfall simulators. (See also W86-04843) (Cassar-PTT)
W86-04877

ANALYSES OF DIFFERENT PROCESSES GOVERNING SOIL EROSION BY WATER IN THE TROPICS,

International Inst. of Tropical Agriculture, Ibadan (Nigeria).
R. Lal.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 351-364, 3 fig, 5 tab, 42 ref.

Descriptors: *Erosion, *Soil erosion, *Sediment transport, *Tropical regions, Rainfall, Africa, Land use, Soil properties, Organic matter, Slopes, Soil loss, Alfisols, Nigeria.

Factors concerned with soil erosion in Africa are described: soil erodibility, rainfall erosivity, slope factor, and soil loss tolerance. Available research on soil, climate, and land use is rather sketchy. It indicates that the severity of the erosion hazard may be attributed to soil characteristics, low soil loss tolerance, and climatic factors that lead to accelerated soil erosion following a change in land use. For some soils in Nigeria, organic matter content and cation exchange capacity were related to soil erodibility. A table lists the soil erodibility indices of several African soils. Soil loss tolerance ranges (theoretically) from 2.5 to 12.5 tons/ha/year, depending on soil characteristics, and is extremely low in the shallow tropical soils with limited rooting depth. For example, a soil loss of 0.1-0.5 t/ha per year in western Nigerian alfisols may cause a 50% yield reduction in 50-100 years. (See also W86-04843) (Cassar-PTT)
W86-04878

STUDY OF THE DYNAMICS OF DROP EROSION UNDER LABORATORY CONDITIONS,

Lajos Kossuth Univ., Debrecen (Hungary).
A. Kerenyi.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 365-372, 5 fig, 4 tab, 2 ref.

Descriptors: *Erosion, *Soil erosion, Erosion control, *Drop erosion, Rainfall simulators, Sand, Kazo rainfall simulator, Statistical analysis.

Drop erosion experiments on sand were carried out with a Kazo type rainfall simulator. The linear correlation between rainfall energy and material displaced was examined by least squares analysis. This defined the energy range at which there is no material transfer (i.e., the range below the drop erosion threshold energy). The threshold energy for sand maintained in a state of humidity in balance with atmospheric humidity (0.4 weight percent) is 500-620 ergs; for sand with a moisture content of 20-22 weight percent (typical of conditions at the end of a rainstorm), 50-120 ergs. The order of magnitude of material transfer corresponding to an infinite falling height has also been evaluated. A plastic net with 1 mm mesh stretched over the soil surface reduced material transfer 33- to 55-fold. (See also W86-04843) (Cassar-PTT)
W86-04879

FIELD MEASUREMENT OF SPLASH EROSION,

National Coll. of Agricultural Engineering, Silsoe (England).
R. P. C. Morgan.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 373-382, 2 fig, 3 tab, 15 ref.

Descriptors: *Erosion, *Soil erosion, *Splash erosion, Field tests, Bedfordshire, England, Sandy soil, Sandy loam, Calcareous clay, Rainfall.

The field splash cup proved to be a suitable method for measuring splash erosion in the field. Mean annual rates of splash detachment were determined at four sites in Bedfordshire, England: (1) sandy soil with no crop cover and slope of 9-11 degrees, (2) sandy loam with winter oats, wheat, and beans, and slope of 4 to 7 degrees, (3) calcareous clay with winter wheat and spring barley and slope of 6 to 10 degrees, and (4) calcareous clay overlain by gravelly drift with spring barley and slope of 7 to 10 degrees. Mean annual values were rainfall, 555 mm; rainfall energy, 1050 J/sq m. Annual rates of splash detachment varied from 30-45 g/cm on the bare sandy soils to 5-8 g/cm on the clay soils under cereals. Most detachment on the bare sandy soils occurred in summer during intense storms with rainfall energies over 100 J/sq m and rainfall totals above 10 mm. Detachment rates for 100-day periods and sandy soils were 15-50 g/cm in summer and 2-9 g/cm in winter; for 100-day periods and clay soils, 0.3-5 g/cm in summer and 7-10 g/cm in winter. Laboratory and field test results were comparable except when surface crusting, frost action, and plant cover interfered with splash erosion. (See also W86-04843) (Cassar-PTT)
W86-04880

INSTRUMENTATION FOR STUDIES OF THE EROSIVE POWER OF RAINFALL,

National Coll. of Agricultural Engineering, Silsoe (England).
For primary bibliographic entry see Field 7B.
W86-04881

SOIL EROSION UNDER SIMULATED RAINFALL IN THE FIELD AND LABORATORY: VARIABILITY OF EROSION UNDER CONTROLLED CONDITIONS,

Scarborough Coll., Westhill (Ontario). Dept. of Geography.
R. B. Bryan.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 391-403, 4 fig, 4 tab, 24 ref.

Descriptors: *Erosion, *Measuring instruments, *Rainfall simulators, Rainfall, Soil erosion, Simulated rainfall, Soil loss, Experimental design.

Rainfall simulators were compared in an effort to standardize experimental conditions and results. Most simulators fall short of producing type rainfall. The most serious problems are lack of intermittent rainfall conditions, insufficient terminal velocity of the raindrop, and lack of provision for random spatial, temporal, intensity, impact, and drop size variations characteristic of natural rainfall. The design differences among simulators leads to a problem in comparing results. On a series of 7 soils the Leuven simulator produced much greater soil losses (0.03-4.40 g/sq mm) than the Toronto simulator (0.03-0.59 g/sq mm). Likewise, test parameters and procedures (rainfall intensity and duration, slope, sample and site preparation) introduce many variables into experiments. Three Toronto soils were used to study the magnitude and sources of soil loss variability. Initial data suggest that variability reflects primarily the superimposition of the effects of two critical variables, raindrops and aggregates, both with wide size spectra. These problems can be minimized by sufficient replication. (See also W86-04843) (Cassar-PTT)
W86-04882

LABORATORY AND FIELD TESTING OF A PROGRAMMABLE PLOT-SIZED RAINFALL SIMULATOR,

Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
W. H. Neibling, G. R. Foster, R. A. Natterman, J. D. Nowlin, and P. V. Holbert.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 405-414, 5 fig, 3 tab, 17 ref.

Descriptors: *Erosion, *Measuring instruments, *Rainfall simulators, Simulated rainfall, Soil loss, Field tests, Rainulator, Rainfall intensity, Nozzles, Runoff.

A programmable rainfall simulator for 4 x 11 m and longer field plots was tested and compared with a current rainulator. The new simulator uses an oscillating nozzle and is programmable for variable intensities in time and space. The nozzles of the programmable simulator are the same as those of the rainulator, but cycle times of a nozzle have been reduced from about 20 to 0.5 sec for a rainfall intensity of 64 mm/hour. Repeatable intensities are easier to obtain with the programmable simulator than with the rainulator, but intensity is slightly more uniform with the rainulator. Runoff and especially soil loss may be less with the programmable simulator than with the rainulator. However, the ease of assembly, short cycle times for minimal effects from intermittent rainfall bursts, and programmable intensities give the programmable simulator definite advantages for research in infiltration, overland flow, and erosion. (See also W86-04843) (Author's abstract)
W86-04883

OUTDOOR PORTABLE RAINFALL EROSION LABORATORY,

Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 7B.
W86-04884

SOME LABORATORY TECHNIQUES OF INVESTIGATING LAND EROSION,

Katholieke Univ. Leuven (Belgium). Lab. voor Experimentele Geomorfologie.
J. de Ploey.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 423-431, 3 fig, 28 ref.

Descriptors: *Erosion, *Soil mechanics, *Consistency indices, *Landslides, Soil erosion, Soil loss, Flumes, Plasticity index, Rill erosion, Soil properties, Rainfall, Rainstorms, Universal soil loss equation, Slopes.

Consistency indices, such as the plasticity index Ip and the proposed index C5-10, are useful in landslide and crustability risk assessments. Another predictive technique is flume experimentation. This is relatively inexpensive and is useful for studying heavy, short-term rainstorms on topsoils with limited internal drainage. Traditional objections to the short flume lengths are answered. The appearance of rill erosion in flumes is not surprising because they are usually tilted at the critical slope angle. The Universal Soil Loss Equation is applicable to short slope lengths; a nomograph gives the topographical factor LS for lengths down to 10 ft. The increase of LS values depends more on the growing steepness of the slope than on the increase of slope length. For most aggregated soils, erodibility is significantly negatively correlated to the quantity of water stable aggregates. (See also W86-04843) (Cassar-PTT)
W86-04885

INVESTIGATION OF SOURCE AREAS OF SEDIMENT AND SEDIMENT TRANSPORT BY OVERLAND FLOW ALONG ARID HILLSLOPES,

Hebrew Univ., Jerusalem (Israel). Inst. of Earth Sciences.
A. Yair, and H. Lavee.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 433-446, 8 fig, 1 tab, 42 ref.

Descriptors: *Erosion, *Sediment transport, *Slopes, Arid lands, Rainfall, Wildlife, Animals, Soil surfaces, Israel, Rainfall rate, Surface flow.

The study of hillslope erosion at the Sde Boqer, Israel, experimental site suggests that sediment delivery from arid slopes 60-70 m long is principally controlled by the combined effect of short-duration rain showers and activity of burrowing animals. Velocities at peak flow are below the threshold value needed to detach particles from the crusted soil due to very shallow overland flow and the rough, stony surface. However, the disaggregated soil produced by burrowing animals is readily transported at these flow velocities. As a result, no correlation between sediment yield and slope gradient and length is found. In most cases rainfall from the short showers does not reach the base of the slope. Under such conditions the proximity of the sediment source to the slope base is an important factor in slope sediment delivery. (See also W86-04843) (Cassar-PTT)
W86-04886

SPATIAL AND TEMPORAL VARIATIONS IN EROSION MEASUREMENTS,

Alberta Univ., Edmonton. Dept. of Geography.
For primary bibliographic entry see Field 7A.
W86-04887

RATE OF EROSION PROCESSES ON EXPERIMENTAL AREAS IN THE MARCHIAZZA BASIN (NORTHWESTERN ITALY),

Consiglio Nazionale delle Ricerche, Turin (Italy). Ist. di Ricerca per la Protezione Idrogeologica nel Bacino Padano.
For primary bibliographic entry see Field 4D.
W86-04888

ESTABLISHMENT OF EXPERIMENTAL PLOTS FOR STUDYING RUNOFF AND SOIL LOSS IN THE ROLLING LOESS REGIONS OF CHINA,

Yellow River Conservancy Commission, Zhengzhou (China). Inst. of Hydraulic Research.
M. Jinze.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 467-477, 5 fig, 3 tab, 2 ref.

Descriptors: *Erosion, *Slopes, *Loess, Soil erosion, Soil loss, China, Erosion control, Soil conservation, Conservation, Yellow River, Tuanshangou, Gully erosion.

Experimental plots covering entire slope areas bordered by natural divides and extending over the entire slope length were established at Tuanshangou in the loess plateau of the Yellow River, China. These were necessary in this type of soil because total annual erosion was less in smaller plots than in larger plots under the same conditions. This was due to the predominance of gully erosion and the increase of sediment concentration along the path of flow. Three methods to compute the quantity of sediment detention by conservation measures currently used in China are as follows: addition of sediment trapped by individual measures of soil and water conservation correlation method (average rainfall over the drainage area with runoff and sediment content), and comparison of the results obtained by using the different methods. (See also W86-04843) (Cassar-PTT)
W86-04889

PORTABLE RILL METER FOR FIELD MEASUREMENT OF SOIL LOSS,

Agricultural Research Service, Pullman, WA.
For primary bibliographic entry see Field 7B.
W86-04890

RELATIONSHIP BETWEEN THREE SCALES OF EROSION MEASUREMENT ON TWO SMALL BASINS IN SIERRA LEONE,

Sierra Leone Univ., Freetown. Dept. of Geography.
A. C. Millington.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 485-492, 3 fig, 6 tab, 4 ref.

Descriptors: *Erosion, *Soil erosion, Soil loss, Freetown Mountains, Sierra Leone, Sediment yield, Slopes, Macroscale studies, Mountain Torrent basin, Bambara Spring basin.

Erosion studies were conducted on three scales (macro-, meso, and micro-) in two dammed second-order basins in the Freetown Peninsula Mountains of Sierra Leone. Sediment was measured in basins or tanks for the macroscale study; in troughs for the mesoscale study; and with pin transects for the microscale study. Soil measurements for the pin measurements tended to be much higher in most cases than the trough measurements, particularly in cassava vs. rice plots. Mean sediment yield (t/sq kg/year) measured by the macroscale method was 2.00 for Mountain Torrent basin and 0.07 for Bambara Spring basin. Sediment yields predicted from the smaller scale measurements were much higher, 5.817 and 0.584 (t/sq km/year), respectively. Reasons for this are as follows: channel sediment production is low, leaf litter filters out downwashed sediment, temporal variations, rarity of lower slope concavity and related deposition, and operator error. (See also W86-04843) (Cassar-PTT)
W86-04891

EROSION AND SEDIMENT TRANSPORT MEASUREMENT IN A WEATHERED GRANITE MOUNTAIN AREA,

Kyoto Univ. (Japan). Dept. of Forestry.
A. Takei, S. Kobashi, and Y. Fukushima.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 493-502, 15 fig, 3 tab, 1 ref.

Descriptors: *Erosion, *Sediment transport, Mountains, Granite, Tanakami, Japan, Sediment yield, Forests, Rivers, Bed load, Soil loss. Soil erosion, Suspended sediment, Settling basins.

In the Tanakami region, a mountainous area underlain by weathered granite, erosion and sediment yield have been measured at several observational scales. First, the peg method, involving measurements of the height of pegs driven into the soil, was applied on three plots (70-115 sq m); measurements were made every month over 10 years. The results show that the annual rate of erosion from each plot is almost constant. Second, the sediment yield from a bare and a reforested plot (5 x 20 m) and from a small basin, (2.66 ha) have been measured for individual storm events using settling basins. The results show that the sediment yield can be estimated using the bed load formula of Meyer-Peter and Muller. Third, the sediment transport from a large basin (1.4 sq km) was measured using sand sampling apparatus which permits the collection of sediment samples at any desired position in the cross section of the river. The results show that particle size is important in influencing the separation between the bed load and the suspended load. (See also W86-04843) (Author's abstract)
W86-04892

FIELD MEASUREMENTS OF RATES OF BANK EROSION AND BANK MATERIAL STRENGTH,

Akademiya Nauk SSSR, Moscow. Soviet Geophysical Committee.
For primary bibliographic entry see Field 7B.
W86-04893

WIND AND WATER EROSION OF WASTE HEAPS AT CONCENTRATION PLANTS FOR POTASSIUM PRODUCTION,

Akademiya Nauk SSSR, Moscow. Soviet Geophysical Committee.
For primary bibliographic entry see Field 5B.
W86-04894

LAND EROSION, RESEARCH EQUIPMENT, FORECASTING METHODS AND PROSPECTS FOR THEIR IMPROVEMENT,

Gruzinskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tiflis (USSR).
Ts. E. Mirtskhoulava.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 521-527, 1 tab, 9 ref.

Descriptors: *Erosion, *Soil erosion, *Model studies, Mathematical models, Soil properties, Cohesion, Scour.

A simplified model for predicting erosion processes was verified by data from field studies on an erosion plot. The model succesfully approximated the erosion process. A new method for measuring soil cohesion is based on a strong correlation between cohesion and the depth of local scour caused by the application of a jet of water to a saturated soil. The advantages of a systems approach to studies of soil stability and erosion is stressed. (See also W86-04843) (Cassar - PTT)
W86-04895

RECENT DEVELOPMENTS IN THE EXPLANATION AND PREDICTION OF EROSION AND SEDIMENT YIELD.

International Association of Hydrological Sciences.
Available from the IAHS, 2000 Florida Ave., NW,

Washington, DC. 20009. Price: $35.00. IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. Edited by D. E. Walling. 430 p.

Descriptors: *Erosion, *Sediment yield, *Sediment erosion, *Runoff, *Erosion rates, *Model studies, *Soil stability, Rivers, Drainage area, Basins, Suspended sediments, Reservoirs, Dams, Water quality, Symposium, Forests.

Material from a symposium on erosion and sediment yield, organized by the International Commission on Continental Erosion, is presented. Studies on erosion processes include the effects of soil characteristics, slope length, terracing and subsurface water exfiltration on erosion; variations in runoff and erosion under various methods of protection; and sediment production under various forest-site conditions. Recent studies on sediment yields and channel adjustments included work on gully hydrology, calculation of sediment yields from reservoir deposition volumes, and long term prediction of the extremes of river bed level fluctuations. Modelling studies involve mathematical simulation and prediction of erosion, sediment yield, sediment transport, and runoff. Also included are studies on sediment quality related to discharge, temporal variation in suspended sediment properties, particle size characteristics, and vertical distribution of sediment concentrations. (See W86-04897 thru W86-04936) (Halterman - PTT)
W86-04896

SEDIMENT PRODUCTION UNDER VARIOUS FOREST-SITE CONDITIONS,

Stephen F. Austin State Univ., Nacogdoches, TX. School of Forestry.
M. Chang, F. A. Roth, and E. V. Hunt.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 13-22, 2 fig, 2 tab, 11 ref.

Descriptors: *Sediments, *Sedimentation, *Sediment erosion, *Erosion, Sheet erosion, Soil erosion, Runoff, Soil management, Soil mechanics, Soil water, Coshocton runoff samplers, Forests, Texas, Storm water, Universal Soil Loss Equation.

Sediment loss was observed using Coshocton N-1 runoff samplers installed on 0.02 ha plot-watersheds under six forest-site conditions in Texas, during 1980-1981. The soil is a highly erodible Woodtell series of Hapludalfs, supporting a 40 year old forest dominated by loblolly and shortleaf pines. Sediment yields from 19 runoff producing storms over a 9 month period were 0.011, 0.017, 0.156, 0.265, 3.462, and 3.423 t/ha, respectively, for the undisturbed, thinned (50%), clearcut without site preparation, chopped, KG bladed, and clear cultivated watersheds. Beside storm energy, variation of sediment losses among the treatments was highly related to storm runoff, soil moisture content, cover conditions, and site disturbance. The observed C values of the Universal Soil Loss Equation (USLE) under the various treatments generally fell within the ranges proposed by other investigators. With continued observations and replications in other soils, the USLE can probably provide reasonable estimates of sediment loss in forest land. (See also W86-04896) (Author's abstract)
W86-04898

EFFECTS OF SLOPE LENGTH AND TERRACING ON RUNOFF AND EROSION ON A TROPICAL SOIL,

International Inst. of Tropical Agriculture, Ibadan (Nigeria).
For primary bibliographic entry see Field 2E.
W86-04899

IMPACTS OF SOIL CHARACTERISTICS ON SOIL ERODIBILITY,

Guelph Univ. (Ontario). School of Engineering.
R. Pall, W. T. Dickinson, D. Green, and R. McGirr.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 39-47, 3 fig, 1 tab, 19 ref.

Descriptors: *Soil stability, *Soil characteristics, *Erosion, *Runoff, *Erosion control, Runoff, Erosion rates, Sediment control, Sediment erosion, Soil water, Catchment areas, Ontario, Canada, Sediment transport.

Field observations from two small drainage basins in the temperate climate of Southern Ontario, Canada, have been explored in the light of laboratory experiments for the purpose of identifying key soil characteristics affecting soil erodibility. High soil erosion and transport rates during and immediately following spring thaw temperature and soil water conditions appeared to be linked to the presence of low soil density, high soil water content and resulting low shear strength values in the surface soils. Laboratory tests on agricultural soil samples from the area verified the vulnerability of the soils to such density and water content conditions. Although the existing data base is acknowledged to be sparse, it is hypothesized that further examination of surface soil shear characteristics may be extremely fruitful in clarifying erosion processes in not only spring thaw but also arid soil/water environments. (See also W86-04896) (Author's abstract)
W86-04900

VARIATIONS IN RUNOFF AND EROSION UNDER VARIOUS METHODS OF PROTECTION,

Lajos Kossuth Univ., Debrecen (Hungary). Inst. of Geography.
Z. Pinczes.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 49-57, 6 fig, 2 tab, 1 ref.

Descriptors: *Soil stability, *Erosion, *Runoff, *Erosion control, Erosion rates, Sediments, Sediment control, Agricultural engineering, Runoff hydrographs, Sediment, Vineyards, Stake-support cultivation.

Methods of decreasing the degree of soil erosion with simple protection measures were studied using experiments on seven 350 sq m vineyard plots under the stake-support cultivation system. Plot treatments included variation in direction of furrows with regard to slope, placement of ridges perpendicular to the slope, and application of individual plate-like depressions. There was little correlation between the precipitation amount and eroded soil and runoff in unprotected plots. Correlation gradually improved with the various methods of protection and are quite high with ridges constructed row by row. (See also W86-04896) (Halterman - PTT)
W86-04901

EROSION INITIATION,

Pretoria Univ. (South Africa). Dept. of Civil Engineering.
A. Rooseboom, and F. J. Mulke.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 59-66, 8 fig, 10 ref.

Descriptors: *Sediments, *Sedimentation, Sediment erosion, Erosion, Sedimentation rates, Hydrological aspects, Mathematical models, Mathematical analysis, Soil water, Soil sampling.

Field observations from two small drainage basins in the temperate climate of Southern Ontario, Canada, have been explored in the light of laboratory experiments for the purpose of identifying key soil characteristics affecting soil erodibility. High soil erosion and transport rates during and immediately following spring thaw temperature and soil water conditions appeared to be linked to the presence of low soil density, high soil water content and resulting low shear strength values in the surface soils. Laboratory tests on agricultural soil samples from the area verified the vulnerability of the soils to such density and water content conditions. Although the existing data base is acknowledged to be sparse, it is hypothesised that further examination of surface soil shear characteristics may be extremely fruitful in clarifying erosion processes in not only spring thaw but also arid soil/water environments. (See also W86-04896) (Author's abstract)
W86-04902

RESULTS OF RECENT RESEARCH ON EROSION PROCESSES IN HUNGARY,

P. Salamin.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 67-71, 17 ref.

Descriptors: *Erosion, *Accelerated erosion, *Erosion classification, *Beach erosion, *Soil erosion, Mass wasting, Rockslides, Weathering, Hungary, Environmental erosion, Agricultural erosion.

A new classification of forms and processes of erosion is presented, together with results of Hungarian research on precipitation characteristics, the effects of splash erosion and soil freezing, and the behavior of clays. Also reported are investigations regarding agriculture, environmental erosion, and education related to erosion-related topics. The new classification scheme is based on the following: static state or weathering; dynamic state, including the destructive process (rockfalls and flows), areal latent processes, areal open processes, linear erosion, depositional processes, particular erosion of shores, deforestation, overgrazing and mining activity; and great complex surface destruction. (See also W86-04896) (Halterman - PTT)
W86-04903

ROLE OF SUBSURFACE WATER EXFILTRATION IN SOIL EROSION PROCESSES,

Tsukuba Univ. (Japan). Inst. of Geoscience.
T. Tanaka.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 73-80, 8 fig, 17 ref.

Descriptors: *Erosion, *Hydrology, *Groundwater, *Storm seepage, Subsurface drainage, Groundwater movement, Subsurface water, Soil erosion, Soil management, Overland flow, Exfiltration, Subsurface Water Exfiltration Model.

Overland flow phenomena were studied in relation to erosion processes in a small forested drainage. The field evidence showed that the major portion of overland flow was produced by water flowing out onto the soil surface through decayed stumps and soil pipes. Outflow points were concentrated in small restricted areas on the valley floor where the hydraulic gradients of the subsurface water evidenced upward flow toward the ground surface. These phenomena were largely controlled by dynamic conditions of the flow system within the subsurface zone. The concept that erosion processes are largely controlled by overland flow due to subsurface water exfiltration is defined as the Subsurface Water Exfiltration Model (SWEEM). Using this model it would be possible to explain the development of the stepped profile observed in the study basin. (See also W86-04896) (Author's abstract)
W86-04904

DEVELOPMENT OF SHEET EROSION ON INTENSIVELY USED SOILS,

Akademiya Nauk SSSR, Moscow. Pochvennyi Inst.
P. S. Tregubov.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 81-87, 1 tab, 9 ref.

Descriptors: *Erosion, *Sheet runoff, *Land use, Agricultural aspects, Snowmelt, Snowmelt runoff, Runoff, Runoff hydrographs, Slope, USSR.

The processes of water erosion, their control by the type, length, steepness and utilization of the slope, and the influence of relief, soil cover and climatic factors are discussed. The depth of snowmelt runoff, sediment particle size distributions within the streams, sedimentation and soil losses in lowland and mountain terrain and the base levels of erosion are described for the main agricultural regions of the USSR. An analysis of the development of mechanical erosion on slopes is presented and the influence of soil erodibility and of the distribution of different crops on the various slope elements on the magnitude of soil loss is also described. The distribution of land and crops within the main natural zones of the USSR, according to their degree of erosion is shown. (See also W86-04896) (Author's abstract)
W86-04905

HYDROLOGICAL AND GEOMORPHOLOGICAL STUDIES OF DEBRIS SLIDES ON FORESTED HILLSLOPES IN JAPAN,

Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Forestry.
Y. Tsukamoto, T. Ohta, and H. Noguchi.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 89-98, 5 fig, 5 tab, 8 ref. Project Nos. 402012 and 544010.

Descriptors: *Hydrology, *Hydrological aspects, *Erosion, *Forests, Landslides, Mass wasting, Japan, Forest hydrology, Forest management, Forest watersheds, Storm water, Slopes, O-order basins.

Debris slides are the predominant erosional process on forested hillslopes in Japan. The hillslopes in a basin are composed of slope units of three different types, i.e. convergent, divergent and plane types. More than 80% of debris slides occur on the convergent slopes, which collect and discharge storm water as well as weathered material most actively. The writers have called this spoon-shaped slope unit an O-order basin, which is the most important slope unit from the hydrological and geomorphological viewpoint. Field investigations in O-order basins indicate that pipes develop in shallow soil layers to discharge the converging subsurface storm water. Nearly 100% of the discharge from a trench profile in an O-order basin was through pipes. Discharge through the soil matrix was negligible. The pipeflow is presumed to play an important role in debris yield in a mountain basin during extremely heavy storms. (See also W86-04896) (Author's abstract)
W86-04906

EROSION AND SEDIMENT TRANPORT PROCESSES IN STEP-POOL TORRENTS,

Lincoln Coll. (New Zealand). Dept. of Agricultural Engineering.
J. G. Whittaker, and T. R. H. Davies.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 99-104, 2 fig, 1 tab, 11 ref.

Descriptors: *Erosion, *Sediments, *Sediment transport, *Streamflow, Flow, High flow, Turbulent flow, Sediment erosion, Sediment load, Sediment carrying capacity, Flow rates, Channel slopes, Slope degradation.

In upland regions, streams often exhibit a step-pool morphology where water cascades between relatively deep pools. The capacity of such streams to entrain adjacent slope material depends not only on water flow rate and channel slope, but also on the degree of infilling of the pools by sediment. This situation has been idealized, using a laboratory channel containing regularly spaced baffles. The results appear consistent with findings of studies of real torrents. The laboratory investigation has revealed that the erosive capacity of step-pool streams reaches a maximum (for a given flow rate) when the pools are almost full of sediment; that is, when sediment transport rates are high. This behavior is conducive to erosion of adjacent slopes and contrasts with that of lowland alluvial streams. Despite steady inputs, water and sediment outputs from the laboratory channel were often independently unsteady. Step-pool streams thus seem to display intrinsic unsteadiness, particularly of sediment movement. This parallels reports of coherent sediment 'waves' moving slowly through mountain torrents. Such behavior is consistent with recent findings on the thermodynamics of nonlinear systems. (See also W86-04986) (Author's abstract)
W86-04907

EFFECT OF SOIL CHARACTERISTICS ON EROSION AND NUTRIENT LOSS,

Agricultural Research Service, Morris, MN.
R. A. Young, and C. A. Onstad.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 105-113, 3 tab, 32 ref.

Descriptors: *Erosion, *Soil erosion, *Rill erosion, Soil classification, Soil aggregates, Soil mechanics, Soil organic matter, Soil physical properties, Soil porosity.

Soil properties which exert a significant influence on the type of erosion occurring, interrill or rill, were compared. Those characteristics most influential in determining a soil's susceptibility to interrill erosion are the degree of aggregation of the surface soil, the stability of soil aggregates to breakdown under raindrop impact, and the type and amount of clay in the soil. The characteristics influencing susceptibility to rill erosion are organic matter content, aggregate density, bulk density of the surface soil, and the dispersion ratio. Some factors affecting the transportability of detached particles were also examined along with their possible effects on nutrient enrichment of sediment. (See also W86-04986) (Author's abstract)
W86-04908

LONG TERM PREDICTION OF THE EXTREMES OF RIVER BED LEVEL FLUCTUATIONS,

Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 2E.
W86-04909

SURFACE FLOW AND EROSIONAL PROCESSES IN SEMIARID MESCOSCALE CHANNELS AND DRAINAGE BASINS,

Scarborough Coll., Westhill (Ontario). Dept. of Geography.
R. B. Bryan, and I. A. Campbell.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 123-133, 3 fig, 2 tab, 14 ref.

Descriptors: *Erosion, *Sediment, *Runoff, *Surface flow, Surface runoff, Sedimentation, Erosion, rates, Channeling, Alberta, Canada, Dinosaur Badlands, Drainage patterns.

Detailed studies of surface flow and initiation of channels and drainage networks are facilitated in badlands where barren, rapidly eroded surfaces offer ideal sites for micro and mesoscale experiments. A study was carried out in the Dinosaur badlands of Alberta to establish the relationship between microscale processes and the hydrologic and sediment budgets for a typical mesoscale badland basin. The study shows a considerable range of responses in erosion rates and sediment and runoff yields at various scales. At the microscale, the response of desiccated shales depends on the detailed interaction of raindrop impact, particle detachment, surface sealing and subsurface flow, while indurated sandstones and pediments yield flow and sediment almost instantly, even under low rainfall. The water and sediment flows form a complex system and different response thresholds pose considerable problems for precise monitoring in mesoscale basins. (See also W86-04986) (Author's abstract)
W86-04910

GULLY HYDROLOGY AND RELATED SOIL PROPERTIES IN LESOTHO,

National Univ. of Lesotho, Roma.
For primary bibliographic entry see Field 2E.
W86-04911

EROSION AND RECOVERY OF SEDIMENT CONCENTRATION IN THE RIVER CHANNEL DOWNSTREAM FROM DANJIANKOU RESERVOIR,

Water Conservancy Hydroelectric Power Scientific Research Inst., Beijing (China).
H. Giwei, W. Yuchin, and X. Xilong.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 145-152, 4 tab, 3 ref.

Descriptors: *Erosion, *Scour, *Sediment transport, *Sediment concentration, China, Reservoirs, Rivers, Alluvial rivers, Hanjiang River, Danjiankou Reservoir.

The scouring of the downstream channel of an alluvial river by the clear water released from a reservoir is considered. The characteristics of the sediment transport capacity of the Hanjiang River downstream from Danjiankou Reservoir (China) and the phenomenon of recovery of sediment concentration by the scouring process are discussed. The author's theory of nonequilibrium transportation of nonuniform sediment is used to describe the recovery of sediment concentration along the river, including the variation of sediment transport capacity, the nature of sediment concentration recovery, and the mechanisms involved. A sediment concentration recovery calculation method is presented. (See also W86-04896) (Halterman - PTT)
W86-04912

PROPOSED METHOD FOR ACCURATELY CALCULATING SEDIMENT YIELDS FROM RESERVOIR DEPOSITION VOLUMES,

J. P. Jolly.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 153-161, 4 tab, 6 ref.

Descriptors: *Sediment yield, *Reservoir silting, *Prediction, Reservoirs, Hydrology, Sediment concentration, Sediment discharge, Catchment areas.

A means of developing a relation between sediment yield and the hydrological, geological and climatic characteristics of the upstream drainage basin, is presented. The method can be used worldwide to estimate sediment loads at potential future reservoir sites. The problems of sediment deposition in reservoirs are discussed, and an overview is presented of the magnitude and controls of major basin sediment yields. Data pertaining to sedimentation in many existing reservoirs were collected, then were synthesized into a form that can be used by engineers to produce more accurate estimates of sediment inflows. The accuracy and economics of

four methods of determining reservoir deposition rates were analysed. (See also W86-04896) (Halterman - PTT)
W86-04913

ESTIMATION OF EROSION AND SEDIMENT YIELD BY VOLUME MEASUREMENTS ON A LACUSTRINE RIVER DELTA,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
A. M. Lambert.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 171-176, 3 fig, 1 tab, 5 ref.

Descriptors: *Erosion, *Drainage area, *Sediment yield, Bathymetry, Prediction, Deltas, Floods, Hydrographs, Switzerland, Linth River, Glarus Alps, Drainage canals, Lacustrine River Delta.

In 1811 the River Linth, which drains 600 sq km of the Glarus Alps (Switzerland), was diverted by the construction of a canal into a lake (the Walensee), where it has built a rapidly growing delta cone. The increase in deposited sediment volume was measured by different bathymetric surveys (1849, 1860, 1911, 1931, 1979) and gives a valuable estimate of erosion in the drainage area. Whereas the wire sounding method was used until 1931, the 1979 survey was performed by a largely automated survey system based on digital terrain models established by high resolution echo-sounding combined with laser-guided and computerized polar positioning. Since the last survey (1983) the increase in the delta volume was about 6,500,000 cu m in 48 years, thus implying an average annual lowering of the drainage area by 0.23 mm. Compared with the earlier survey period (1911-1931: 0.17 mm/year), this indicates increased erosion, probably as a result of unusual floods. Based on these data, a simple model is used to predict erosion in the drainage area of the River Linth. (See also W86-04896) (Author's abstract)
W86-04914

ANALYSIS OF SEDIMENT YIELD AND TRANSPORT DATA FOR EROSION CONTROL WORKS,

Public Works Research Inst., Tsukuba (Japan).
For primary bibliographic entry see Field 4D.
W86-04915

EROSIONAL PROCESSES AND SEDIMENT YIELD IN THE UPPER OLDMAN RIVER BASIN, ALBERTA, CANADA,

Northwest Hdrualic Consultants Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 4D.
W86-04916

EROSION AND SEDIMENT YIELD IN THE KRISHNA RIVER BASIN, INDIA,

Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 193-198, 3 fig, 1 tab, 11 ref.

Descriptors: *Erosion, *Sediment yield, *Erosion rates, *Catchment areas, Sediment load, Runoff, Hydrology, Dams, India, Krishna River, Bay of Bengal.

Discharge and sediment data obtained from the Central Water Commission for the Krishna River basin in India are analyzed and certain basin erosion processes are highlighted. The annual sediment load of the Krishna River has been shown to vary regularly with annual runoff over a 6 year period (1971-1976). Similar relationships have also been observed for individual regions of the basin. The quantity of sediment discharged into the Bay of Bengal does not truly reflect the actual sediment load because of the influence of upstream dams. Rates of erosion calculated for various sub-basins indicate that smaller basins erode more rapidly than larger basins. Again, annual variations exist but the erosion rate/basin area relationship is similar every year. While at the river mouth the sediments are texturally uniform, in the upstream region the relative proportions of clay silt and sand vary erratically. The apparent homogeneity at the river mouth is perhaps due to selective sedimentation at the dam sites. (See also W86-04896) (Author's abstract)
W86-04917

MORPHOLOGICAL INVESTIGATIONS ON THE LOWER SALZACH RIVER DOWNSTREAM OF SALZBURG,

Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
F. H. Weiss, and J. Mangelsdorf.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 209-218, 5 fig, 6 ref.

Descriptors: *Rivers, *River beds, *Erosion, *River morphology, Bed load, Stream erosion, Alpine regions, Hydrography, Sediments, Salzach River, Hydroelectric plants, Gages, Water level.

A case study involving a morphological investigation on the River Salzbach in the Central Alps is presented. The study was prompted by the proposed building of four hydroelectric power plants, and attempted to predict the resultant changes in river morphology. A geographical and historical review is presented, along with a study of bed erosion and bed load transport by three methods: firstly, by analysis of the hydrographs of annual mean water level from several gages for which about 150 years of staff gage operations exist; secondly, by longitudinal surveys carried out at low water under comparable discharges, and finally, by cross seection surveys (thalweg or mean bed level of several years). The causes of bed erosion, namely river training, removal of bed material and the installation of upstream supporting weirs, are discussed. (See also W86-04896) (Author's abstract)
W86-04918

MATHEMATICAL SIMULATION OF EROSION ON GRADED TERRACES,

Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W86-04919

APPLICABILITY OF THE UNIVERSAL SOIL LOSS EQUATION IN MOUNTAIN WATERSHEDS IN SEMIARID AND HUMID REGIONS,

Centre for Water Resources, Madras (India).
For primary bibliographic entry see Field 4D.
W86-04920

DEVELOPMENT OF DRAINAGE NETWORKS,

Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
For primary bibliographic entry see Field 4D.
W86-04921

SEDIMENT MODELLING AND DATA SOURCES: A COMPROMISE IN ASSESSMENT,

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
G. Fleming, and A. al Kadhimi.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 251-259, 5 fig, 18 ref.

Descriptors: *Model studies, *Mathematical models, *Sediment erosion, Erosion, Sediment yield, Drainage area, Hydrology, Sediment transport, Catchment areas.

The major problem in modelling sediment erosion, transport and deposition for the assessment of sediment yield is the shortage of reliable data with which to develop and test the desired model. This data source limitation restricts the model developer in selecting the appropriate theory to describe a model structure that accounts for the correct interaction between processes contributing to the sediment yield of drainage basins. It also restricts the application of developed models in their practical design application. The development of sediment modelling is reviewed, and a discussion is presented of the compromise that must be made before models can be usefully employed in sediment yield assessment for design of water resource systems. It is concluded that the use of total river basin sediment-hydrology models can play an important part in bridging the gap between limited data sources and understanding of the relation between factors affecting drainage basin response. (See also W86-04896) (Author's abstract)
W86-04922

SOIL EROSION AND AGRICULTURE IN THE WORLD: AN ASSESSMENT AND HYDROLOGICAL IMPLICATIONS,

Moscow State Univ. (USSR). Dept. of Hydrology.
For primary bibliographic entry see Field 4D.
W86-04923

ESTIMATION OF EXTREME SEDIMENT TRANSPORT FROM TORRENTIAL DRAINAGE BASINS IN THE EAST ALPS,

Torrent and Avalanche Control Research Inst., Vienna (Austria).
For primary bibliographic entry see Field 4D.
W86-04924

DEVELOPMENT OF A PROCEDURE TO ESTIMATE RUNOFF AND SEDIMENT TRANSPORT IN EPHEMERAL STREAMS,

Agricultural Research Service, Tucson, AZ. Southwest Watershed Research Center.
L. J. Lane.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 275-282, 2 fig, 33 ref.

Descriptors: *Model studies, *Watersheds, *Sediment transport, Semiarid lands, Small watersheds, Hydrologic models, Sediment yields, Alluvial channels, Flood frequency, Runoff, Ephemeral streams.

A hydrological model for application on small semiarid watersheds is developed. The model incorporates simplified routing schemes to include the influence of transmission losses on runoff. A sediment transport model, by sediment size fractions, is developed to compute transport capacity and sediment yield in noncohesive, alluvial channels. Based on available information published on soils and topographic maps and on channel and bed sediment characteristics, the procedure is used to estimate runoff rates and amounts together with sediment yields from semiarid watersheds. Example applications include flood frequency analysis and sediment yield. The procedure requires a minimum of observed data for calibration and is designed for practical applications. (W86-04896) (Author's abstract)
W86-04925

HYDRODYNAMIC MODEL OF SEDIMENT TRANSPORT IN RILL FLOWS,

Mississippi Univ., University. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W86-04926

PREDICTION OF SEDIMENT YIELD FOR MOUNTAINOUS BASINS IN COLUMBIA, SOUTH AMERICA,

Rijkswaterstaat, Arnhem (Netherlands). Directorate for Water Management and Hydraulic Research.
For primary bibliographic entry see Field 4D.
W86-04927

SEDIMENT AVAILABILITY AND THE PREDICTION OF STORM-PERIOD SEDIMENT YIELDS,

Exeter Univ. (England).
For primary bibliographic entry see Field 4D.
W86-04928

SEDIMENT QUALITY RELATED TO DISCHARGE IN A MINERALIZED REGION OF WALES,

University Coll. of Wales, Aberystwyth. Dept. of Geography.
For primary bibliographic entry see Field 5B.
W86-04929

TIMESCALES OF DENUDATION: THE LAKE-DRAINAGE BASIN APPROACH,

Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
For primary bibliographic entry see Field 4D.
W86-04930

IDENTIFICATION AND QUANTIFICATION OF SEDIMENT SOURCES USING 137-CS,

Newcastle Univ. (Australia). Dept. of Geography.
R. J. Loughran, B. L. Campbell, and G. L. Elliott.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 361-369, 1 fig, 3 tab, 17 ref.

Descriptors: *Cesium, *Radioactive tracers, *Cultivated lands, *Sediment, *Heavy metals, Erosion, Soil erosion, Australia, Drainage area, Hunter Valley, New South Wales.

The environmental radioactive tracer 137-Cs (a fallout product of atmospheric nuclear weapons' testing) was used to indicate sources of soil erosion in a small drainage basin the Hunter Valley, New South Wales, Australia. At sites undergoing little or no erosion, the 137-Cs had accumulated in the upper soil profile, and eroded soils contained relatively less 137-Cs. Cultivated soils were identified as the chief sediment source, since they contained, on average, only one-third the 137-Cs of soils under grass cover. While the calibration of the 137-Cs technique to quantify soil loss remained uncertain, 137-Cs concentrations did appear to be related to some degree to a soil aggregate stability index. (See also W86-04896) (Author's abstract)
W86-04931

INFLUENCE OF SEASON, SOURCE AND DISTANCE ON PHYSICAL AND CHEMICAL PROPERTIES OF SUSPENDED SEDIMENT,

National Water Research Inst., Winnipeg (Manitoba).
For primary bibliographic entry see Field 5B.
W86-04932

USE OF LAMINATED LAKE SEDIMENTS IN THE ESTIMATION AND CALIBRATION OF EROSION RATES,

Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W86-04933

PARTICLE SIZE CHARACTERISTICS OF FLUVIAL SUSPENDED SEDIMENT,

Exeter Univ. (England).
For primary bibliographic entry see Field 5B.
W86-04934

TEMPORAL VARIATION OF SUSPENDED SEDIMENT PROPERTIES,

Exeter Univ. (England).
For primary bibliographic entry see Field 5B.
W86-04935

ANALYSIS OF THE VERTICAL DISTRIBUTION OF HIGH SEDIMENT CONCENTRATIONS IN THE YELLOW RIVER AND STUDIES OF METHODS OF OBSERVATION,

Yellow River Conservancy Commission, Zhengzhou (China).
Z. Boliang, and N. Zhan.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 421-430, 7 fig, 2 tab, 4 ref.

Descriptors: *Suspended sediments, *Erosion, *Rivers, *Sediment concentration, Vertical distribution, Yellow River, China, Soil types, Sediment, Mathematical analysis.

Based on analyses of field data, it is demonstrated that the distribution of sediment at high concentrations in the Yellow River (China) is uniform. This is primarily due to three cause; firstly the effect of the initial conditions of sediment yield in the basin, secondly, the influence of the ultimate tangential stress of the fluid and, thirdly, the structure of the sediment mass. It has been found that theoretical formulae for determining the vertical distribution of sediment concentration, derived for low silt contents, are not applicable to conditions of hyperconcentration. Requirements for the methods and instruments used in measuring hyperconcentrations of sediment should be different from those for the measurement of low sediment content. (See also W86-04896) (Author's abstract)
W86-04936

SEDIMENT DYNAMICS IN A PARTIALLY CULTIVATED CATCHMENT IN NEW SOUTH WALES, AUSTRALIA,

Newcastle Univ. (Australia). Dept. of Geography.
R. J. Loughran, B. L. Campbell, and G. L. Elliott.
Journal of Hydrology, Vol. 83, No. 3/4, p 285-297, March 1986. 5 tab, 3 fig, 19 ref.

Descriptors: *Australia, *Runoff, *Sediment, *Sediments transport, *Catchment basins, New South Wales, Maluna Creek, Cesium, Environmental tracers, Hydrographs, Runoff plots, Surface runoff, Agricultural runoff, Cropland, Erosion, Forests, Grazing.

The relationships between the hydrology of runoff episodes and sediment transport are examined in the partially cultivated drainage basin of Maluna creek, in the Hunter River Valley, New South Wales, Australia, and interpreted by the use of runoff plot data and the environmental tracer cesium-137 over a three year period. The sediment output of 49.8 t/sq km/year was dominated by three runoff events, which together accounted for 79% of the total, though occupying only 0.6% of the study period time. These three events represented 10% of all episodes and accounted for 43% of the total runoff measured. In Maluna Creek, sediment concentrations usually reached a peak on the falling stage of the hydrograph, and mean concentration per event was positively related to discharge peakedness index, a measure of runoff intensity. Data from five erosion plots and water sampling within the catchment revealed cultivated vineyard soils as the major sediment source, compared with eucalypt forest and grassland, which made up 60 and 30% of the basin area, respectively. Cesium-137 concentration on stream-borne sediment delivered to the basin outlet was used to quantify sediment source. It was estimated that at least 93% of the sediment output was derived from vineyards, and the remaining 7% from forests and grazing land. (Peters-PTT)
W86-05114

MIGRATION PATTERNS OF AN ASYMMETRIC MEANDERING RIVER: THE ROUGE RIVER, QUEBEC,

National Hydrology Research Inst., Hull (Quebec).
For primary bibliographic entry see Field 2E.
W86-05219

WATER DISCHARGE AND SUSPENDED SEDIMENT CONCENTRATIONS IN THE AMAZON RIVER: 1982-1984,

Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 2E.
W86-05222

KINETICS OF MICROBIAL MANGANESE OXIDATION AND TRACE METAL BINDING IN SEDIMENTS: RESULTS FROM AN IN SITU DIALYSIS TECHNIQUE,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2H.
W86-05278

DISSOLUTION KINETICS OF CHRYSOTILE AT PH 7 TO 10,

California Inst. of Tech., Pasadena. Dept. of Environmental Health Engineering.
For primary bibliographic entry see Field 2K.
W86-05290

MORPHOLOGIC EFFECTS OF CHANNELIZATION: THE CASE OF THE NEEBING-MCINTYRE FLOODWAY, THUNDER BAY, ONTARIO, CANADA,

Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 8B.
W86-05408

CHANNEL ADJUSTMENTS TO THE REMOVAL OF LOG STEPS: AN EXPERIMENT IN A MOUNTAIN STREAM,

Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
For primary bibliographic entry see Field 4D.
W86-05409

2K. Chemical Processes

RADIOACTIVITY OF SPAS ON THE GREEK ISLAND IKARIA AND INFLUENCING FACTORS,

Democritus Nuclear Research Center, Athens (Greece).
S. Danali, G. Margomenou, and K. Veldeki.
Health Physics, Vol. 50, No. 4, p 509-513, April 1986. 3 tab, 1 fig, 18 ref.

Descriptors: *Radioactive springs, *Greece, Geological composition, Temperature effects, Spectroscopy, Radioisotopes.

A qualitative and quantitative determination by gamma spectroscopy analysis of all the natural radioisotopes which exist in the waters of the municipal thermometallic radioactive springs (spas) of the Greek island Ikaria was made. The spas of Ikaria show high concentrations of 222Rn, especially Apollo and Asclepius, which can be considered as among the most radioactive spas in the world. The other spas are Spelaion and Lefkada. Besides the high concentration of 222Rn, the spas of Ikaria, especially the high temperature ones, show high concentrations of 226Ra as well as 232Th. High concentrations of 40K also have been found in these spas. The spas with high concentrations of 222Rn show lower concentrations of 226Ra and vice versa. This may be due, mainly, to the difference in the temperature of these spa waters. The concentrations of radioisotopes in the water of the spas vary with the season and also with time. The number of the examined samples is not sufficient for a clear conclusion to be drawn. (Peters-PTT)
W86-04691

GAS CHROMATOGRAPHIC EVALUATION OF THE ORGANIC COMPONENTS PRESENT IN THE ATMOSPHERE AT TRACE LEVELS WITH THE AID OF CARBOPACK B FOR PRECONCENTRATION OF THE SAMPLE,

Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. Inquinamento Atmosferico.
For primary bibliographic entry see Field 5A.
W86-04710

SINGLET OXYGEN IN SURFACE WATERS. 3. PHOTOCHEMICAL FORMATION AND STEADY-STATE CONCENTRATIONS IN VARIOUS TYPES OF WATERS,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. R. Haag, and J. Holgne.
Environmental Science and Technology ESTHAG, Vol. 20, No. 4, p 341-348, April 1986. 8 fig, 3 tab, 26 ref.

Descriptors: *Singlet oxygen, *Surface waters, *Photolysis, *Dissolved organic carbon, *Molecular structure, *Water pollution, Switzerland, Furfuryl alcohol, Light, Lakes, Rivers, Wastewater, Color, Gel permeation chromatography.

For prediction of the rate with which organic compounds are oxidized and photoproducts formed in the aquatic environment by the singlet molecular oxygen singlet oxygen route, the steady-state concentrations of singlet oxygen in various waters were determined using furfuryl alcohol as a trapping agent. Under noon, summer sunlight (Switzerland) in lake, river, and wastewaters, surface concentrations were (0.3-3) x 10 to the minus 14th power mol singlet oxygen per mg of dissolved organic carbon/liter. The more highly colored waters actually tend to produce less singlet oxygen for a given amount of adsorbed light. Separation of natural aquatic organic compounds by gel permeation chromatography resulted in fractions showing little correlation between singlet oxygen production efficiency and molecular weight, indicating that large macromolecular structures are not a prerequisite for the sensitization of singlet oxygen formation. Application of the specific 102 concentration data to the estimation of lifetimes of environmental pollutants yields half-lives as short as several hours only for a few especially reactive types of compounds but orders of magnitude longer for most of the compounds expected to be found in the aquatic environment. (Author's abstract-PTT)
W86-04720

FLUORESCENCE CORRECTION FOR MEASUREMENTS OF ENZYME ACTIVITY IN NATURAL WATERS USING METHYLUMBELLIFERYL-SUBSTRATES,

Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
R. J. Chrost, and H. J. Krambeck.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 1, p 79-90, 1986. 4 fig, 4 tab, 16 ref.

Descriptors: *Fluorescence, *Enzyme activity, *Natural waters, *Methylumbelliferone, Enzymatic hydrolysis, Hydrogen ion concentration, Aquatic habitats, Mathematical analysis, Lakes, Water samples.

Substrates linked to a highly fluorescent compound, 4-metylumbelliferone (MUF), provide a very sensitive system for detecting and quantifying enzyme activity in aquatic environments. Fluorescence of MUF liberated after enzymatic hydrolysis of MUF-substrates was dependent on the concentration of released MUF, affected by pH of the sample. At a constant pH, fluorescence of MUF was proportional to its concentration between 1 and 150 nM. A more complex relationship between MUF-fluorescence and various pHs occurred, approaching asymptotes at low ($pH < 3$) and high ($pH > 10$) pH values, with a sigmoid pattern between pHs 2 and 13. Maximum MUF-fluorescence occurred at $pH = 10$ and higher alkalinity did not increase the fluorescence. Rapid decreases in MUF-fluorescence between pH 9.0 and 7.0 occurred at all investigated MUF-concentrations. Enzyme activity determination in aquatic habitats should be assayed at the natural pH of the water sample. The most rapid decrease of MUF-fluorescence with increasingly acidity was observed within this pH range. MUF-fluorescence at $pH = 6.5$ was only 15.3% of the fluorescence measured at $pH = 9.5$. This pH-MUF-fluorescence relationship is critical when calculating and comparing enzyme activities measured at different pHs of samples from aquatic environments, and therefore a measured fluorescence must be corrected when calculating real enzyme activity values. The simple correction method when calculating enzyme activity, measured using MUF-substrates at different pH values was determined. Using mathematical formulae and sets of constants, the calculation of MUF-concentration (liberated after enzymatic hydrolysis) from measured MUF-fluorescence at various pHs of water samples was simple. The proposed method was applied for the calculation of exoenzymatic activity (phosphatase, Phosphodiesterase, beta-glucosidase, beta-galatosidase, protease) of water samples from different lakes of various pHs. (Lantz-PTT)
W86-05087

GEOCHEMISTRY AND DEPOSITION OF (7)BE IN RIVER-ESTUARINE AND COASTAL WATERS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
C. R. Olsen, I. L. Larsen, P. D. Lowry, and N. H. Cutshall.
Journal of Geophysical Research, Vol. 91, No. C1, p 896-908, January 15, 1986. 4 tab, 5 fig, 43 ref.

Descriptors: *Coastal waters, *Rivers, *Geochemistry, *Estuaries, *Beryllium, James estuary, Virginia, Norfolk, Tennessee, Oak Ridge, Salinity, Particulate matter, Carbon, Silicon, Aluminum, Potassium, Iron, Sediment, Chemical properties, Suspended sediments, Deposition.

The atmospheric flux of cosmogenic (7)Be (53.3-day half-life) and the mode of (7)Be deposition in river-estuarine and coastal environments have been examined. (7)Be measurements for water, suspended matter, and sediment samples collected in several river, estuarine, and coastal systems during 1981 to 1984 are reported. The atmospheric flux of (7)Be commonly supports inventories ranging from 1.0 to 2.0 pCi/sq cm (1 pCi=0.037 Bq). Beryllium 7 concentrations in water phase samples, collected across salinity gradients in several estuaries along the eastern coastline of the United States, range from 0.03 to 0.53 pCi/L and primarily reflect variations in (7)Be supply and sorption kinetics. The major process controlling the concentration of (7)Be on estuarine suspended particles appears to be the length of time that these particles remain in the water column. Field particle-to-water distribution coefficients for (7)Be have a median value of about 4 times 10 to the fourth power but range over an order of magnitude reflecting short-term variations in (7)Be input, particle dynamics, and particulate iron content rather than equilibrium sorption-desorption responses to change in water salinity or particle type. Residence times of (7)Be in the water column range from a few days in estuarine areas of rapid fine-particle deposition, to several weeks in high-energy environments where pronounced sediment resuspension reintroduces deposited (7)Be back into the water column. Inventories of (7)Be in sediments range from nondetectable to 3.3 pCi/sq cm, with the highest inventories in areas where fine particles are accumulating rapidly. Such sites are also major repositories for other particle-reactive substances. A (7)Be budget for the James estuary (Norfolk, VA) indicates that less than 5% of the expected (7)Be input is in the water column and that the short-term estuarine trapping efficiency for atmospherically derived (7)Be is somewhere between 50 and 100%. (Peters-PTT)
W86-05095

SOURCES AND SINKS OF IONS IN A SOFT WATER, ACIDIC LAKE IN FLORIDA,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5B.
W86-05217

USE OF STREAM CHEMISTRY TO ESTIMATE HYDROLOGIC PARAMETERS,

Risk Science International, Washington, DC.
M. J. Brown.
Water Resources Research WRERAO, Vol. 22, No. 5, p 805-811, May 1986. 6 fig, 6 tab, 12 ref.

Descriptors: *Stream chemistry, *Path of pollutants, *Hydrologic properties, Runoff, Chemical properties, Chemical analysis, Minerals, Ions, Mathematical models, Nitrates, Nitrites, Streamflow, Groundwater, Phytoplankton.

The influence of direct and indirect runoff on the concentrations of chemical constituents in streams may be exploited as an aid to model calibration. In the Housatonic basin, data on streamflow and mineral ion concentrations conform well to a two-segment log-linear model. The fitted relationship between streamflow and mineral ion concentration depends primarily on the site; rather than on the mineral. Parameters of this fit yield estimates of hydrologic model parameters. Nonconservation constituents such as nitrate and nitrite exhibit varied patterns. At sites affected by large point source inputs, concentration decreases with flow. A simple model of load and streamflow produces estimates of the concentrations in indirect and direct runoff. The estimated concentrations in indirect runoff agree well with typical measured values of concentration in groundwater. At sites not affected by point sources, the (NO3-NO2) concentrations are lower, do not correlate with streamflow, and exhibit seasonal cycles. The cycles are due to such factors as uptake by phytoplankton. (Lantz-PTT)
W86-05227

CHEMICAL REACTIONS WITHIN ROOT ZONE OF ARID ZONE SOILS,

California Univ., Davis. Water Science and Engineering Section.
For primary bibliographic entry see Field 5B.
W86-05233

DISSOLUTION KINETICS OF CHRYSOTILE AT PH 7 TO 10,

California Inst. of Tech., Pasadena. Dept. of Environmental Health Engineering.
R. C. Bales, and J. 1J. Morgan.
Geochimica et Cosmochimica Acta, Vol. 49, No. 11, p 2281-2288, November 1985. 7 fig, 36 ref.

Descriptors: *Fate of pollutants, *Chrysotile, *Kinetics, Minerals, Hydrogen ion concentration, Magnesium hydroxide, Chemical reactions, Dissolution, Adsorption, Surface charge Inorganic compounds.

The rate of chrysotile dissolution over five days was studied in constant pH batch concentrations at 25 C. After the first day, release of magnesium occurred at a constant rate and exhibited a fractional dependence on pH. Interpreted in terms of a site binding model for adsorption of protons on the surface, this fractional dependence implies that the rate is limited by a chemical reaction involving less than one adsorbed proton per magnesium released into solution. The actual magnitude of the rate at pH 8 supports this interpretation. Three related processes were followed dissolution, adsorption and surface charge development. Inorganic materials such as chlorine, bicarbonate, sulfate, and nitrate ions and the organic substances catechol and oxalate affected the rate of magnesium release only during the initial 12 to 24 hours of each experiment. Silica release was linear from the outset of each experiment, but showed no definite pH dependence. The results suggest that magnesium hydroxide is more easily dissolved than minerals such as aluminum oxide, and that attack by water and hydrogen are both important in chrysotile dissolution. (Master-PTT).)
W86-05290

HELIUM ACCUMULATION IN GROUNDWATER. II: A MODEL FOR THE ACCUMULA-

TION OF THE CRUSTAL 4HE DEGASSING FLUX,

Australian National Univ., Canberra. Research School of Earth Sciences.
For primary bibliographic entry see Field 2F.
W86-05291

REGIONAL PH-ALKALINITY RELATIONSHIP,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
M. J. Small, and M. C. Sutton.
Water Research, Vol. 20, No. 3, p 335-343, March 1986. 5 fig, 4 tab, 24 ref.

Descriptors: *Hydrogen ion concentration, *Alkalinity, *Models, Acidic streams, *Acid rain, Mathematical studies, Acidity, Mathematical models, Mathematical equations, Carbon dioxide, Regional analysis, Fate of pollution.

An explicit equation relating the pH and alkalinity of natural waters is derived as an inverse hyperbolic sine function. For the range of pH generally encountered in lake and stream acidification studies, the parameters of the equation are related to the dissolved CO2 saturation relative to atmospheric CO2 and the concentration of weak acid anions, though the relationship is approximate. The functional form allows for statistical parameter estimation given a regional or temporal pH-alkalinity data-set. The relationship simplifies pH estimation in regional aquatic acidification models where alkalinity is computed as the master variable. (Author's abstract)
W86-05338

COMPARISON OF METHODS FOR ESTIMATING SULFATE EXPORT FROM A FORESTED WATERSHED,

Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5B.
W86-05389

ONE-DIMENSIONAL MODEL OF CHEMICAL DIFFUSION AND SORPTION IN SATURATED SOIL AND AQUATIC SYSTEMS,

Morrison-Knudsen Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 5B.
W86-05390

USE OF RAIN AND DRY DEPOSITION COMPOSITIONS FOR INTERPRETING GROUNDWATER CHEMISTRY,

Arkansas Univ., Fayetteville. Dept. of Geology.
G. H. Wagner, and K. F. Steele.
Groundwater, Vo. 23, No. 5, p 611-616, September-October 1985. 6 fig, 2 tab, 13 ref.

Descriptors: *Groundwater, *Chemical properties, *Rain composition, Evapotranspiration, Ion exchange, Spring water, Arkansas, Chlorine, Sodium, Potassium, Calcium carbonate, Ammonium, Magnesium, Calcium.

Waters from 91 springs in a 130 X 140 km area of west-central Arkansas were analyzed for all the major ions. The yearly flux of these ions in the rain and pure-water extract of the dry deposition 180 km north of this area was measured and assumed to represent the composition of the recharge to the groundwater feeding the springs. Cation/Cl(-) flux ratios were used as a norm for the concentration of ions in the spring waters by evapotranspiration. Ratios above the norm were interpreted as ion exchange or rock dissolution into groundwaters. Ratios below the norm were interpreted as ion adsprtion or, for Ca(+), CaCO3 precipitation processes. Na(+) and Mg(2+) are invariably above the norm. K(+), NH4(+) and H(+) are invariably below the norm; whereas Ca(2+) values are about equally divided between above and below the norm. Equivalents of cations above the norm and below the norm were compared for a number of springs to determine the main groundwater processes for each spring. The Na(+)/Cl(-) and K(+)/Cl(-) norms for the rain water form near-perfect minimum and maximum envelopes, respectively, of the Na(+) vs Cl(-) plots of the spring water compositions. This is due to the adsorption affinities of the soil for Na(+) being low, and for K(+) being high. (Author's abstract)
W86-05394

ROLE OF SPECIATION IN MERCURY METHYLATION IN SEDIMENTS AND WATER,

Leicester Polytechnic (England). School of Chemistry.
For primary bibliographic entry see Field 5B.
W86-05395

2L. Estuaries

LABORATORY MODELING OF A COASTAL UPWELLING,

University of Southern California, Los Angeles. Dept. of Mechanical Engineering.
S. Narimousa, and T. Maxworthy.
EOS, Transactions, American Geophysical Union, Vol. 67, No. 1, p 2-3, January 17, 1986. 4 fig, 9 ref.

Descriptors: *Standing waves, *Upwelling, *Ocean circulation, *Hydraulic models, Topographical features, Satellite technology, United States, Peru, Coasts.

Coastal upwelling was modeled in a rotating cylindrical tank (90 cm diameter, 22 cm depth), which has a conical bottom to simulate the geometry of the coastal shelf. In some experiments, the coastline and the conical bottom were free of any perturbations, whereas in others a cross shelf, a radial ridge, and/or a coastline perturbation (cape) were introduced into the tank to study their effects on the simulated upwelling circulations. The presence of a topographical feature on the conical bottom had a dramatic effect on the upwelled front. The first sign of the upwelled water at the surface was always a high-speed jetlike plume at the ridge. When a coastline perturbation or cape, but no bottom ridge, was employed, a high-speed jet was generated downstream of the cape with only one significant downstream standing wave, in contrast to the previous case in which there were a series of large meandering standing waves. Applications of the present results to upwelling events off the coast of the United States and Peru were in reasonably good agreement with the values measured from a satellite infrared image or reported from field observations. (Rochester-PTT)
W86-04980

GEOCHEMISTRY AND DEPOSITION OF (7)BE IN RIVER-ESTUARINE AND COASTAL WATERS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2K.
W86-05095

SALINITY INTRUSION IN THE EASTMAIN RIVER ESTUARY FOLLOWING A MAJOR REDUCTION OF FRESHWATER INPUT,

McGill Univ., Montreal (Quebec). Inst. of Oceanography.
S. Lepage, and R. G. Ingram.
Journal of Geophysical Research, Vol. 91, No. C1, p 909-915, January 15, 1986. 2 tab, 8 fig, 19 ref.

Descriptors: *Eastmain River, *Saline water intrusion, *Estuaries, LaGrand River, Velocity, James Bay, Canada, Mathematical models, Diversion.

On July 19, 1980, 80% of the runoff of Eastmain River (it originates in the Canadian Shield and empties into the eastern portion of James Bay), a subartic shallow estuary, was diverted into the La Grande River for hydroelectric development. Consequent to the diversion the estuary, which had been mostly salt-free, was subjected to a gradual saltwater intrusion along a 10-km section in its lower reaches. The adjustment of the salinity regime to a new quasi-steadystate took place over a period of about 40 days. The circulation field reached a new quasi-equilibrium within 8 days. The 2-month interval following the river diversion, the transition period, was analyzed in terms of both time and space modifications of the circulation and salinity fields. A one-dimensional finite difference explicit scheme was obtained between the model results and the low frequency current meter observations of salinity and longitudinal velocity. The salinity intrusion was primarily governed by tidal dispersion. Overall, the low-frequency response of the estuary to the rapid change in discharge occurred much more rapidly for the velocity regime than for salinity, with salinity intrusion occurring over approximately one month. Changes to the velocity regime were accomplished within a week. Modeling of the Eastmain estuary during the major transition demonstrated the capability of the model to follow satisfactorily the observed salinity changes. Numerical diffusion accounted for only a 15% addition to the calculated dispersion coefficients and might explain the higher than observed upstream salinities. (Peters-PTT)
W86-05096

MARINE BENTHOS IN RELATION TO PORE WATER CHEMISTRY AND SEDIMENT GEOCHEMISTRY OF SIMULATED DREDGED MATERIAL,

Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 5C.
W86-05152

INFLUENCE OF COPPER IN VARIOUS FORMS ON NATURAL PHYTOPLANKTONIC POPULATIONS FROM THE SAGUENAY RIVER, QUEBEC, CANADA. (INFLUENCE DE LA SPECIATION DU CUIVRE SUR LES POPULATIONS PHYTOPLANCTONIQUES NATURELLES DE LA RIVIERE DU SAGUENAY, QUEBEC, CANADA.),

Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.
For primary bibliographic entry see Field 5C.
W86-05162

BENTHIC MACROFAUNA ASSOCIATED WITH THE OYSTER REEFS OF THE JAMES RIVER ESTUARY, VIRGINIA, USA,

Virginia Inst. of Marine Science, Gloucester Point.
P. F. Larsen.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 6, p 797-814, 1985. 6 tab, 4 fig, 39 ref.

Descriptors: *Benthic fauna, *Oysters, *Estuaries, James River, Macrofauna, Salinity, Temperature, Species diversity.

Productive, natural oyster reefs within the James River estuary, were quantitatively sampled for associated macrofauna for one year. The James River is the southernmost tributary of the Chesapeake Bay system and contributes about 16 percent of the Bay's yearly freshwater input. It is shallow and is moderately well mixed vertically. Salinity varies about 4% between low and high water throughout the middle reaches of the estuary where the study took place. Tidal currents seldom exceed 1 m/sec. The annual temperature is about 25 C. The 192 samples yielded 142 taxa. Mean faunal density on these reefs ranged from 5,757 to 57,857/sq m. More than 77% of the individuals collected belonged to 11 taxa. The number of species and informational diversity decreased up the estuarine gradient. The quality of shell surface was deemed important in determining density. The spatial heterogeneity provided by the shell surface allowed development of a densely populated, diverse faunal assemblage which differs from soft-bottom assemblages principally in quantitative aspects. The assemblage is not spatially or temporally homogeneous and undergoes significant changes in community structure both seasonally and along the estuarine gradient. (Peters-PTT)
W86-05166

DYNAMICS OF A TIDAL ESTUARY: ESTIMATION OF THE PRINCIPAL FACTORS. (ESTIMATION DES PARAMETRES FONDAMENTAUX DE LA DYNAMIQUE D'UN ESTUAIRE A MAREES),

Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
J.-L. Douville, and C. Riaux.
International Revue der Gesamten Hydrobiologie, Vol. 71, No. 1, 65-77, 1986. 1 tab, 6 fig, 16 ref.

Descriptors: *Tidal hydraulics, *Water currents, *Estuaries, *Saline-freshwater interfaces, Brittany, Current velocity, Mathematical studies, Topography, Freshwater discharge, Tidal range, Sediment-water interfaces, Flow pattern.

A study of tidal dynamics obtained a better understanding of the relationship between salt and fresh-water masses in an estuary on the Northern Brittany coast. A simple method for calculating the mean current velocity parameter in the lower cross section of the Dour duff estuary is proposed. This model incorporates the topography of the estuary, instantaneous fresh-water discharge and the tidal range. From this model, the three parameters that characterize the flow pattern, i.e., Richardson's Froude's and Reynold's number were calculated; these parameters allow a prediction of the displacement of particles at the sediment-water interface. Salinity stratifications and the vertical gradients of current do not last long and confirm the partially to well mixed character of this sea-water dominated estuary. (Peters-PTT)
W86-05170

ANALYSIS OF A 24-HOUR CYCLE OF ZOOPLANKTON SAMPLING IN A LAGOON OF THE PO RIVER DELTA,

Parma Univ. (Italy). Ist. di Ecologia.
I. Ferrari, M. T. Cantarelli, M. G. Mazzochi, and L. Tosi.
Journal of Plankton Research JPLRD9, Vol. 9, No. 6, p 849-865, November 1985. 11 fig, 4 tab, 33 ref.

Descriptors: *Zooplankton, *Lagoons, *Po River, *Deltas, *Tidal hydraulics, Italy, Sacca del Canarin, Tidal currents, Bonifazi channel, Spring tides, Estuaries.

A 24-hour cycle of zooplankton samples, collected at spring-tide in August 1981 in a lagoon of the Po River Delta, Sacca del Canarin, is analyzed. The short-term zooplankton samples were collected, with the biocenosis represented mainly by taxa (especially copepods) coming into the lagoon from the sea and, to a lesser extent, by autochthonous zooplankton (gastropod, cirripede and decapod larvae). Density fluctuations of some taxa were influenced by hydrodynamic factors, particularly the tidal currents. A daily balance of input and output through one of the two mouths connecting the lagoon to the sea was calculated for different taxa. Quantitative estimates of zooplankton exchanges between the lagoon and the sea, due to tidal transportation, were obtained. Because of the morphological and hydrographic features of the lagoon (reduced area, wide openings to the sea), zooplankton variability depended on hydrodynamic factors and, particularly after the closure of the Bonifazi channel, on factors associated with the influence of the sea. (Peters-PTT)
W86-05179

SEASONAL FLUCTUATIONS IN THE BIOMASS AND METABOLIC ACTIVITY OF BACTERIOPLANKTON AND PHYTOPLANKTON IN A WELL-MIXED ESTUARY: THE EMS-DOLLARD (WADDEN SEA),

McGill Univ., Montreal (Quebec). Dept. of Biology.
W. Admiral, J. Beukema, and F. B. Van Es.
Journal of Plankton Research JPLRD9, Vol. 7, No. 6, p 877-890, November 1985. 7 fig, 7 tab, 39 ref.

Descriptors: *Biomass, *Phytoplankton, *Ems-Dollard Estuary, *Wadden Sea, Germany, Netherlands, Algae, Intertidal flats, Ems River, Seasonal variation, Population dynamics, Radioactive tracers, Tritium, Carbon radioisotopes, Bioassay, Bacteria analysis.

The biomass and metabolic activity of bacterioplankton were measured over one year in the Ems-Dollard Estuary, a part of the Dutch-German Wadden Sea. Very productive phytoplankton blooms, composed mainly of diatoms and the haptophycean alga Phaeocystis pouchetii, are a feature of the estuarine section studied. The estuarine section considered is 115 sq km in extent and is bordered by intertidal flats. The average water depth in the section is 6.7 meters with an average water volume of 768 cu km. The tidal fluxes are large and this, together with the discharge of the River Ems, is responsible for a flushing time of approximately one week. The production of bacterial populations, as measured using the (3-H)thymidine method broadly followed the phytoplankton density during blooms in spring and late summer. There was no indication of a disproportionate increase in bacterial production during the bloom or decline of particular algal species. The rate at which (14-C)-labelled glucose, glutamate and leucine were incorporated by bacterial populations, measured as a metabolic potential, varied seasonally, but did not precisely follow the rate of (3-H)thymidine incorporation. The utilization of the adsorbed (14-C) substrates for respiration or for cellular synthesis was constant over a prolonged period of bacterial growth. A preliminary experiment with a mixed culture of the abundantly occurring diatom species Thalassiosira excentrica and a marine spirillum, indicated that part of the algal exudates were rapidly converted by the bacteria, but another part resisted degradation. The incomplete bacterial degradation of algal exudates, together with the short residence time of the estuarine phytoplankton, may contribute to the apparently incomplete mineralization of the primary production in the water. (Peters-PTT)
W86-05181

AMMONIUM EXCRETION AND GLUTAMATE DEHYDROGENASE ACTIVITY OF ZOOPLANKTON IN GREAT SOUTH BAY, NEW YORK,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
Y. C. Park, E. J. Carpenter, and P. G. Falkowski.
Journal of Plankton Research JPLRD9, Vol. 8, No. 3, p 489-503, May 1986. 5 fig, 6 tab, 28 ref. New York Sea Grant NA8100027.

Descriptors: *Zooplankton, *Ammonium, *Great South Bay, Long Island, New York, *Glutamate dehydrogenase, *Estuarine environment, Nutrient availability, Excretion.

In Great South Bay, on the south shore of Long Island, New York, nanoplankton accounted for the largest fraction of zooplankton glutamate dehydrogenase (GDH) activity over a one-year period. Microzooplankton and macrozooplankton accounted for 20% and 24%, respectively. Total zooplankton ammonium regeneration in Great South Bay could account for 74% of the ammonium requirement by phytoplankton in winter, but in summer when phytoplankton demand was greater, the zooplankton population was low, it supplied less than 5%. This suggests that the smallest zooplankton fraction can be the most important with regard to nitrogen regeneration in estuarine environments. Observed macrozooplankton excretion rates showed a strong correlation with the excretion rates indirectly estimated from GDH activities. The GDH/excretion ratio seems to vary depending on the internal physiological states of zooplankton as well as on food availability. The high correlation between macrozooplankton GDH activities and ammonium excretion rates, indicates that determination of GDH activity can be useful to indirectly estimate ammonium excretion rates of zooplankton, particularly microzooplankton. (Peters-PTT)
W86-05184

BIOMASS AND PRODUCTION ESTIMATES FOR AN ESTUARINE MEIOBENTHIC COPEPOD, WITH AN INSTANTANEOUS ASSESSMENT OF EXPLOITATION BY FLATFISH PREDATORS,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Dairy Science.
G. R. F. Hicks.
New Zealand Journal of Ecology, Vol. 8, p 125-127, 1985. 1 tab, 17 ref.

Descriptors: *Estuaries, *Fish, *Biomass, *Copepods, *Aquatic productivity, New Zealand, Predators, Food chain, Estuarine fisheries, Flatfish, Productivity.

Estuarine basins play a critical role as nursery areas and sheltered feeding habitats for the juveniles of a number of commercially important fish species. Estimates of functional characteristics such as biomass, production, and food web relationships are made with respect to the New Zealand estuaries. The meiobenthic harpacticoid copepod Parastenhelia megarostrum Wells, Hicks and Coull, is the dominant epibenthic metazoan on Mana Bank in Pauatahanui Inlet, Porirua Harbour. A first assessment of biomass and secondary production of the P. megarostrum population in Pauatahanui Inlet is provided and the consequences of predatory removal by flatfish are evaluated. A measurement of instantaneous predation pressure on P. megarostrum by juvenile flatfish revealed that predator abundance is highest in January. Flatfish predation probably has very little overall impact on the abundance of P. megarostrum. (Peters-PTT)
W86-05198

DIFFERENCES IN STANDING LIVE AND DEAD CROPS IN ESTUARINE MARSHES ON VANCOUVER ISLAND,

Northern Forest Research Centre, Edmonton (Alberta).
K. A. Kennedy, and V. C. Brink.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 2, p 322-325, February 1986. 4 fig, 1 tab, 12 ref.

Descriptors: *Estuarine environment, *Standing crops, *Marshes, *Vancouver Island, British Columbia, Detritus, Estuaries, Food chain, Plant populations.

The purpose of this study was to determine the standing crops of vascular plants in estuaries on the east coast of Vancouver Island, British Columbia. Carex lyngbyei Hornmen. stands did not have standing dead crops for the final 5 months of the 7-month study, though C. lyngbyei stands produced the most matter (i.e., a peak standing live crop of 1450 g dry matter/sq m). In a Salicornia virginica L. stand, the standing dead crop exceeded the standing live crop throughout the study and the stand had the greatest amount of dead matter with a peak standing dead crop of 1470 g dry matter/sq m. This suggested that vascular plant matter produced in the C. lyngbyei stands was more likely to enter the detrital food web of an estuary than was matter produced in the S. virginica stand. (Lantz-PTT)
W86-05348

OVERVIEW OF THE HYDROLOGIC CONCERNS RELATED TO WETLANDS IN THE UNITED STATES,

Connecticut Univ., Storrs. Ecology Section.
For primary bibliographic entry see Field 2H.
W86-05349

ESTUARINE, COASTAL AND OCEAN POLLUTION: EEC POLICY AND RESEARCH,

Commission of the European Communities, Brussels (Belgium). Directorate General for Research, Science and Education.
For primary bibliographic entry see Field 5G.
W86-05352

DEVELOPMENT, TESTING AND INTERCALIBRATION OF REFERENCE METHODS FOR POLLUTION STUDIES IN COASTAL AND ESTUARINE WATERS,

International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5C.
W86-05354

ANALYTICAL QUALITY CONTROL (AQC) FOR MONITORING TRACE METALS IN THE COASTAL AND ESTUARINE ENVIRONMENT,

Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5G.
W86-05355

STANDARDIZATION OF WATER QUALITY INFORMATION IN A TIDAL RIVER,
Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-05356

MONITORING EFFECTS OF CATCHMENT MANAGEMENT PRACTICES ON PHOSPHORUS LOADS INTO THE EUTROPHIC PEEL-HARVEY ESTUARY, WESTERN AUSTRALIA,
Western Australia Dept. of Conservation and Environment, Perth.
For primary bibliographic entry see Field 5B.
W86-05357

EFFECTIVENESS OF SAMPLING STRATEGIES FOR INTERTIDAL MONITORING,
Victoria Univ. of Manchester (England). Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W86-05358

SOME RECENT DEVELOPMENTS IN THE CHARACTERIZATION OF ESTUARINE PARTICULATES,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 5A.
W86-05360

SOLUTE DISPERSION AND SEDIMENT TRANSPORT IN ESTUARIES,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-05361

INVESTIGATION OF MATERIAL TRANSPORT AND LOAD IN TIDAL RIVERS,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik.
For primary bibliographic entry see Field 5B.
W86-05362

SEDIMENT MOBILITY AND ITS CONTRIBUTION TO TRACE METAL CYCLING AND RETENTION IN A MACROTIDAL ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5B.
W86-05363

CHEMICAL FRACTIONATION OF HEAVY METALS IN ANOXIC ESTUARINE AND COASTAL SEDIMENTS,
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5B.
W86-05364

CADMIUM AND LEAD CYCLING BETWEEN WATER, SEDIMENT, AND BIOTA IN AN ARTIFICIALLY CONTAMINATED MUD FLAT ON BORKUM (F.R.G.),
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 5B.
W86-05365

DISTRIBUTION OF MERCURY IN THE SEDIMENTS AND FISHES OF THE LAGOONS OF AVEIRO, PORTUGAL,
Aveiro Univ. (Portugal). Dept. de Quimica.
For primary bibliographic entry see Field 5B.
W86-05366

BACILLUS PHAGES AS TRACERS OF WATER MOVEMENT,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W86-05367

MERCURY CONTAMINATION IN COMPONENTS OF AN ESTUARINE ECOSYSTEM,
Forth River Purification Board, Queensferry (Scotland).
For primary bibliographic entry see Field 5C.
W86-05369

MERSEY ESTUARY (U.K.) BIRD MORTALITIES - CAUSES, CONSEQUENCES AND CORRECTIVES,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5C.
W86-05370

ECOLOGICAL IMPACTS OF THE CONSTRUCTION OF DAMS IN AN ESTUARY,
Rijkswaterstaat-Deltadienst, Middelburg (Netherlands). Hoofdafdeling Milieu en Inrichting.
For primary bibliographic entry see Field 6G.
W86-05371

IMPACT OF TRIBUTYL TIN (TBT) ANTIFOULING PAINTS ON MOLLUSCAN FISHERIES,
Brest Univ. (France). Lab. d'Oceanographie Biologique.
For primary bibliographic entry see Field 5C.
W86-05372

STEADY STATE AND TIME-VARYING WATER QUALITY MODELS FOR THE HOOGHLY ESTUARY, INDIA,
Calcutta Metropolitan Development Authority (India).
For primary bibliographic entry see Field 5B.
W86-05378

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVERSE OSMOSIS MODULES FOR WATER DESALINATION,
Toyabo Co. Ltd., Otsu (Japan).
M. Sekino, K. Matsunaga, K. Gotoh, Y. Yanaga, and H. Nikko.
Chemical Engineering Progress, Vol. 81, No. 12, p 52-56, December, 1985. 5 fig, 4 tab, 8 ref.

Descriptors: *Reverse osmosis, *Desalination, *Water reuse, Toyobo modules, Japan, Middle East, Water treatment, Saline water, Drinking water.

In Japan, since September 1979, an 800 cu m/d desalination plant has been in operation at Water Reuse Promotion Center Chigasaki Testing Ground. The 8 in. diameter modules made by Toyobo are being used in this plant. A feasibility study has been conducted for more than five years. Performance tests for the 12 in. diameter multielement reverse osmosis modules began 2.5 years ago. Long term results at various manufacturers of plant facilities using Hollosep were determined. In a desalination plant producing 2,000 cu m/d of pure water, the product water costs $2.00/cu m. The sea that surrounds the Arabian Peninsula offers high-temperature, high-concentration seawater. Trailer-mounted-type reverse osmosis seawater desalination units have been put to the feasibility test in this area. Drinking water made from the Toyobo reverse osmosis seawater desalination units produced high-quality fresh water from high-temperature, high-concentration seawater. The results of bacteria removal and pyrogen removal test for high-flux-type modules are shown. Long-range endurance tests on Yoyobo reverse osmosis modules confirm: (1) It obtained required volume and required quality of desalinated water in ordinary seawater desalination. (2) Seawater desalination process was successful in the Middle East countries. (3) Pyrogen-free pure water application, product water was produced for medical and pharmaceutical needs. (Main-PTT)
W86-05259

3B. Water Yield Improvement

OBSERVATIONAL RAINFALL-RUNOFF ANALYSIS FOR ESTIMATING EFFECTS OF CLOUD SEEDING ON WATER RESOURCES IN NORTHERN ISRAEL,
Tel-Aviv Univ. (Israel). Dept. of Statistics.
Y. Benjamini, and Y. Harpaz.
Journal of Hydrology, Vol. 83, No. 3/4, p 299-306, March 1986. 3 fig, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Israel, *Cloud seeding, Water resources, Galilee, Catchment basins, Springs, Regression analysis, Runoff rates, Streams, Mathematical studies.

The main objective of the rain enhancement program implemented in Israel over the past 24 years is augmentation of its scarce water resources. The program comprises randomized cloud seeding experiments and operational seeding. A method of evaluating the hydrological effectiveness of this program by a rainfall-runoff method was developed and applied to 26 water sources (springs and streams) within the Galilee target area. Double regression analysis was performed on each water source, first between the runoff and its catchment-basin rainfall in the target area and then between the same runoff and a control rainfall. Comparisons were made between seeding and pre-seeding periods. The Jackknife technique was used to determine the statistical significance of the runoff increments. Evaluation for the last 13 years of cloud seeding indicates only weak overall runoff increase, though results of individual sources were not rated adequately significant. Median runoff increments for the six target zone range from 0 to 14%, whereas power calculations show that runoff changes higher than 20-25% could have been detected by this method. (Peters-PTT)
W86-05115

RAINWATER FOR DRINKING IN SRI LANKA,
Loughborough Univ. of Technology (England). WEDC Group.
A. Cotton.
Aqua AQUAAA, No. 2, p 72-76, 1986. 1 fig, 4 tab, 10 ref, 1 append.

Descriptors: *Rain, *Drinking water, *Sri Lanka, Domestic water, *Water supply development, Rainfall, Water supply, Cost analysis, Potable water.

This paper describes the potential use of collecting household rainwater, to provide drinking water for rural areas of Sri Lanka where water supply presents severe problems. Rainfall data from five climatically different regions are analyzed, and it is shown that the water requirements for drinking and cooking can be satisfied without the need for unduly large storage. It is assumed that traditional sources would continue to be used for bathing. The average incremental costs are high, varying between US $1.00 to $1.42/ cu m. The data presented are currently being used to start up a small pilot program in Sri Lanka, in which one of the main aims will be to ascertain householders' response to rainwater collection. A great advantage of household rainwater collection is that maintenance is the responsibility of householders, and not of a government agency. (Lantz-PTT)
W86-05145

3C. Use Of Water Of Impaired Quality

SIMULATED CROP-WATER PRODUCTION FUNCTIONS FOR SEVERAL CROPS WHEN IRRIGATED WITH SALINE WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. Letey, and A. Dinar.
Hilgardia, Vol. 54, No. 1, p 1-32, January 1986. 4 tab, 21 fig, 33 ref, 2 append.

Descriptors: *Saline water, *Crop production, *Irrigation, Simulation, Alfalfa, Cauliflower, Celery, Corn, Cowpea, Lettuce, Oats, Sugarbeet, Tomato, Wheat, Mathematical models, Evapotranspiration.

A model was developed to formulate crop water production functions when irrigating with saline waters. Crop water production functions are computed from the model for several crops. Three relationships are combined: yield and evapotranspiration, yield and average root zone salinity, and average root zone salinity and leaching fraction. The model allows plant growth adjustment, and evapotranspiration adjustment, to root zone salinity. Using the model, product functions were computed for several crops. Calculated relative yields were compared with measured relative yields from experiments that had water quality and quantity as variables. Reasonable agreement between the two values provides some assurance of the model's utility and reported production functions under field conditions. The crops used included alfalfa, cauliflower, celery, corn, cowpea, lettuce, oats, sugarbeets, tomato and wheat. The production functions as presented are for uniform water application. In the case of nonuniformity, which is typical of agricultural field crops, the ultimate relationship between average applied water and yield can be significantly different from those presented. (Peters-PTT)
W86-04690

SOME OBSERVATIONS ON THE EFFECTS OF SALINITY ON ION DISTRIBUTIONS AND CELL ULTRASTRUCTURE IN WHEAT LEAF MESOPHYLL CELLS,
Sussex Univ., Brighton (England). School of Biological Sciences.
D. M. R. Harvey, and J. R. Thorpe.
Journal of Experimental Botany, Vol. 37, No. 174, p 1-7, January 1986. 2 tab, 38 ref.

Descriptors: *Salinity, *Wheat, Agriculture, Salinity sensitivity, Ion concentrations, Plant Physiology, Agronomy.

The distribution of ions in wheat leaf mesophyll cells from plants grown in saline conditions wasd studied and the results related to changes in the volume fractions occupied by the analyzed cell compartments. The plants were grown in the presence of 100 mol per cm NaCl; the distribution of ions were determined by X-ray microanalysis. Generally, the cells did not accumulate high ion concentrations in their vacuoles, and the much higher Na and Cl concentrations in the cell walls would produce an imbalance of cell water relations. The Na, K, and Cl concentrations in the cytoplasm were often too high to be compatible with biochemical activity. In response to saline growth conditions, the volume fractions occupied by the cytoplasm and chloroplasts increased. (Peters-PTT)
W86-04699

RIVER DEE SCHEME AND INTAKE PROTECTION SYSTEMS,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5F.
W86-04752

INFORMATIONAL/EDUCATIONAL APPROACHES TO PUBLIC ATTITUDES ON POTABLE REUSE OF WASTEWATER,
Denver Research Inst., CO.
For primary bibliographic entry see Field 5D.
W86-04827

TRACKING SALTY SOIL, SAVING FRESH WATER,
D. Senft.
Agricultural Research, Vol. 34, No. 1, p 7-10, January 1986.

Descriptors: *Mapping, *Salinity, *Irrigation, *Conductivity, *Farm management, *Soil management, *Soil solution, *Electronic equipment, Water table, Leaching fraction, Field tests, Groundwater salinity, Computer simulation, Cotton, Sugar beets, Melons, Wheat, Agricultural Research Service, Crop yield.

Agricultural Research Service scientists are studying areas of high soil salinity using measurement probes and mapping techniques under development to eliminate much of the need for soil sampling and laboratory analysis. Map overlay techniques are employed to display water table depth, soil permeability, leaching fraction (the amount of excess irrigation water applied to leach salts below the route zone), and groundwater salinity. With maps displaying these features farmers will be able to locate areas on their land where salt problems are likely to occur. The measurement probe currently in use employs conductivity to indicate salt level in the soil. A probe under development uses an electromagnetic probe to generate a current flow in the soil. With the second probe, contact with the soil is unnecessary, and it eventually may be possible to measure soil salinity from an all-terrain vehicle or low-flying aircraft using this device. Crop rotation strategies are being developed to make better use of brackish water for irrigation. Cotton, sugar beets, melons, and wheat have been tested in field trials of crop rotation, and a computer simulation model has been developed to aid in predicting the effects of irrigation waters of different salinities on crop growth. (Rochester-PTT)
W86-04982

OPTIMAL RATIOS OF SALINE AND NONSALINE IRRIGATION WATERS FOR CROP PRODUCTION,
Agricultural Research and Education Center, Jay, FL.
A. Dinar, J. Letey, and H. J. Vaux, Jr.
Soil Science Society of America Journal, Vol. 50, No. 2, p 440-443, March/April 1986. 1 tab, 3 fig, 8 ref.

Descriptors: *Saline water, *Crop production, *Irrigation, Salinity, Salt tolerance, Economic efficiency, Water mixing, Alfalfa, Cauliflower, Celery, Corn, Cotton, Cowpea, Lettuce, Oats, Sugarbeet, Tomato, Wheat, Conductivity, Costs, Water costs.

A quantitative method for determining the optimal mix of saline and nonsaline waters for crop production is presented. Equal yield curves (isoquants), which quantify the extent of substitutability between waters of different qualities when constant yield is sought, were derived from crop water production functions for waters of different qualities computed from a previously published model. Isoquants were derived for several crops (alfalfa, cauliflower, celery, corn, cotton, cowpea, lettuce, oats, sugarbeet, tomato, and wheat) for relative yield (RY) values of 1.0, 0.9, and 0.8. The waters considered for mixing were nonsaline waters and waters of electrical conductivity (EC) equal to 4, 6, or 11 dS/m. Extending the supply of water by combining nonsaline and saline water is not always technically or economically feasible, and depends on specific crop and water pricing situations. The technical and economic feasibility of mixing waters of different quality increases as the EC of the saline water decreases, crop tolerance to salinity increases, desired RY decreases, or the relative price of saline to nonsaline water decreases. (Peters-PTT)
W86-05126

EVAPORITE MINERALOGY ASSOCIATED WITH SALINE SEEPS IN SOUTHWESTERN NORTH DAKOTA,
University of East Anglia, Norwich (England). School of Environmental Sciences.
M. E. Timpson, J. L. Richardson, L. P. Keller, and G. J. McCarthy.
Soil Science Society of America Journal, Vol. 50, No. 2, p 490-493, March/ April 1986. 5 tab, 2 fig, 25 ref.

Descriptors: *Saline Soils, *North Dakota, *Evapotranspiration, *Leaching, Evaporites, Saline-sodic soils, Saline seeps, Magnesium, Root zone, Soil profiles, Solubility, Seasonal variation, Cropland.

The evaporite minerals present in the saline seeps of Hettinger County, southwestern North Dakota were characterized. Saline seepage occurs when water in excess of crop use leaches soluble salts from the root zone and transports them laterally to lower landscape positions. Evapotranspiration moves these dissolved salts upward through the soil, resulting in salt crust formation at the surface. The mineralogic composition of the saline efflorescences present at the soil surface of four saline seeps in Hettinger County, ND were determined. Mineralogic changes resulting from upward water movement in soils were accurately predicted using the Hardie-Eugster model of closed basin brine evolution. The sequence calcite-gypsum-and mixed Na-Mg-(SO4) minerals occurs as saline waters migrate upward through the profile. The following minerals occur in surface (NaMg(SO4)2.4H20), konyaite (Na2Mg(SO4)2.5H2O, loewite Na12Mg7 (SO4)13.15H2O), and gypsum. Hydration state, mineral occurrence, and mineral solubility were seasonally dependent. (Peters-PTT)
W86-05128

CHEMICAL REACTIONS WITHIN ROOT ZONE OF ARID ZONE SOILS,
California Univ., Davis. Water Science and Engineering Section.
For primary bibliographic entry see Field 5B.
W86-05233

SALT PROBLEMS FROM INCREASED IRRIGATION EFFICIENCY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 5B.
W86-05234

LAND APPLICATION OF DOMESTIC WASTEWATER, WOOD PRODUCTION, AND SLUDGE COMPOSTING: AN INTEGRATED DESIGN,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
G. B. Keefer, and M. W. Gilliland.
Resources and Conservation, Vol. 12, p 13-27, August 1985. 3 fig, 1 tab, 20 ref.

Descriptors: *Sludge disposal, *Composting, *Wood, Domestic wastewater, Waste disposal, Omaha, Hydraulic loading, Nitrogen loading, Land Disposal, Nebraska, Water reuse.

A process which combines land treatment of wastewater following primary sedimentation, with tree production and sludge composting, was evaluated for land requirements. The sludge composting process generally utilizes a bulking material to reduce the moisture content and increase the carbon/ nitrogen ratio of the sludge. The cost of the bulking material, which is often woodchips, can represent a substantial portion of the total system operating cost. Growing trees in the land application system produces both woodchips for composting, and firewood, for which there may be a market. Background information, including design criteria, is given for the land application and composting processes. In addition, laws and regulations pertaining to both processes are reviewed. The general range of land area necessary to apply a wastewater flow of 0.044 cu m/s was determined for the Omaha, Nebraska area. Hydraulic loading and nitrogen loading parameters were included in the analysis. Calculations showed that 25-320 hectares would be required according to the hydraulic loading criteria while 41-85 hectares would be

required according to the nitrogen loading criteria. Only 2.2-11.2 hectares would be needed to grow enough trees in order to produce woodchips. Thus, the majority of land under irrigation could be used for the production of firewood. (Master-PTT).)
W86-05293

WASTEWATER TREATMENT USING AQUATIC PLANTS. SURVIVABILITY AND GROWTH OF SALVINIA MOLESTA (MITCHELL) OVER WATERS TREATED WITH ZINC (II) AND THE SUBSEQUENT UTILIZATION OF THE HARVESTED WEEDS FOR ENERGY (BIOGAS) PRODUCTION,
Centre for Water Resources Development and Management, Kunnamangalam (India).
For primary bibliographic entry see Field 5D.
W86-05294

3D. Conservation In Domestic and Municipal Use

SALVAGING A WATER RESERVOIR,
Overman (W.C.) Associates, Virginia Beach, VA.
For primary bibliographic entry see Field 8A.
W86-04739

DURABLE CHEMICAL GROUT SOLVES 'CASE OF THE DISAPPEARING LAKE',
For primary bibliographic entry see Field 8A.
W86-04742

DAILY WATER USE IN NINE CITIES,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and S. -P. Miaou.
Water Resources Research WRERAO, Vol. 22, No. 6, p 845-851, June 1986. 3 fig, 4 tab, 7 ref. NSF Grant CEE 82-04761.

Descriptors: *Water use, Data acquisition, Data interpretation, Municipal water, Rainfall, Air temperature, Pennsylvania, Texas, Florida, Water management, Model studies, Forecasting, Planning.

Daily water use data from nine cities were studied (three cities each from Florida, Pennsylvania, and Texas) using transfer functions, to model the short-term response of daily municipal water use to rainfall and air temperature variations. The dynamic response of water use to rainfall and air temperature is similar across the cities within each State; in addition the responses of the Pennsylvania cities is more sensitive to air temperature and less to rainfall. There is little impact of city size on the response functions. The response of water use to rainfall depends first on the occurrence of rainfall and second on its magnitude. The occurrence of a rainfall more than 0.05 in/day (0.13 cm/day) causes a drop in the seasonal component of water use one day later that averages 38% for the Texas cities, 42% for the Florida cities, and 7% for the Pennsylvania cities. In Austin, Texas, a spatially averaged rainfall series shows a clearer relationship with water use than does rainfall data from a single gage. There is a nonlinear response of water use to air temperature changes with no response for daily maximum air temperature between 40 and 70 F (4-21 C); an increase in water use with air temperature beyond 70 F; above 85-90 F (29-32 C) water use increases 3-5 times more per degree than below that limit in Texas and Florida. The model resulting from these studies can be used for daily water use forecasting and water conservation analysis. (Lantz-PTT)
W86-05241

BETTER ACCOUNTING FOR UNACCOUNTED FOR WATER,
Wessex Water Authority, Poole (England).
J. E. Philip.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 6, p 475-484, December 1985. 3 fig, 4 tab, 8 ref.

Descriptors: *Leakage, *Water use, *Water metering, *Monitoring, Water consumption, Error analysis, Flow rates.

Results are presented of studies carried out in Wessex Water Authority on domestic consumption by monitoring houses in small groups of similar rateable value. Twelve groups of 24 houses were studied from 1983-1984 to improve data on the household domestic use of water and to develop a simple model to allow the use of this information in unaccounted for water (UFW) calculations applicable to each supply area within the Authority. For the 12 groups of houses in the study, the average minimum night flow was 2.9 liter/property/hr. In view of the variation in supply taken from storage, the age of ball valves and to avoid over estimation, a minimum night flow of 2.4 liter/property/hr was proposed for the Wessex region. Major weakness in using the total integrated flow equation for estimating UFW include errors in the measurement of metered quantities, population estimate errors, seasonal variation in water use, and lack of data on average domestic consumption. To improve results in estimating UFW the Authority will monitor groups of houses to gather data on average domestic consumption, and upgrade night exercises to read all the meters in the supply zone to improve the estimates of night flow rates applicable to various classes of metered users based on average daily flows. (Geiger-PTT)
W86-05315

3F. Conservation In Agriculture

TRACKING SALTY SOIL, SAVING FRESH WATER,
For primary bibliographic entry see Field 3C.
W86-04982

INVESTIGATION OF WATER MOVEMENT IN THE UNSATURATED ZONE UNDER AN IRRIGATED AREA USING ENVIRONMENTAL TRITIUM,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2G.
W86-05210

ROLE OF SUSPENDED SEDIMENT IN IRRIGATION RETURN FLOW CHEMISTRY, SOUTHERN ALBERTA,
Department of Energy, Mines and Resources, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W86-05211

REPORT OF TASK COMMITTEE ON WATER QUALITY PROBLEMS RESULTING FROM INCREASING IRRIGATION EFFICIENCY,
American Society of Civil Engineers, New York. Irrigation and Drainage Div.
For primary bibliographic entry see Field 5G.
W86-05231

DRAINAGE REQUIRED TO MANAGE SALINITY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
G. J. Hoffman.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 199-206, September 1986. 3 fig, 1 tab, 18 ref.

Descriptors: *Saline water, *Drainage programs, Crop yield, Impaired water use, Saline soils, Mathematical analysis, Leaching, Root zone, Model studies, Correlation coefficient.

The amount of drainage required to prevent loss in crop productivity from excess soil salinity has been termed as the leaching requirement (L sub gamma). Several steady-state models that have been proposed to predict the L sub gamma, to avoid a loss in crop yield from excess soil salinity, were compared with experimentally measured values for a number of crops. The exponential model, based upon an exponential pattern of crop water uptake, correlated best with the measured values but underestimated at high L sub gamma's. A simplified model that approximates an average soil salinity based on values for the top and bottom of the root zone also gave acceptable estimates. The highest correlation coefficient between predicted and measured values of L sub gamma was 0.67, indicating that none of the models is completely satisfactory. (Lantz-PTT)
W86-05232

EFFECT OF IRRIGATION EFFICIENCIES ON NITROGEN LEACHING LOSSES,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter, and K. A. Manger.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 230-240, September 1985. 35 ref.

Descriptors: *Irrigation efficiency, *Leaching, *Nitrogen, Nitrates, Irrigation practices, Water management, Chemical analysis, Fertilizers, Soil texture, Models, Irrigation effects, Humid areas.

A literature review was conducted to determine the effect increasing irrigation efficiencies have had on NO3-N leaching. The mass of NO3-N leached is directly related to drainage volume. By increasing irrigation efficiencies, both the drainage volume and amount of NO3-N leaching are reduced. Both water management and nitrogen management are important in controlling NO3-N leaching. By using improved water management practices that control of amount of water applied, and using the proper time to apply water, the irrigation efficiency is increased and NO3-N leaching is reduced. Applying only enough N fertilizer to meet crop requirements for a realistic yield goal, time of application, and use of slow release fertilizers are N management practices that will reduce NO3-N leaching. However, it is impossible to reduce NO3-N leaching to zero in the humid region on coarse-textured soils and still maintain adequate crop yields. Nitrogen simulation models cannot be widely used to evaluate N management practices and irrigation water management practices that increase irrigation efficiencies because of the lack of required input data. (Lantz-PTT)
W86-05235

BASIN-WIDE IMPACTS OF IRRIGATION EFFICIENCY,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
L. S. Willardson.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 241-246, September 1985. 6 ref.

Descriptors: *Irrigation efficiency, *Irrigation effects, *Basins, *River basins, Water quality, Return flow, Leaching, Percolation, Salinity, Irrigation-return flow.

Irrigation efficiency is one of the important factors affecting river basin water quality. Questions frequently arise as to whether increasing irrigation efficiency in a basin will have a net positive or negative effect on basin water quality. Quality and quantity of return flow from irrigation are related to irrigation efficiencies and leaching fractions. River basins have leaching fractions analogous to irrigation leaching fractions inasmuch as salts generated by mineral weathering and those dissolved by percolating waters are carried out of the basin by a fraction of the precipitation falling on the basin. Reducing the leaching fraction of a basin by increasing irrigation efficiency and consuming more water in the basin, will decrease downstream water quality and quantity. Irrigation efficiency, as a salinity control measure, must be considered in the context of total water management to be properly interpreted. (Lantz-PTT)
W86-05236

AUTOMATIC THROTTLE HOSE - NEW FLOW REGULATOR,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
P. U. Volkart, and F. de Vries.
Journal of Irrigation and Drainage Engineering

JIDEDH, Vol. 111, No. 3, p 247-264, September 1985. 15 fig, 1 tab, 11 ref, append.

Descriptors: *Automatic Throttle Hose, *Flow regulators, Irrigation engineering, Storm water, Design standards.

Flow regulators in both irrigation and storm water engineering are often not very exact, but should be simple to construct and maintain, 'fool-proof,' and ideally inexpensive. A new flow regulator which matches these requirements, the so-called Automatic Throttle Hose, is described. The device delivers an almost constant discharge independent of fluctuations in the upstream water level. No external power supply is needed for running the device, as it takes all required energy from the fluid itself. Following an explanation of the regulating principle, the application of this new regulator to irrigation practice is described and a design chart for application in the low head range presented. Further, modifications are listed which may be used to extend the effective head range. Practical experiences in both irrigation schemes and storm water projects indicate that this flow regulator has a place alongside other proven regulators for rather low discharges. (Lantz-PTT)
W86-05237

IRRIGATION WATER REQUIREMENTS FOR SENEGAL RIVER BASIN,
Army Engineer District, New York.
For primary bibliographic entry see Field 6D.
W86-05238

PLASTIC LINING ON RIVERTON UNIT, WYOMING,
For primary bibliographic entry see Field 8G.
W86-05240

IRRIGATED AGRICULTURE AND GROUNDWATER MINING ON THE HIGH PLAINS OF TEXAS, USA,
Saint David's Univ. Coll., Lampeter (Wales).
For primary bibliographic entry see Field 4B.
W86-05283

OUTPUT AND INVESTMENT FRONTIERS OF UNITED STATES IRRIGATED AGRICULTURE,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W86-05326

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

INGENUITY SOLVES THE CITY'S DRAINAGE AND RECREATIONAL SPACE NEEDS
D. L. Pilz.
Public Works, Vol. 117, No. 3, p 80, 113, March 1986.

Descriptors: *Detention reservoirs, *Storm runoff, *Financing, *Recreation, Portage, Indiana, Flood protection, Storm sewers, Bond issue.

The city of Portage, Indiana, simultaneously solved problems of poor drainage facilities in suburban areas and lack of neighborhood parks by combining the two facilities. Park bonds were used for land acquisition and general obligation bonds were used to construct drainage facilities, including a pond at each of the two sites. The Lenburg project consists of a dry-type stormwater detention area and small active recreation areas, with the detention basin sculptured for a more natural look. The second project, Bender, included new interceptor storm sewers and a 3.6-acre pond with 1,500-ft discharge sewer to carry the overflow, all on a 32-acre site. Land cost 1 million dollars at each site; drainage facilities cost 33,200 dollars at Lenburg and 771,000 dollars at Bender. (Rochester-PTT)
W86-04737

DETENTION PONDS: THE POSITIVE AND THE NEGATIVE,
Overman (W.C.) Associates, Virginia Beach, VA.
R. M. Silver.
Public Works, Vol. 117, No. 4, p 40-41, April 1986. 1 fig.

Descriptors: *Detention reservoirs, *Maintenance, *Aquatic plants, *Sedimentation, *Flood peak, Mosquitoes, Surface runoff, Hydroelectric power, Groundwater recharge, Erosion control, Oxygen deficit.

A detention pond is a facility, natural or artificial, that provides temporary storage for surface runoff, accompanied by its controlled release. Reduction of peak flows, water supply augmentation, electrical power, recreation, replenishment of groundwater, decrease in soil erosion, better control of sediment deposition, improvement of receiving water quality, and ease of implementation in planned developments are among the benefits of detention ponds. Without a well-planned overall design, releases from multiple ponds may create delayed peak flows, which at some points downstream actually may be higher than natural flows. Steep bank slopes can make it difficult to establish good vegetative cover, whereas slopes that are too flat can cause the land to be soggy and marsh-like, encouraging mosquitoes. Shallow water depths promote uncontrolled weed growth within the pond, and because of the decay of this vegetation, the pond becomes deficient in oxygen and polluted, and will not sustain aquatic life. Periodic maintenance is necessary to control sediment buildup and maintain pond water quality. (Rochester-PTT)
W86-04738

DAILY FLOW STATISTICS OF ALASKAN STREAMS,
National Weather Service, Anachorage, AK. Alaskan River Forecast Center.
D. L. Chapman.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-180133, Price codes: A05 in paper, A01 in microfiche. NOAA Technical Memorandum NWS AR-35, October 1982. 57 p, 2 fig, 2 ref.

Descriptors: *Flow rates, *Statistics, *Statistical analysis, *Streams, *Alaska, Hydrographs, Hydrography.

Frequent requests to compare current river flow to the normal flow, when to expect spring breakup, when to expect the highest flow for the year, etc., led to a statistical analysis of daily flows at all Alaskan stations for which sufficient discharge records were available. Some of the results were plotted and are presented graphically for quick-look reference. The purpose of this report is to present full-year hydrographs of the mean flow for each date, the flow that can be expected to be exceeded nine times out of ten on average for each data, and the flow that can be expected to be exceeded only one time in ten. A secondary purpose is to demonstrate, by examples, how to interpret the hydrographs for guidance in answering questions like the above. (Lantz - PTT)
W86-04784

ADVANCES IN HYDROMETRY.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W86-04785

HADDINGTON FLOOD WARNING SYSTEM,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W86-04808

AUTOMATION OF DAILY WATER DISCHARGE COMPUTATION FOR RIVERS WITH DIFFERENT REGIMES,
Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
For primary bibliographic entry see Field 7C.
W86-04814

ENTRAINMENT DESCRIPTIONS FOR MATHEMATICAL MODELING OF PUMPED-STORAGE INFLOWS IN RESERVOIRS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-04940

CHARACTERIZATION OF HYDROGRAPH RECESSIONS OF LAND DRAINS,
Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
E. G. Youngs.
Journal of Hydrology, Vol. 82, No. 1/2, p 17-25, November 30, 1985. 7 fig, 1 tab, 6 ref.

Descriptors: *Hydrograph analysis, *Land drains, Discharge hydrographs, Soil water table, Permeability coefficient, Specific yield, Drain spacing, Drainage practices, Mathematical analysis.

A relationship between the drain-flow rate and time during the water-table recession in uniform soils drained by parallel drain lines is derived from a power-law drainage equation. This relationship shows that the non-steady drainage behavior can be characterized by two parameters, one that depends on the spacing of the drains and their height above an impermeable floor, and the other that depends also on the hydraulic conductivity and specific yield of the soil. When these are plotted on logarithmic graph paper, the results indicate that field drains can be analyzed to give the characteristic parameters by superimposing them on type curves of the theoretical relationship plotted on similar paper. Drain hydrograph recessions can provide a simple means of monitoring soil structure changes over seasons and years; the graphical method of analysis provides easy indices for this purpose. (Khumbatta-PTT)
W86-05073

APPROACH FOR FREQUENCY ANALYSIS OF MULTIYEAR DROUGHT DURATIONS,
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-05212

FLOOD FREQUENCY ANALYSIS USING THE COX REGRESSION MODEL,
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 2E.
W86-05248

EFFECT OF SERIAL CORRELATION ON RESERVOIR SIZE,
Monash Univ., Clayton (Australia).
For primary bibliographic entry see Field 2H.
W86-05253

4B. Groundwater Management

GROUNDWATER RECHARGE ESTIMATE BY NUMERICAL MODELING: A CASE STUDY,
Port Harcourt Univ. (Nigeria). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-05146

IRRIGATED AGRICULTURE AND GROUNDWATER MINING ON THE HIGH PLAINS OF TEXAS, USA,
Saint David's Univ. Coll., Lampeter (Wales).
P. Beaumont.
Environmental Conservation, Vol. 12, No. 2, p

119-130, 1985. 12 fig, 1 tab, 28 ref.

Descriptors: *Groundwater mining, Groundwater irrigation, *Irrigation efficiency, *Agriculture, Texas, Aquifers, Ogallala aquifer.

The rise and possible fall of groundwater irrigated agriculture on the High Plains are outlined in both temporal and spatial contexts, with attention focused on how Man's view of the resource he has been exploiting has changed. The major aquifer of the Texas High Plains is the Ogallala Formation, consisting of unconsolidated sands, silts, and clays. The early history of the Great Plains and the growth of irrigated agriculture are discussed, and charts outlining the water table decline of the Ogallala are presented. The early perceptions of the water resources available were those of a limitless aquifer, which meant that there was no need for water conservation. By the early 1960s, as well-water levels declined, the finiteness of the aquifer became clear and sprinkler irrigation was introduced as a conservation measure. Farmers began to accept, or even welcome, state intervention in supplying water from outside the Ogallala. Present trends indicate a shift from groundwater irrigation to a return to dry farming. (Master-PTT).)
W86-05283

SUBMERSIBLE PUMPS HELP IMPROVE WATER SUPPLY FROM DEEP LIMESTONE WELL,
Bluffton Electrical and Water Utilities Dept., IN.
For primary bibliographic entry see Field 8C.
W86-05320

SINKING CITIES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
R. Dolan, and H. G. Goodell.
American Scientist, Vol. 74, No. 1, p 38-47, January-February 1986. 7 fig, 1 tab, 35 ref.

Descriptors: *Flooding, *Subsidence, *Groundwater mining, *Urban areas, Groundwater depletion, Structural engineering, Structural geology, Structural settlement, Flood plains, Dikes, Sea level.

Many of the world's great cities are sinking because of the removal of groundwater and oil and gas beneath them. Differential subsidence and lateral movements of the earth have dislocated utilities, buckled pavements, and structurally damaged some famous historical buildings. Endogenic or natural subsidence is related to processes that originate within the earth, including most of the tectonic processes. Exogenic subsidence is related to processes that originate near the earth's surface as a result of human activities such as fluid extraction and mining, and as a result of conditions such as loading and hydrocompaction. Rates of exogenic subsidence may exceed 50 cm/yr. A dramatic increase in subsidence in Venice can be dated from 1950 when great quantities of groundwater were pumped from the nearby mainland to meet industrial demands. London is sinking as the clay upon which it is built dewaters and compacts. This process is caused by groundwater being pumped from the chalk aquifer immediately below the clay. In Mexico City, a high differential subsidence is causing problems with structures and sewers. Groundwater withdrawal has also caused subsidence problems in Tokyo, Osaka, and Shanghai. Subsidence areas in the United States include Houston-Galveston, the San Joaquin Valley, Long Beach and Los Angeles, California, and New Orleans. Even though rapid subsidence in many cities appears to be arrested over the last 50 yr, there is no indication of ground elevation. Rises in sea level may be aggravated by increased use of fossil fuels and melting of polar ice. (Geiger-PTT)
W86-05321

ANALYSIS OF FLOW TO A LARGE-DIAMETER WELL DURING THE RECOVERY PERIOD,
Roorkee Univ. (India). School of Hydrology.
G. C. Mishra, and A. G. Chachadi.
Ground Water GRWAAP, Vol. 23, No. 5, p 646-651, September-October 1985. 6 fig, 5 tab, 7 ref.

Descriptors: *Wells, *Aquifer characteristics, *Pumping tests, Groundwater, Drawdown, Transmissivity, Storage coefficient, Groundwater recharge, Groundwater storage, Mathematical models.

A discrete kernal approach was developed to analyze drawdown at the well face during recovery of a large diameter well in a confined aquifier. Long duration pumping tests can be used to reveal aquifier characteristics in small diameter wells, but are not practical in large diameter wells. Using the new approach, pump test recovery data can be employed to reveal such aquifer parameters as transmissivity and storatge coefficient. The amount of error in the calculation of drawdown depends critically on the choice of measurement time steps (expressed as a fraction of a day). A procedure for selecting an appropriate time step is presented. Families of type curves, representing the variation of well function with pumping time for various storage coefficient/well dimension relationships, are matched to pump test data to yield aquifier parameters. The new approach offers an alternative to numerical methods for the analysis of flow to a large diameter well. (Robinson-PTT)
W86-05401

4C. Effects On Water Of Man's Non-Water Activities

INGENUITY SOLVES THE CITY'S DRAINAGE AND RECREATIONAL SPACE NEEDS,
For primary bibliographic entry see Field 4A.
W86-04737

FLOODS IN BRITAIN'S BASEMENT; INDUSTRY'S DEMAND FOR WATER IS PLUMMETING. AS A RESULT, RISING GROUND WATER THREATENS TUNNELS AND DEEP FOUNDATIONS IN MANY CITIES,
T. Nield.
New Scientist, Vol. 109, No. 1501, p 26-29, March 27, 1986.

Descriptors: *Water table, *Groundwater level, *Floods, England, London, Birmingham, Liverpool, Thames River, Lea Aquifer, Groundwater recharge, Aquifers, Piles, Pumping, Tunnels.

As factories close because of Britain's recession, water tables have risen. Floods have halted trains in Liverpool and forced the government's Property Services Agency to install pumps to keep a defence telecommunications link in Birmingham dry. In London, water engineers have been forced to shelve plans to create an underground reservoir for two years while researchers try to discover how higher water tables are likely to affect buildings. The foundations of structures such as Spaghetti Junction are threatened. The rising water table in London is affecting the Thames Water Authority's plan to recharge the Lea Aquifer under the Lea Valley. The piles of the new British Library are wider at the base to allow for corrosion when the water table rises in the future. Pumps in Liverpool extract ground water, preventing the railway tunnel from flooding. The water then flows to the Daily Post and Echo where it cools the presses. Now warm, it heats the offices of Royal Insurance before it is pumped into the Mersey. Because people now use water more efficiently, water tables will never sink to the depths they were immediately after the Second World War. (Peters-PTT)
W86-04969

STORM FLOW AND SEDIMENT LOSSES FROM SITE-PREPARED FORESTLAND IN EAST TEXAS,
Texas A and M Univ., College Station. Dept. of Range Science.
W. H. Blackburn, J. C. Wood, and M. G. DeHaven.
Water Resources Research WRERAO, Vol. 22, No. 5, p 776-784, May 1986. 2 fig, 6 tab, 21 ref.

Descriptors: *Storm flow, *Sediment loss, *Forest management, Clear-cutting, Cutting management, Forest watershed, Sediment erosion, Sediment transport, Texas.

Nine small (2.57 to 2.79 ha) forested watersheds in East Texas were instrumented in December 1979 to determine the effect of harvesting and site preparation on storm flow and sediment loss. Three replications of three treatments were used: 1) clearcutting, followed by shearing, windrowing, and burning; 2) clearcutting, followed by roller chopping and burning; and, 3) undisturbed control. Prior to treatment, mineral soil was exposed on 3% of the watersheds. Following treatment in June 1981, 57% of the mineral soil was exposed on the sheared and windrowed watersheds compared to 16% on the chopped watersheds. At the end of the second, third, and fourth years' growing season, mineral soil was exposed on 20.9, and 10% of the sheared and 4, 4, and 3% of the chopped watersheds, respectively. The first year following treatment, mean storm flow was greater from the sheared watersheds (14.6 cm) than from the chopped (8.3 cm) watersheds, with the storm flow from the latter greater than from the undisturbed (2.6 cm) watersheds. During the third posttreatment year there was no significant difference in mean storm flow from the sheared and chopped watersheds or from chopped and undisturbed watersheds. Storm flow during the fourth posttreatment year was greater from the sheared watersheds (6.1 cm) than from the chopped (3.5 cm) watersheds, which had greater stormflow than the undisturbed (1.4 cm) watersheds. Although sediment losses were significantly different between treatment, they were small and below Soil Conservation Service tolerable levels. Mean sediment concentrations and losses from the chopped and undisturbed watersheds were similar during the four posttreatment years. Sediment concentrations from the sheared watersheds were greater than from chopped or undisturbed watersheds during the four posttreatment years. However, concentrations the first year after treatment (2119 mg/L) were greatly reduced the second (167 mg/L), third (54 mg/L), and fourth year (331 mg/L). (Lantz-PTT)
W86-05224

MONITORING EFFECTS OF CATCHMENT MANAGEMENT PRACTICES ON PHOSPHORUS LOADS INTO THE EUTROPHIC PEEL-HARVEY ESTUARY, WESTERN AUSTRALIA,
Western Australia Dept. of Conservation and Environment, Perth.
For primary bibliographic entry see Field 5B.
W86-05357

4D. Watershed Protection

DETENTION PONDS: THE POSITIVE AND THE NEGATIVE,
Overman (W.C.) Associates, Virginia Beach, VA.
For primary bibliographic entry see Field 4A.
W86-04738

ANALYSIS OF STRATIGRAPHIC CONTROL ON RIVER BANK FAILURE,
Nigeria Univ., Nsukka. Dept. of Geology.
C. O. Okagbue, and T. K. S. Abam.
Engineering Geology, Vol. 22, No. 3, p 231-245, April 1986. 7 fig, 4 tab, 13 ref.

Descriptors: *Bank erosion, *Niger delta, *Slip circle model, *Nigeria, Sand, Clay, Stratigraphy, Recessional mechanisms, Soil engineering, Plant cover, Sedimentation, Mathematical model, Precipitation, Flooding.

Most of the rivers of the Niger Delta, Nigeria, flow through alluvial deposits whose general stratigraphy is that of cohesionless sand overlain by cohesive silty clay. Erosion and recession of the river banks have constituted a threat to many villages along the various creeks in the delta area. Analyses of the recessional mechanisms indicated that bank failure is initiated by a fluvial erosion of the lower cohesionless bank layer at a much faster

rate than the upper cohesive bank layer. This leads to the development of overhangs of the upper cohesive materials. The failure mechanism of the river bank is complex, ranging from slip failures in high banks to shearing and toppling failures in low banks. The use of the common slip circle model for stability evaluation appears to be adequate only for high banks. Results obtained for the low banks suggest that the use of this model of stability analyses for low banks may yield misleading results. The engineering properties of the soils, seasonal variation of precipitation and flooding, density of vegetation, and the balance between rates of sediment supply from failed materials and their removal from bank toe all appear to influence the rate of bank retreat. (Rochester-PTT)
W86-04748

EROSION AND SEDIMENT TRANSPORT MEASUREMENT: SYMPOSIUM.

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2J.
W86-04843

STUDIES OF SEDIMENT PRODUCTION ON MOUNTAIN SLOPES,

Kyoto Univ. (Japan). Faculty of Agriculture.
H. Hiura, K. Murakami, and K. Ohte.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 257-266, 8 fig, 4 tab, 1 ref.

Descriptors: *Sediment transport, *Erosion, *Soil mechanics, *Landslides, *Mountains, *Slopes, Sediment yield, Kizu River, Japan, Sediment yield, Disasters, Mudflows, Typhoons, Typhoon Ise, Penetration tests.

Accurate estimation of the volume of sediment production on mountain slopes is required for erosion control and forestry conservation. In order to produce such estimates, penetration tests using a Doken-type penetration testing machine, and morphologic analysis of topographical maps have been undertaken. Interpretation and analysis of the results have revealed: (a) sediment production on mountain slopes is mainly due to sliding of the surface soil, and information on the depth of the surface soil is needed; (b) the results of the penetration tests have shown that the depth of N sub 10 = 10 roughly corresponds to the depth of the surface soil layer, and a morphologic analysis have indicated that the most important topographical factor influencing sediment production is the area/height distribution; and (d) the estimate of sediment volume based on the above results is 27,030 cu m/sq km. (See also W86-04843) (Author's abstract)
W86-04869

RATE OF EROSION PROCESSES ON EXPERIMENTAL AREAS IN THE MARCHIAZZA BASIN (NORTHWESTERN ITALY),

Consiglio Nazionale delle Ricerche, Turin (Italy). Ist. di Ricerca per la Protezione Idrogeologica nel Bacino Padano.
E. Caroni, and D. Tropeano.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 457-466, 1 fig, 7 tab.

Descriptors: *Erosion, *Slopes, *Slope erosion, Marchiazza Basin, Italy, Soil erosion, Freezing, Rainfall, Slope degradation, Rills, Thalwegs.

This paper deals with the results of a 3-year study on slope erosion. Systematic surveys were performed on seven experimental plots and two small basins. Freeze-thaw cycles appear to be a preliminary factor inducing soil erosion. The displacement of grains occurs due to the impact of raindrops. The eroded material moves downward to the rills and thalwegs, whence periodically it is removed by debris flow phenomena. Comparing the material carried away and rainfall, it was observed that the amount of erosion is related, in the first place, to maximum rainfall intensity and, in the second place, to duration of erosive rainfalls as well as total rainfall depths. In spring and late summer when heavy rainstorms often occur, slope erosion is very intense and 60-80% of the annual erosion occurs. The rate of erosion on bare soil was 6 mm per year, on grass it was 0.2 mm per year; no erosion was observed in wooded areas. (See also W86-04843) (Author's abstract)
W86-04888

RECENT DEVELOPMENTS IN THE EXPLANATION AND PREDICTION OF EROSION AND SEDIMENT YIELD.

International Association of Hydrological Sciences.
For primary bibliographic entry see Field 2J.
W86-04896

ANALYSIS OF SEDIMENT YIELD AND TRANSPORT DATA FOR EROSION CONTROL WORKS,

Public Works Research Inst., Tsukuba (Japan).
T. Mizuyama.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 177-182, 4 fig, 5 ref.

Descriptors: *Erosion control, *Dams, *Sedimentation, Erosion, Sediment discharge, Japan, Sediment yield, Reservoirs, Drainage area.

Erosion control dams have been constructed on mountain torrents in Japan for 100 years, but their purpose and methods of evaluation are now being questioned. Some available sediment data (including sediment discharge of debris flows, the sediment yield of individual storms, and the rates of sedimentation in reservoirs in Japan) are analysed to evaluate the purpose of erosion control in Japan. The relationship of sediment yield to the area of the drainage basin is made clear and the magnitude of catastrophic sediment discharge is estimated. Based on these data, the purposes of erosion control works can be established as follows: in a small basin to check a very rare catastrophic sediment discharge such as a debris flow with erosion control dams, and in a large basin to reduce the sediment discharge and to make it uniform with erosion control dams or retarding basins. (Seee also W86-04896) (Halterman - PTT)
W86-04915

EROSIONAL PROCESSES AND SEDIMENT YIELD IN THE UPPER OLDMAN RIVER BASIN, ALBERTA, CANADA,

Northwest Hdrualic Consultants Ltd., Edmonton (Alberta).
C. R. Neill, and J. D. Mollard.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 183-191, 7 fig, 1 tab, 6 ref.

Descriptors: *Erosion, *Sediment yield, *Runoff, Gully erosion, Wind erosion, Geologic erosion, Aerial photography, Rivers, Alberta, Canada, Oldman basin, Continental Divide, Rocky Mountains, Suspended sediments, Stream channels.

The upper Oldman basin descends eastward from the Continental Divide of the Continental Divide of the Rocky Mountains in southwest Alberta. Its 4000 sq km area can be divided into Mountains, Foothills, and High Plains. The sediment yield and the associated erosional processes are discussed. Suspended sediment yield averages 70 t/sq km/yr, but varies greatly from year to year. This compares with a range of 20-100 elsewhere in Alberta and 0-350 in Canada generally. Principal erosional features identified include stream channel instability, ravine erosion, grassland gullying, wind erosion, and gravity-induced mass movements. An assessment of information obtained from airphoto interpretation and field reconnaissance indicates that erosional features are generally local in extent and are not creating widespread distress, that most present erosion is associated with streams and rivers, and that a substantial part of this is of natural geologic origin. The main source of man-made erosion appears to arise from public roads and associated interferences with natural drainage. A potential for accelerated erosion appears to exist on grazing lands on substantial slopes. In the forest areas, erosion is minor compared to that in agricultural areas. (See also W86-04896) (Author's abstract)
W86-04916

MATHEMATICAL SIMULATION OF EROSION ON GRADED TERRACES,

Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. O. Akan, and S. C. Ezen.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 221-228, 6 fig, 1 tab, 12 ref.

Descriptors: *Mathematical models, *Simulation, *Erosion rates, Kinematic wave theory, Model studies, Sediment carrying capacity, Sediment transport, Overland flows, Channel flows, Erosion.

A physically-based mathematical model is developed to simulate flow on a graded terrace idealized as an erodible and pervious overland flow plane and a terrace channel. A nonlinear kinematic wave scheme is adopted for routing the water and the sediment discharges through the overland and the channel flows. The erosion and the sediment transport capacities, the erosion rate and the sediment concentration in the overland flow are interrelated through a closed form equation. The transport capacity of the channel is determined by using the unit stream power concept. A finite difference method is employed to solve the partial differential equations of the mathematical model. The model is verified by a set of observed data. (See also W86-04896) Author's abstract)
W86-04919

APPLICABILITY OF THE UNIVERSAL SOIL LOSS EQUATION IN MOUNTAIN WATERSHEDS IN SEMIARID AND HUMID REGIONS,

Centre for Water Resources, Madras (India).
S. Chinnamani, V. S. Venkata, and R. Sakthivadivel.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 229-237, 3 fig, 2 tab, 10 ref.

Descriptors: *Mountains, *Erosion rates, *Watersheds, Erosion, Watershed management, Erosion control, Soil erosion, Mathematical equations, Sediments, India, Bhavani Basin, Universal soil loss equation, Sediment transport, Humid areas, Semiarid lands.

The mountain watersheds of the Bhavani basin in south India (latitude 10 deg 55 min - 11 deg 45 min N and longitude 75 deg 30 min - 77 deg 45 min E) lie partly in humid and partly in semiarid climatic regions. Due to increased population growth, many of these watersheds are undergoing rapid land use changes, especially from forest to agriculture, and consequently heavy soil erosion is taking place. Planning for proper development of these watersheds requires estimates of soil loss due to land use change. An attempt is made to predict soil erosion using the Universal Soil Loss Equation and to ascertain the soil erosion rate due to land use change. The computed annual soil loss (t/ha) agrees fairly well with the observed soil loss data provided by pilot studies. The sediment delivery ratios worked out for some of these waersheds compare favorably with those obtained for humid and semiarid areas in other countries. It is concluded that scientific land management with mixed forest, rural and urban land use is the final answer for erosion control in the Bhavani Basin. (See also W86-04896) (Author's abstract)
W86-04920

DEVELOPMENT OF DRAINAGE NETWORKS,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. R. Cordova, I. Rodriguez-Iturbe, and P. Vaca.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 239-249, 3 fig, 1 tab, 7 ref.

Descriptors: *Mathematical models, *Overland flow, *Drainage patterns, Model studies, Erosion, Drainage area, Sediment transport, Surface runoff, Horton's Laws.

An attempt is made to describe the genetic relationships involved in drainage network growth and differentiation. A two-dimensional mathematical model of water and sediment is implemented to describe both flow and soil movement over a hillslope of a given geometry resulting from an effective rainfall pattern. A concentration of flow is induced at the outlet with resulting erosion which propagates upslope. The model permits study of the patterns of growth of the drainage network. When the hillslope contains a random topographic field of elevations or a random field of critical shear stresses in soil properties (or both) the resulting growth upslope quickly develops into a branching structure which fulfills Horton's laws. (See also W86-04896) (Author's abstract)
W86-04921

SOIL EROSION AND AGRICULTURE IN THE WORLD: AN ASSESSMENT AND HYDROLOGICAL IMPLICATIONS,
Moscow State Univ. (USSR). Dept. of Hydrology.
G. N. Golubev.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 261-268, 4 fig, 1 tab, 9 ref.

Descriptors: *Soil erosion, *Sediment transport, *Agricultural watersheds, *Model studies, Cultivated lands, Erosion, Mathematical models, Phosphorus.

Data from various areas of the world show that ploughing of virgin lands creates a drastic increase in water erosion of soils. On the average, it can be assumed that after transformation of forest into cropland, soil erosion increases by two orders of magnitude and for unforested territories the increase is of one order of magnitude. A special methodology was developed to assess the level of soil erosion in different landscapes and in the world as a whole for pre-agricultural time, the present, and the situation when (and if) all suitable land resources would be transformed into cropland. Both the methodology and the results are discussed. The results indicate that soil erosion in the world now is five times more than in pre-agricultural time and could be ten times more if all suitable lands are ploughed. The increased soil erosion leads to an increase in river sediment transport as well as accumulation of the eroded material in river networks. The problem of modification of chemical cycles (the phosphorus cycle in particular) as related to agricultural erosion is also discussed. (See also W86-04896) (Author's abstract)
W86-04923

ESTIMATION OF EXTREME SEDIMENT TRANSPORT FROM TORRENTIAL DRAINAGE BASINS IN THE EAST ALPS,
Torrent and Avalanche Control Research Inst., Vienna (Austria).
G. Kronfellner-Kraus.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 269-273, 13 ref.

Descriptors: *Model studies, *Soil erosion, *Flooding, Mathematical models, Sediment yield, East Alps, Drainage area, Erosion rates, Hydrographs, Flood hydrographs, Landslides, Gully erosion, Bed load, Sediment load.

A knowledge of the dangers and possible damage caused by torrents is one of the most important preconditions of sensible land use planning. Torrent erosion and sediment yield here include the whole process of excessive erosion (soil erosion, landslides, gully erosion) as well as bed load transport and deposition of bed load on debris cones or on valley floors. While our understanding of soil erosion has reached a high level, the quantitative estimation of torrent erosion and torrential sediment yields is much more difficult. Based on both special investigations in experimental drainage basins and the systematic sampling of data relating to all extreme events associated with torrents in the East Alps, general formulae for calculating extreme sediment yields from torrential drainage basins during floods and mud flows have been developed. These are discussed and compared with other procedures. (See also W86-04896) (Author's abstract)
W86-04924

HYDRODYNAMIC MODEL OF SEDIMENT TRANSPORT IN RILL FLOWS,
Mississippi Univ., University. Dept. of Civil Engineering.
S. N. Prasad, and V. P. Singh.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 293-301, 1 fig, 10 ref. NSF-CEE-81-19878.

Descriptors: *Erosion, *Mathematical equations, *Sediment transport, *Cultivated lands, Soil erosion, Rill erosion, Rills, Runoff, Flow.

Essentially all of the sediment lost from intensively cropped land during rainstorms is transported by runoff along row furrows, rills and other flow concentrations. The rate of sediment transport for such conditions depends on the rate at which the sediment is eroded from the interrill areas to the concentrated flows, the size and density of the sediment and hydrodynamic characteristics of the flow channels. A detailed hydrodynamic analysis of the flow of sediment in such furrows is presented. Emphasis is placed on the transport mode in the form of a densely packed moving layer near the bottom of the channel. Governing equations for the thickness of the bed layer are derived which are based upon the results of some recent studies pertaining to the constitutive laws for stress and deformation rate of granular materials. (See also W86-04896) (Halterman - PTT)
W86-04926

PREDICTION OF SEDIMENT YIELD FOR MOUNTAINOUS BASINS IN COLUMBIA, SOUTH AMERICA,
Rijkswaterstaat, Arnhem (Netherlands). Directorate for Water Management and Hydraulic Research.
W. E. van Vuuren.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 313-325, 3 fig, 1 tab, 7 ref.

Descriptors: *Sediment yield, *Mathematical equations, *Rivers, Mountains, Basins, Columbia, South America, Sediment transport, Universal Soil Loss Equation, Rio Cauca.

The Universal Soil Loss Equation is tested for prediction of the sediment yield of the Rio Cauca (in Columbia, South America). An attempt is made to develop a procedure for estimation of sediment yield on the basis of basin characteristics rather than by measuring sediment transport in streams. Computed basin soil loss is shown to be sensitive to the method of handling spatially distributed data on basin characteristics. Universal Soil Loss Equation procedures are found inadequate for extreme topographic and vegetational conditions, while it is probable that vegetation types are more dense than USA equivalents. Possibly due to this, computed soil loss greatly overestimates sediment yield calculated from limited transport data. Additional information about soil loss determination and measured transport is required for deciding whether soil loss is a good estimate for sediment yield in the area or that sedimentation on the flood plains of tributaries produces unacceptable delivery ratios. Prediction of sedimentation rates in mountainous reservoirs does not suffer this problem. Good station independent correlation between annual erosivity and a monthly precipitation index is found. (See also W86-04896) (Author's abstract)
W86-04927

SEDIMENT AVAILABILITY AND THE PREDICTION OF STORM-PERIOD SEDIMENT YIELDS,
Exeter Univ. (England).
D. E. Walling, and B. W. Webb.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 327-337, 4 fig, 36 ref.

Descriptors: *Sediment yield, *Sediment discharge, *Drainage area, Basins, Suspended sediments, Sediment concentration, Storms, Model studies, Runoff, Hydrographs, Sediment transport, Erosion, Devon, England.

The form of the suspended sediment concentration/discharge relationship or rating curve for a drainage basin reflects the overall pattern of erosion and sediment delivery operating in the upstream area. As such it may prove useful in the development of a realistic model of storm-period sediment yield. Several workers have highlighted the existence of 'exhaustion effects' in the form of the relationship and an attempt has been made to evaluate the evidence for temporal variations in sediment availability. Detailed records of suspended sediment concentration provided by continuous recording turbidity sensors installed in several basins in Devon, United Kingdom, have been used to study this feature of basin response. The implications for the development of sediment yield models are discussed. (See also W86-04896) (Author's abstract)
W86-04928

TIMESCALES OF DENUDATION: THE LAKE-DRAINAGE BASIN APPROACH,
Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
J. A. Dearing, I. D. L. Foster, and A. D. Simpson.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 351-360, 2 fig, 1 tab, 33 ref.

Descriptors: *Erosion, *Sedimentation, *Denudation, Drainage area, Lakes, Erosion rates, Environment, Sediment erosion, Catchment areas.

Two methods for estimating rates of denudation in two different areas were studied: first, a small drainage basin experiment which provides detailed solute and sediment budgets for a short time period; and secondly, an analysis of sediments from a lake below the monitored stream in order to establish erosion rates over the past 140 years and to relate them to environmental change. Results from the drainage basin indicate a total particulate denudation of approximately 70 kg/ha/yr, some 10% of total output. The lake sedimentation data suggest an annual loss from the basin of approximately 100 kg/ha. Explanations are presented for the discrepancies found in extrapolating data. Further studies are suggested to examine rates of particulate denudation in forested, cultivated and mined environments, and to observe environmental stabilization following disturbance on a relatively long timescale which may well occur at rates not measurable by the present short term monitoring scheme. (See also W86-04896) (Halterman - PTT)

W86-04930

HYDROLOGIC CHARACTERISTICS AND MODELLING OF A SMALL FORESTED CATCHMENT IN SOUTHEASTERN NEW SOUTH WALES, PRE-LOGGING CONDITION,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2E.
W86-05116

STORM FLOW AND SEDIMENT LOSSES FROM SITE-PREPARED FORESTLAND IN EAST TEXAS,

Texas A and M Univ., College Station. Dept. of Range Science.
For primary bibliographic entry see Field 4C.
W86-05224

MORPHOLOGIC EFFECTS OF CHANNELIZATION: THE CASE OF THE NEEBING-MCINTYRE FLOODWAY, THUNDER BAY, ONTARIO, CANADA,

Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 8B.
W86-05408

CHANNEL ADJUSTMENTS TO THE REMOVAL OF LOG STEPS: AN EXPERIMENT IN A MOUNTAIN STREAM,

Rocky Mountain Forest and Range Experiment Station, Tempe, AZ. Forestry Sciences Lab.
B. H. Heede.
Environmental Management, Vol. 9, No. 5, p 427-432, September, 1985. 4 fig, 2 tab, 12 ref.

Descriptors: *Channel morphology, *Vegetation effects, Gravel bars, Mountain streams, Bed loads, Debris.

Fallen trees and their large debris often form log steps in small mountain streams, where they are incorporated into the hydraulic geometry. The hypothesis that these log steps take the place of gravel bars that otherwise would have been required for channel slope adjustment was tested. The streams are located in virgin mixed conifer forests and until the study began no human activity had interfered with the natural developments. All log steps were removed from the test stream and the fallen trees and branches. Five years later, 74% of all the removed logs had been replaced by gravel bars. In the control creek, the bars increased by only 18% and logs steps decreased by 9%. This proves the hypothesis that increased bedload movement was required to offset the loss of log steps. Implications are that streamside forests should be managed so that they can provide a steady supply of debris for channel stability. (Peters-PTT)
W86-05409

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

RADIOACTIVITY OF SPAS ON THE GREEK ISLAND IKARIA AND INFLUENCING FACTORS,

Democritus Nuclear Research Center, Athens (Greece).
For primary bibliographic entry see Field 2K.
W86-04691

DETERMINATION OF DICAMBA AND 2,4-D IN WATER AND SOIL BY ISOTOPE DILUTION GC/MS,

Acurex Corp., Mountain View, CA.
V. Lopez-Avila, P. Hirata, S. Kraska, and J. H. Taylor.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 34, No. 3, p 530-535, May/June 1986. 4 fig, 4 tab, 18 ref. EPA Contract No. 68-03-3100 and 68-03-3226.

Descriptors: *Pollutant identification, *Dicamba, *2,4-D, *Water pollution, *Soil contamination, *Isotope studies, Gas chromatography, Mass spectrometry, Water sampling, Water analysis.

An isotope dilution gas chromatography/mass spectrometry (GC/MS) technique for the analysis of low part per billion (ppb) concentrations of dicamba and 2,4-D in water and soil is described. Known amounts of stable-labeled isotopes such as dicamba d sub 3 and 2,4-D d sub 3 are spiked into each sample prior to extraction. Water samples are extracted with methylene chloride at pH < or = 1; soil samples are extracted with acetone-hexane at pH < or = 1. Analysis is performed by high-resolution GC/MS, with the mass spectrometer operated in the selected ion monitoring mode, following derivatization of extracts with pentafluorobenzyl bromide (PFBBr). Accuracy greater than 84% and precision better than 19% were demonstrated with spiked samples. This technique has been used successfully in the analysis of over 300 water and 300 soil samples. Detection limits of 0.1-1.0 ppb for waters and 1-10 ppb for soils were achieved by selected ion monitoring GC/MS. Although superior in terms of accuracy and precision, the SIM GC/MS technique developed here lacks the specificity of the full-scan mode since only selected ions are monitored. The lack of specificity, however, has turned out to be a significant advantage for quantitative work for several reasons: (1) it eliminates the cleanup step and allows concentration of reaction extracts to 0.2 mL even in the absence of silica gel cleanup. (2) Interfering peaks from reaction of PFBBr with itself or with acetone under the catalytic influence of K2CO3 are not detected since only certain ions are being monitored. (Lantz-PTT)
W86-04692

ENERGY DISPERSIVE XRFA OF SOLUTIONS CONTAINING FE AND TRACE AMOUNTS OF CO AND OTHER HEAVY METALS AFTER SELECTIVE SEPARATION ON THE CELLULOSE EXCHANGER HYPHAN,

Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Anorganische Chemie und Kernchemie.
P. P. Coetzee, and K. H. Lieser.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 323, No. 3, p 257-260, February 1, 1986. 1 fig, 2 tab, 10 ref.

Descriptors: *Energy-dispersive x-ray fluorescence analysis, *Iron, *Cobalt, *Cellulose exchanger, *Hyphan, *Iron interference, *Water analysis, Rain, Municipal water, Chemical analysis.

The elimination of FeKsubalpha interference in the determination of cobalt by energy dispersive x-ray fluorescence analysis (XRFA) was investigated. Two procedures were compared: (1) elution of iron from cellulose Hyphan filter used for the preconcentration of metal ions from solution prior to XRF analysis; cobalt is not eluted and can be subsequently determined free from interference, and (2) selective prevention of the sorption of iron onto cellulose Hyphan filters by boiling the analytical solution in the presence of 1% H202 before starting the sorption process. The methods were applied to the analysis of municipal water and rain water. The detection limit for cobalt is 0.4 microgram/liter in the presence of up to 1 mg/liter iron. (Author's abstract-PTT)
W86-04706

PHOTOMETRIC DETERMINATION OF BORON IN GROUND- AND SURFACE WATER (PHOTOMETRISCHE BESTIMMUNG VON BOR IM GRUND- UND OBERFLACHENWASSER),

Trier Univ. (Germany, F.R.). Abt. fuer Anorganische und Analytische.
U. de la Chevallerie-Haaf, A. Meyer, and G. Henze.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 323, No. 3, p 266-270, February 1, 1986. 4 fig, 1 tab, 36 ref.

Descriptors: *Pollutant identification, *Rosocyanin, *Boron, *Water analysis, *Curcumin, *Photometry, Extraction, 2-Ethyl-1,1-hexanediol, Methylisobutylketone, River water, Tap water, Mineral water.

The colored complex 'rosocyanin' which formed after reaction with curcumin, is suited for the photometric determination of boron in water. An optimized procedure is described, which is superior to the usually applied standard method. Boron is separated from interfering matrix components in ground- and surface water by extraction with 2-ethyl-1,3-hexanediol in methylisobutylketone. Another advantage, in comparison with other methods, is the immediate formation of the curcumin complex in the extraction phase. For the determination of 1 ppb boron, the relative standard deviation was calculated to + or - 4.3%, for 100 ppb to + or - 11.1%. The boron contents of tap water, mineral water, and river water of different origins were investigated. Reference measurements were carried out using emissions spectrometry with ICP excitation. (Author's abstract)
W86-04707

GAS-CHROMATOGRAPHIC ELEMENTAL ANALYSIS VIA DI(TRIFLUORETHYL)DITHIOCARBAMATO CHELATES IX. OPTIMIZATION OF THE CAPILLARY-GAS-CHROMATOGRAPHIC DETERMINATION OF TRACE METALS,

Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie.
H. Schaller, and R. Neeb.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 323, No. 5, p 473-476, March 1, 1986. 6 fig, 11 ref.

Descriptors: *Pollutant identification, *Trace metals, *Gas chromatography, *Chelates, *Di(trifluorethyl) dithiocarbamato-chelates, *Water analysis, Zinc, Copper, Nickel, Cadmium, Palladium, Cobalt, Iron, Lead, Chromium, Chemical analysis.

The capillary-gas-chromatographic conditions for the determination of trace metals after extraction from aqueous solutions are optimized by coupling of capillaries and improvement of injection technique. Different detectors (FID and ECD) were tested, and pH range and buffer systems for extraction of metal chelates are discussed. Among the metals involved in analyses were Zn, Cu, Ni, Cd, Pd, Co, Fe, Pb, and Cr. Analysis of aqueous solutions at the ppt level appears to be possible with an ECD. The reproducibility of the FID used here proved to be better than the ECD. Work with ECD is much more complicated than with the FID, and requires careful optimization of detector operation parameters. (Rochester-PTT)
W86-04708

SCREENING COMPLEX HAZARDOUS WASTES FOR MUTAGENIC ACTIVITY USING A MODIFIED VERSION OF THE TLC/SALMONELLA ASSAY,

Health Effects Research Lab., Research Triangle Park, NC. Genetic Bioassay Branch.
V. S. Houk, and L. D. Claxton.
Mutation Research MUREAV, Vol. 169, No. 3, p 81-92, March 1986. 2 fig, 4 tab, 41 ref.

Descriptors: *Thin layer chromatography, *Ames assay, *Salmonella assay, *Hazardous wastes, *Mutagenicity, Bioassay, Nitrosamine, Heterocyclics, Polycyclic aromatic hydrocarbon, Antitumor agents, Alkylating agents.

Ten complex hazardous wastes were tested for mutagenic activity using a modified version of the thin-layer chromatography/Salmonella assay developed by Bjoerseth and others. Unadulterated hazardous wastes and selected hazardous waste extracts were fractionated on commercially available TLC plates, and mutagenicity testing was performed in situ by applying a single overlay of minimal growth agar, tester strain TA98 or TA100, and the optional metabolic activation

system directly onto the developed chromatogram. Seven of the 10 wastes (including tars, emulsions, sludges, and spent acids and caustics) demonstrated mutagenic activity when tested by this method. fourteen Salmonella mutagens, including heterocyclic, aromatic amines, alkylating agents, antitumor agents, a nitrosamine and nitroaromatic were tested also. Of these, 11/14 tested positive. The three compounds refractory to analysis including a polycyclic aromatic hydrocarbon and two volatiles. (Rochester-PTT)
W86-04709

GAS CHROMATOGRAPHIC EVALUATION OF THE ORGANIC COMPONENTS PRESENT IN THE ATMOSPHERE AT TRACE LEVELS WITH THE AID OF CARBOPACK B FOR PRE-CONCENTRATION OF THE SAMPLE,

Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. Inquinamento Atmosferico.
P. Ciccioli, E. Brancaleoni, A. Cecinato, C. DiPalo, and A. Brachetti.
Journal of Chromatography, Vol. 351, No. 3, p 433-449, January 31, 1986. 9 fig, 2 tab, 14 ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Adsorbents, *Carbopack B, Tenax GC, *Organic compounds, *Air pollution, *Rain, Nitrous oxide, Oxidants, Acids, Diesel engine exhaust, Simulated atmospheres, Hydrocarbons, Chemical analysis, Water analysis, Sampling.

Enrichment on traps packed with Carbopack B adsorbent is proposed as a suitable method for the evaluation of organic compounds present at parts per 10(9)-10(12) levels in atmospheric samples. The technique has been applied to the determination of organics, dispersed in a suburban atmosphere, dissolved in rain water, or volatilized from the particulate matter emitted from an industrial emission and a diesel engine exhaust. A comparison between the efficiencies of Carbopack B and Tenax GC in the sampling of C6-C10 hydrocarbons, conducted with both simulated and natural atmospheres, indicates that Carbopack B is more efficient and does not give rise to sampling artifacts in the presence of oxidants and acidic pollutants, which are shown to cause decomposition of the Tenax GC polymeric matrix. The chemical inertness of Carbopack B also permits the determination of organic compounds in antropogenic emissions, where large amounts of NO2, water, and strong acids are present. (Author's abstract)
W86-04710

BROMINATION AND GAS CHROMATOGRAPHIC DETERMINATION OF MICRO AMOUNTS OF ACROLEIN IN RAIN WATER,

Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
H. Nishikawa, T. Hayakawa, and S. Ikeda.
Journal of Chromatography, Vol. 351, No. 3, p 566-570, January 31, 1986. 2 fig, 4 tab, 11 ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Acrolein, *Bromination, *Rain, Chemical analysis, Electron-capture detection, Air pollution.

The best condition for extracting the brominated derivative of acrolein from rain water was investigated, and a method was established for the determination of acrolein in rain water based on bromination followed by gas chromatography with electron-capture detection. This method permits the sensitive and selective detection of 4-200 nanogram/ml of acrolein in rain water without interference from related compounds. Total time required to conduct the analysis was about 80 min. (Rochester-PTT)
W86-04711

COMPARISON OF DIRECT HEADSPACE AND AQUEOUS INJECTION TECHNIQUES FOR HALOGENATED HYDROCARBONS IN WATER,

Florida International Univ., Miami. Drinking Water Quality Research Center.
M. Mehran, W. J. Cooper, M. Mehran, and W. Jennings.
Journal of Chromatographic Science JCHSBZ, Vol. 24, No. 4, p 142-146, April 1986. 5 fig, 1 tab, 10 ref. USEPA Grant R-811473-01-0.

Descriptors: Description: *Pollutant identification, *Gas Chromatography, *Halogenated hydrocarbons, *Water analysis, *Headspace injections, *Direct aqueous injections, Phase ratio focus, Cold trap, Model system, Apolar columns, Retention gap, Distribution constant focus.

Gas chromatographic methods for detection of volatile hydrocarbons in water are described and compared in which direct headspace injection and direct water injection into fused silica capillary columns are employed. Both the separation of components and the sensitivity of their detection are affected by the lengths of the chromatographing solute bands; factors that affect the lengths of those bands are defined. A model system, composed of deionized water containing trace amounts of 16 halocarbons was used for comparison of the methods. Two methods for focusing the headspace sample band following injection also were compared. Direct aqueous injections onto thick film apolar columns offer a simple method for the detection of many purgeable pollutants in water. Headspace injections, using a method that permits deposition of a vapor sample directly inside the fused silica column, yield improved sensitivity. Sensitivity and resolution are further enhanced when the injected band is focused prior to beginning the chromatographic process. A 'phase ratio focus,' employing an ultra-thick film column preceded by a section of uncoated tubing (retention gap) requires no cold trap. However, increased sensitivity results when a suitable cold trap is used to generate a 'distribution constant focus.' (Rochester-PTT)
W86-04712

DETERMINATION OF LINEAR ALKYLBENZENESULFONATES IN SEWAGE SLUDGE BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/MASS SPECTROMETRY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. McEvoy, and W. Giger.
Environmental Science and Technology ESTHAG, Vol. 20, No. 4, p 376-383, April 1986. 7 fig, 2 tab, 41 ref.

Descriptors: *Linear alkylbenzenesulfonates, *Sludge, *Particulate matter, *Biodegradation, *Gas chromatography, *Mass spectrometry, Wastewater treatment, Aqueous phase.

Linear alkylbenzenesulfonates (LAS) were identified and quantitatively determined in anaerobically and aerobically stabilized sewage sludges. The analyses were accomplished by the formation of the sulfonyl chlorides and subsequent high-resolution gas chromatography (HRGC) and flame ionization detection and directly coupled mass spectrometry (HRGC/MS) employing both electron impact and chemical ionization modes. The total LAS concentrations ranged from 0.3 to 1.2% of dry sludge, with only minor variations in the relative composition of LAS homologues and isomers. These concentrations are considerably larger than those of other pollutants that have been reported in sewage sludges. Although LAS are soluble in water, sorption of these amphiphilic chemicals onto suspended particles in sewage appears to be significant. In contrast to their biodegradability in the aqueous phase, LAS seem to be resistant to biodegradation during sludge treatment. (Author's abstract)
W86-04721

MEASUREMENT OF THE WATER-OCTANOL PARTITION COEFFICIENT OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,

Syntex Research, Inc., Palo Alto, CA.
L. Marple, B. Berridge, and L. Throop.
Environmental Science and Technology ESTHAG, Vol. 20, No. 4, p 397-399, April 1986. 2 tab, 12 ref.

Descriptors: *Dioxin, *Water-octanol partition coefficient, *Chemical analysis, Shake flask method.

The problem inherent in the 'shake flask' method for measurement of water-octanol partition coefficients were avoided by the use of a cell in which dioxin was allowed to diffuse from the octanol phase into the water phase. Starting from mutually presaturated water and octanol phases, dioxing equilipration appears to be complete within 1 wk. Partition coefficients ranged from 33.48 x 10(6) to 8.87 x 10(6). Starting from unsaturated phases, a rapid transport of dioxin was observed from the octanol phase into the water phase, followed by a reversal that corresponds to the formation of hydrated dioxin. The average of all partition coefficient measurements for systems at equilibrium is 4.24 + or - 2.73 x 10(6), giving a log K sub ow of 6.64. (Author's abstract)
W86-04722

OCCURRENCE OF CADMIUM IN CRABS (CANCER PAGURUS) AND THE ISOLATION AND PROPERTIES OF CADMIUM METALLOTHIONEIN,

Institute of Marine Biochemistry, Aberdeen (Scotland).
J. Overnell.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 101-105, Marc 1986. 1 tab, 7 fig, 16 ref.

Descriptors: *Cadmium, *Crabs, *Amino acids, *Proteins, Chromatography, Metallothionein, Chemical analysis, Metals, Tissue analysis.

A method of purifying metallothionein from crab tissues avoids problems previously encountered. The method uses an initial batch absorption on DEAE-cellulose followed by G-75 and DEAE-cellulose chromatography. Quantitative amino acid analysis of the purified protein suggests that it has a total of 55 residues, including 19 Cys, and a molecular weight of approximately 5800. This yields an extinction coefficient at 220 nanometers for the protein in HCl, pH 1.5, of 50,000 and at 250 nanometers for the native cadmium protein in Tris-HCl, pH 8.4, of 92,000. The other amino acids present in crab metallothionein include: Asp, Thr, Ser, Glu, Pro, Gly, Ala, and Lys. A total metal-to-protein ratio of 6 gram-atoms per mole was obtained. (Peters-PTT)
W86-04756

METAL-BINDING PROTEINS AS METAL POLLUTION INDICATORS,

National Research Inst. for Oceanology, Stellenbosch (South Africa).
For primary bibliographic entry see Field 5C.
W86-04763

FRESHWATER BIOLOGICAL MONITORING.

International Association on Water Pollution Research and Control, London (England).
Available from Pergamon Press, New York, NY. $35.00. Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. Edited by D. Pascoe and R. W. Edwards. 167 p.

Descriptors: *Biological monitoring, *Rivers, *Water pollution effects, Monitoring, Bioassays, Water sampling, Data analysis, Analysis, Water pollution, Invertebrates, Fish, Plants, Toxicity.

Biological monitoring of rivers and other natural waters, a long-established practice, traditionally utilizing the structural changes to natural communities which pollution induces, has only recently responded to the opportunities afforded by developments in such fields as sampling methodology, physiological and bioassay procedures, and data analysis. This seminar explores the interpretation of traditional community surveillance studies through the application of the modern computer and multivariate statistical techniques; it also tries to relate such field community responses to laboratory studies of pollutants. Attention is given to the design, validation and use of novel monitoring systems employing plants, invertebrates and fish, and recent developments in the in vitro assessment of mutagenicity of chemicals present in water are discussed. (See W86-04768 thru W86-04783) (Lantz - PTT)

W86-04767

FRESHWATER BIOLOGICAL MONITORING: KEYNOTE ADDRESS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. Cairns.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 1-14, 23 ref.

Descriptors: *Monitoring, *Water pollution, *Water pollution effects, *Toxicity, Assimilative capacity, Application factors, Regulatory standards, Regulations.

The field of biological monitoring has advanced quite rapidly in the past 20 years. However, fuller use of existing methodology is hampered by doubts in both industrial and regulatory agencies regarding both the precision of the tests and the ways in which the information will be used. Factors which should be considered when using the tests to predict the capability of any quality control system, are: (1) reliability of extrapolations from test systems to natural systems, (2) interpretation of test data, (3) sensitivity, with respect to avoiding false negative responses, (4) variability, and (5) replicability of testing methods and results. However, none of these factors present insurmountable problems for biological monitoring, but rather necessitate the need for sound scientific judgement when evaluating the monitoring data. (See also W86-04767) (Lantz - PTT)
W86-04768

PERFORMANCE OF AN INVERTEBRATE COLONISATION SAMPLER (S. AUF.U.) IN BIOLOGICAL SURVEILLANCE OF LOWLAND RIVERS,

Aston Univ., Birmingham (England).
A. J. Watton, and H. A. Hawkes.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 15-24, 4 tab, 40 ref.

Descriptors: *Monitoring, *Biological samples, *Biological monitoring, *Rivers, Sampling, Macroinvertebrates, Gammaridae, Asellus aquaticus, Potamopyrgus Potomopyrgus jenkinsi, Polycentropidae, Biotic indices, Water pollution.

The objective of this investigation was to assess the usefulness of the colonisation sampler (S.Auf.U) in collecting macro-invertebrates indicative of river water quality in lowland rivers which have proved difficult to monitor by direct biological sampling methods. The validity of applying different biotic and diversity indices was also examined. S.Auf.U. were immersed for one month periods at 24 sites on 14 different rivers for which regular physiochemical data were available from the respective Water Authorities. The macro-invertebrate species and their relative abundance collected on the S.Auf.U. from the different sites were clearly related to the water quality. Heavy metal pollution was reflected by a reduction in the numbers of Gastropods and bivalve molluscs. Increasing organic pollution was reflected by a decline in the Gammarus/Asellus ratio and by a reduction in numbers of Potamopyrgus jenkinsi and the Polycentropidae. The numbers of Erpobdellidae increased with increasing organic pollution. None of six indices calculated adequately represented these differences in macro-invertebrate assemblages over the whole range of water quality. It is concluded that colonisation samplers could be used to advantage in water quality monitoring in lowland rivers. However indices currently in use are not appropriate for presenting the data. Instead it is recommended that the data be summarized in the form of a taxa-relative abundance list based on 18 taxa. (See also W86-04767) (Author's abstract)
W86-04769

BIOLOGICAL SURVEILLANCE IN WELSH RIVERS FOR WATER QUALITY AND CONSERVATION ASSESSMENT,

Welsh Water Authority, Gwent. Nash Area Lab.
M. P. Brooker.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 25-33, 4 fig, 1 tab, 24 ref.

Descriptors: *Monitoring, *Biological monitoring, *Water quality standards, *Water conservation, *Rivers, Macroinvertebrates, Statistical analysis, Multivariate analysis, Water pollution, Wales.

Studies of macroinvertebrates in several Welsh rivers are examined to assess needs of sampling, identification and data analysis in relation to biological assessment of water quality and conservation evaluation. Because of the costs of sampling and processing the identification of redundant information in biological collections is an important procedure. The restriction of sampling to one habitat type (e.g. riffles) and the omission of taxonomically difficult groups had no major effects on the establishment of spatial patterns relevant to water quality assessment in a number of Welsh rivers. However, preliminary conclusions from a single river catchment indicate that conservation evaluation requires collections from at least three habitat types (eroding, depositing and vegetation) and detailed taxonomic information. Biotic indices, many based upon empirical assessment of macroinvertebrate distributions, principally in relation to organic pollution, have been widely used to assess water quality. Some of the relatively more complex indices based upon detailed taxonomy and semi-quantitative data (e.g. Chandler score) are not demonstrably better than the simple BMWP score, which is based upon the presence/absence of family groups. Multivariate techniques are increasingly being used to identify causal relationships between river macroinvertebrates and specific changes in water quality so leading to a greater understanding of species tolerances. In particular the application of classification techniques, based upon correlation and similarity coefficients and reciprocal averaging (TWINSPAN), to collections from several Welsh rivers is considered. (See also W86-04767) (Author's abstract)
W86-04770

INVERTEBRATE DRIFT IN THE BIOLOGICAL MONITORING OF WATER QUALITY,

National Inst. for Water Research, Pretoria (South Africa).
F. M. Chutter.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 35-44, 8 fig, 3 tab, 14 ref.

Descriptors: *Rivers, *Running waters, *Benthos, *Water pollution, *Monitoring, Biological monitoring, Biotic index, Nitrogen, Biological oxygen demand, Phosphorus, Chironomidae, Exuviae, Water quality.

Water chemistry, benthos and drift were monitored simultaneously at seven sites over 60 km below a sewage works outfall in a fast-flowing river. Objectives were to record both the living and exuvial drift along the course of the river and to test a previously described biotic index of water quality based on the benthos. All sampling was undertaken between 09h00 and 15h30 during the dry winter season. Biotic index values correlated significantly ($P < 0.01$) with total nitrogen and total phosphorus concentration and with five-day biochemical oxygen demand of the water. Drift density increased with rising water temperatures. There were marked changes in the composition of the drift, particularly among the Chironomid pupae, along the course of the river. The biotic index is a useful measure of water quality, but drift density is not useful in this way. However, drift composition has considerable potential, which will only be realized when drift variation following water quality is known from more rivers and when the taxonomy of Chironomid pupae is further advanced. (See also W86-04767) (Author's abstract)
W86-04771

EARLY WARNING OF EUTROPHICATION IN RIVERS BY ANALYSIS OF PERIPHYTON CHLOROPHYLL A,

National Board of Waters, Helsinki (Finland). Water Research Inst.
P. Heinonen.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 45-52, 3 fig, 1 tab, 8 ref.

Descriptors: *Rivers, *Eutrophication, *Periphyton, *Chlorophyll a, *Biological monitoring, Fish farming, Phosphorus, Nitrogen, Water quality.

Detection of the early stages of eutrophication in running waters is very difficult. Problematic situations have arisen particularly in waters downstream of fish breeding stations. Fish farms are usually of necessity situated in the course of unpolluted, oligotrophic rivers or running waters in lake chains, but are themselves considerable sources of nutrient loading and eutrophication. An investigation was carried out of a watercourse (MQ - 43 cu m/s) eutrophication, resulting from the activities of a fish breeding station producing about 180, 000 kg of rainbow trout annually. Eutrophication due to the phosphorus and nitrogen loading from this plant reduced the value of the watercourse. Natural reproduction of trout ceased almost completely and the possibilities of recreational utilization of the watercourse decreased. Standard physical-chemical analysis of water samples taken from above and below the fish farm did not reveal any statistically significant differences between water quality variables. Periphyton was investigated by incubating artificial growth plates in the river for three weeks and analyzing periphyton chlorophyll a. The eutrophying effects of the fish breeding station were clearly demonstrated by this method. Differences between the upstream and downstream amounts of periphyton on the growth plates were statistically highly significant. (See also W26-04767) (Author's abstract)
W86-04772

INVESTIGATIONS INTO THE CAUSES OF FISH KILLS OCCURRING IN THE RIVER MEUSE (1979-1983),

Antwerpse Waterwerken (Belgium).
For primary bibliographic entry see Field 5C.
W86-04773

ASPECTS OF UTILIZING CONTINUOUS AUTOMATIC FISH BIOMONITORING SYSTEMS FOR INDUSTRIAL EFFLUENT CONTROL,

National Inst. for Water Research, Pretoria (South Africa).
W. S. G. Morgan, and P. C. Kuhn.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 65-73, 6 fig, 10 ref.

Descriptors: *Biological monitoring, *Monitoring, *Water pollution control, *Automation, *Industrial wastes, *Effluents, Toxicity, Fish physiology, Wastewater, Wastewater pollution.

Automated biological monitoring systems, employing pre-mortal symptoms in fish as an indication of insidious toxic conditions, have been developed to prevent hazardous industrial discharges from deleteriously affecting freshwater ecosystems. The parameters used to detect the occurence in wastewaters of situations toxic to fish have been opercular movement, monitored by processing the signal which arises as a result of a change in potential between stainless steel electrodes caused by ventilatory movements, and locomotory activity, monitored by means of ultrasonic echoes. Laboratory investigations have been conducted on the capability of such systems to detect acute, sublethal and chronic levels of intoxication; the effect of longterm exposure to very low toxicant concentrations on fish sensitivity; the effect of ambient temperature on the parameters employed and the adequacy of the statistics used to establish hazard detection levels. The results of such investigations have enabled researchers to define the problems

associated with the incorporation of biomonitoring systems into industrial effluent control complexes. (See also W86-04767) (Author's abstract)
W86-04774

AUTOMATED MULTISPECIES BIOMONITORING EMPLOYING FISH AND AQUATIC INVERTEBRATES OF VARIOUS TROPHIC LEVELS,

Tennessee Technological Univ., Cookeville.
E. L. Morgan, R. C. Young, and C. M. Crane.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 75-80, 1 fig, 11 ref.

Descriptors: *Biological monitoring, *Monitoring, *Water quality, *Trophic levels, Invertebrates, Computers, Bluegills, Mussels, Mayflies, Computer programs, Toxicity, Water pollution.

Automated biomonitoring may provide real-time insight into cause/effect relationships between developing toxicity and a representative aquatic animal, usually fish. However, since the applicability of single-species biomonitoring information may be subject to question when viewed in light of community toxicity and ecological quality control programs, the authors developed a computer-assisted multiple species biosensing system for stream-side water quality monitoring. In addition to using bluegill, emphasis was placed on refining techniques for detecting species-specific bioelectric responses produced by unrestrainted mussels, burrowing mayfly nymph (Hexagenia spp.) and preliminary work with caddis fly larva case builders. A specially designed differential amplifier was used for measuring bioelectric responses induced from specific movement activities generated by each test subject. Selected responses were detected as discrete analog signals, digitized and filed on disk. A management program provided various means for data gathering, filing and retrieval. Two pilot biomonitors were developed, each consisting of a 16-bit instrumentation minicomputer with hardcopy and modum outputs. These systems coupled to an IBM-PC based biomonitor having multichannel biosensor and physical parameter inputs, complete the present network. (See also W86-04767) (Author's abstract)
W86-04775

TOXICITY TESTING WITH FRESHWATER MACROINVERTEBRATES: METHODS AND APPLICATION IN ENVIRONMENTAL MANAGEMENT,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. Williams, D. Green, and D. Pascoe.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 81-91, 5 fig, 2 tab, 27 ref. Contract ENV.484.81.UK.14.

Descriptors: *Toxicity, *Macroinvertebrates, *Environmental policy, *Monitoring, Biological monitoring, Water pollution, Water quality, Water pollution effects.

The importance of using freshwater macroinvertebrates in toxicity tests is discussed. Existing test methods are examined in relation to their potential in evaluating the environmental effects of the release of toxic substances. The role of laboratory test data in explaining known distribution patterns of macroinvertebrates in the field is considered with reference to specific examples. A systematic scheme of data generation for the derivation of water quality criteria is presented with respect to the compatibility between the choice of test design, test species and appropriate measurement of response. (See also W86-04767) (Author's abstract)
W86-04776

PREDICTION OF THE TOXICITY OF COPPER TO AUSTRALIAN FRESHWATER ANIMALS,

New South Wales Inst. of Tech., Broadway (Australia).
For primary bibliographic entry see Field 5C.
W86-04777

COMPARISON OF BIOMONITORING TECHNIQUES FOR EVALUATING EFFECTS OF JET FUEL ON BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W86-04778

LEMNA AS AN INDICATOR OF WATER POLLUTION AND THE ABSORPTION OF HEAVY METALS BY LEMNA,

Shinshu Univ., Matsumoto (Japan). Dept. of Public Health.
Y. Nasu, M. Kugimoto, O. Tanaka, and A. Takimoto.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. p 113-120, 11 fig, 1 tab, 8 ref.

Descriptors: *Biological monitoring, *Monitoring, *Lemna paucicostata, *Water pollution effects, *Bioindicators, Water pollution, Heavy metals, Cadmium, Zinc, Manganese, Arsenic, Absorption, Arsenic, Copper.

To determine the potential for use of Lemna paucicostata 6746 as an indicator of water pollution, and for its utilization as a purifier of waste water, and to study the biokinetics of heavy metals, the sensitivity of Lemna to heavy metals and the mode of metal absorption by Lemna were studied. The concentration factor of cadmium for Lemna was from approximately 100 to 500 at the 24th hour after the start of culture on Bonner-Devirian medium containing cadmium (pH6.1). Seven days after the start of culture, 70% of cadmium in 25 ml of medium was absorbed by Lemna on 0.01 ppm cadmium-containing medium, 50% on 0.1 ppm, and 2% on 1 ppm cadmium-containing medium. Those factors which make Lemna more sensitive to cadmium -- the high pH value of the medium, dilution of the medium, and high temperature -- were also effective in causing the rapid adsorption of cadmium by Lemna. The frond multiplication of Lemna for 7 days was inhibited 50% by 0.1 ppm of cadmium or copper, and by 1 ppm of zinc, manganese or arsenic. Arsenic and copper inhibited the growth of each frond more effectively than frond multiplication, whereas zinc, manganese and cadmium primarily inhibited frond multiplication. (See also W86-04767) (Author's abstract)
W86-04779

APPLICATION OF AN ALGAL ASSAY TO ASSESS TOXICITY AND EUTROPHICATION IN POLLUTED STREAMS,

Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W86-04780

MICROBIAL MUTAGENICITY TESTING OF WATER SAMPLES,

Water Research Centre, Marlow (England).
P. Wilcox, and H. Horth.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. p 131-141, 5 fig, 26 ref.

Descriptors: *Toxicity, *Carcinogens, *Water pollution, *Microbial studies, *Water sampling, Mutagenicity, Carcinogenicity, Salmonella typhimurium, Water pollution sources, Chlorination.

The use of microbial test systems for investigating the mutagenic activity of water samples is discussed and the problems associated with testing complex environmental samples in such assays considered. A number of different experimental approaches which can be used to investigate the mutagenicity of water samples are summarised and illustrated by studies carried out at the Water Research Centre (WRC). Concentrated extracts of chlorinated drinking water samples derived from surface waters can be consistently shown to possess mutagenic activity in bacterial test systems. One source of these mutagenic chemicals appears to be the chlorination of naturally-occurring compounds in water, such as humic acids. The significance of these findings in relation to human health is, at present, unknown. (See also W86-04767) (Author's abstract)
W86-04781

BACILLUS SUBTILIS/MICROSOME REC-ASSAY FOR THE DETECTION OF MUTAGENS IN WATERS OF A MUNICIPAL WASTEWATER TREATMENT PLANT,

Kanazawa Univ. (Japan). Dept. of Construction and Environmental Engineering.
S. Matsui.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. p 143-152, 4 fig, 5 tab, 4 ref. Grant No. 57550328.

Descriptors: *Bioassays, *Water pollution effects, *Wastewater pollution, *Toxicity, Bacillus subtilis, Rec-assay, Dichloromethane, Probit theory, Target theory, Activated sludge, Mutagens.

A Bacillus subtilis/microsome rec-assay was improved by the introduction of a period for the test sample to interact with bacteria before cultivation in a Monod tube. During the interaction period the nutrient level is insufficient for the bacteria to duplicate their DNA. This method is called the liquid B. subtilis/microsome rec-assay stationary method. Evaluation of the rec-assay is presented in terms of R50, S-probit and RS, which were analyzed with computer programs developed on Probit theory and Target theory. Results could be classified into four categories: strong mutagenic, mutagenic, not mutagenic and reverse. One possible explanation for the 'reverse' effect is that the recombination repair enzyme system may be disrupted by test substances. Application of the rec-assay to water samples from a municipal wastewater treatment plant showed that effluents from both primary and secondary treatment contained mutagens and also substances giving the reverse effect. Both dichloromethane extraction and XAD-2 adsorption were useful for concentration and separation of mutagens and reverse effective substances from the water samples except for substances of low boiling point. It is likely that biological treatment is not effective for the removal of mutagens. (See also W86-04767) (Author's abstract)
W86-04782

COMPLIANCE BIOMONITORING - STANDARD DEVELOPMENT AND REGULATION ENFORCEMENT USING BIOMONITORING DATA,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, and D. J. Schaeffer.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. p 153-166, 2 tab, 28 ref.

Descriptors: *Biological monitoring, *Water quality standards, *Water quality control, *Water quality management, Toxicity, Water sampling, Bioassays, Monitoring, Regulations, Standards.

The development and enforcement of chemical water quality standards has been the primary focus of water quality planning, management, and regulation. The typical water quality standard is driven by criteria developed from experimental analysis of biological effects. Recently, this indirect method of protecting aquatic life has been bypassed. Compliance biomonitoring has been encouraged as a method for application of biological standards to effluent monitoring and water quality enforcement. The selection of the biological parameter for which a standard will be developed as well as actually setting a standard of biological condition or performance have impeded the implementation of regulatory programs based on biomonitoring results. The use of biomonitoring data in regulatory activity requires data collection and analysis

procedures which must meet stringent tests of statistical reliability, interpretative strength, and regulatory efficiency. This paper reviews the requirements for implementation of compliance biomonitoring, evaluates several methods of data collection and analysis, and suggests a mechanism for selection of compliance measures from biomonitoring data. In contrast to conventional regulatory methods which evaluate standard using only single species toxicity testing or simplified microcosm/community analysis, the basis of our approach to compliance biomonitoring is analysis of hierarchies of biological organization and the reliability of measures available at each level. Emphasis is placed on sampling of systems which vary through space and time, determination of thresholds of effect, and requirements which must be met to assure maintenance of evidentiary standards for legal proceedings. (See also W86-04767) (Author's abstract)
W86-04783

CHEMICAL AND BIOLOGICAL CHARACTERIZATION OF BLACK ROCK HARBOR DREDGED MATERIAL,

Environmental Research Lab., Narragansett, RI.
P. F. Rogerson, S. C. Schimmel, and G. Hoffman.
Technical Report D-85-9, September 1985. Final Report. 123 p, 20 fig, 16 tab, 26 ref, 2 append.

Descriptors: *Dredging, *Chemical analysis, *Biological analysis, Organic compounds, Mytilus edulis, Blue mussel, Heavy metals, Copper, Nickel, Zinc, Chromium, Lead, Cadmium, Mercury, Black Rock Harbor, Bridgeport, Connecticut.

Black Rock Harbor, Bridgeport, Conn., dredged material contained substantial concentrations of both organic and inorganic contaminants, many of which were shown to be biologically available to the blue mussel, Mytilus edulis, in a laboratory bioassay. Tissue PCB concentrations were 44% of the concentration found in the sediment (6800 ng/g), while tissue concentrations of parent polynuclear hydrocarbons were 28% of sediment concentrations that ranged up to 9800 ng/g. Also present in the sediment were Cu, Cr, Zn, Pb, Ni, Cd, and Hg at 2380, 1430, 1200 380, 140, 23, and 1.7 micrograms/g, respectively. Of these, Cu, Cr, Pb, Ni, and Cd accumulated in the mussels. In acute solid phase toxicity tests, the sediment was lethal to only one of the eleven species tested, Ampelisca abdita, although behavioral changes were observed in two additional species, both infaunal species. No effect was noted with epibenthic or water column species in either solid phase or in combination with suspended particulate phase. This investigation is the first phase in developing field-verified bioassessment evaluations for the Corps of Engineers and the US Environmental Protection Agency regulatory program for dredged material disposal. This methodologies that are field verified will be available at the conclusion of this program. (Author's abstract)
W86-04937

CONFIRMATION OF THE WATER QUALITY MODEL CE-QUAL-R1 USING DATA FROM EAU GALLE RESERVOIR, WISCONSIN,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W86-04941

MODEL TO PREDICT BOD FROM COD VALUES,

Benin Univ., Benin City (Nigeria). Centre for Social, Cultural and Environmental Research.
C. M. A. Ademoroti.
Effluent and Water Treatment Journal, Vol. 26, No. 3/4, p 80-84, March/April 1986. 3 tab, 1 fig, 12 ref.

Descriptors: *Biochemical oxygen demand, *Chemical oxygen demand, *Wastewater, Domestic wastes, Poultry wastes, Animal wastes, Industrial wastewater, Brewery wastes, Mathematical analysis.

The BODs and the chemical COD values for domestic, poultry and brewery wastewaters were determined and their values compared. The domestic wastewater was from the University of Benin Teaching Hospital community in Benin City and the amount generated daily was estimated at 67,000 liters. The poultry wastewater was from a poultry farm stocking about 10,000 fowls on the outskirts of Benin city. The brewery wastewater was from a brewery in Benin. A linear relationship was established: COD = a time BOD plus b where a and b are constants. The values of a were 1.65, 1.45, and 2.32 for domestic, poultry, and brewery wastewaters respectively; and the corresponding b values were 11.36, 55.7, and 46.2 mg/l. The linear regression of COD values on the corresponding BOD values was positive and strongly related for the various wastewaters. The equation was found useful for predicting BOD from the corresponding COD values. (Peters-PTT)
W86-04951

TRACE METALS IN MUSSELS (MYTILUS EDULIS) FROM THE WADDENZEE, COASTAL NORTH SEA AND THE ESTUARIES OF EMS, WESTERN AND EASTERN SCHELDT,

Fish Technology Inst. TNO, Ijmuiden (Netherlands).
For primary bibliographic entry see Field 5C.
W86-04967

TIRE FIRE OIL: MONITORING A NEW ENVIRONMENTAL POLLUTANT,

Virginia Dept. of General Services, Richmond. Div. of Consolidated Lab. Services.
J. C. Peterson, D. F. Clark, and P. S. Sleevi.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 70A-72A, 74A, January 1986. 4 fig, 2 tab.

Descriptors: *Tires, *Fire, *Oil pollution, *Monitoring, *Gas chromatography, *Toxicity, Runoff, Caprolactam, Benzothiazole derivatives, Benzoic acid, Benzamides, Aromatic polyamide fibers, Benzonitrile, Hydrocarbons.

To monitor the oil draining from beneath a burning pile of 5-7 million discarded tires flame ionization and thermionic specific detectors were employed with capillary gas chromatography in a dual, simultaneous detection set-up. In addition to the oil itself, water from streams contaminated by the oil flow was sampled. The pollutants found in the water were consistent with tire-manufacturing components, and included caprolactam, benzothiazole derivatives, benzoic acid, benzamides (likely degradation products of aromatic polyamide fibers), and benzonitrile (possibly formed by dehydration of benzamide). The ensemble of contaminants was highly toxic to all life in the stream as far as 1.1 km from the fire, but it is not known which of the compounds was responsible for the toxicity. The concentration levels of contaminants increased substantially downstream after rain, but the composition and relative proportions remained similar. (Rochester-PTT)
W86-04979

AUTOMATED ION CHROMATOGRAPHIC DETERMINATION OF ANIONS IN PRECIPITATION SAMPLES,

Geological Survey, Reston, VA.
G. S. Pyen, M. R. Brown, and D. E. Erdmann.
American Laboratory, Vol. 18, No. 5, p 22, 24, 26, 28, 30, 32, May 1986. 5 tab, 2 fig, 7 ref.

Descriptors: *Anions, *Chromatography, *Precipitation, Fluorides, Chlorides, Sulfates, Bromides, Halides, Phosphates, Nitrates, Chemical analysis.

The ion chromatographic technique is a rapid, precise, and accurate method for the determination of anions in precipitation samples. Detection limit of 0.01 milligrams/liter can be achieved without using a concentrator column. Ion chromatographic results for Cl, PO4-P, NO3-N, and SO4 were compared with values obtained by automated colorimetric and turbidimetric methods and showed good agreement for the low concentration ranges encountered. Since precipitation samples rarely contain measureable amounts of F, PO4-P, and Br, it was necessary to prepare synthetic precipitation samples to conduct comparison studies. Excellent agreement was obtained between ion chromatography and colorimetry for the PO4-P determination on six samples over the range of 0.01 to 0.50 milligrams/liter. A good comparison was also shown between ion chromatography and ion selective electrode for determination of F on four samples over the range of 0.02 to 0.05 milligrams/liter. (Peters-PTT)
W86-04984

FUSED SILICA OPEN TUBULAR COLUMN OPTIMIZED FOR THE ANALYSIS OF VOLATILE ORGANIC POLLUTANTS,

J and W Scientific.
R. R. Freeman, and R. M. A. Lautamo.
American Laboratory, Vol. 18, No. 5, p 60, 62-64, 66-68, May 1986. 7 fig, 9 ref.

Descriptors: *Organic wastes, *Chromatography, *Volatile pollutants, Megabore column, Chemical analysis, Drinking water, Industrial wastewater, Effluents, Benzenes, Aromatic compounds, Water quality standards.

A stationary phase has been synthesized for use with fused silica open tubular columns which can be readily cross-linked and surface-bonded to the silica. The selectivity of the phase has been optimized for the separation of volatile organic pollutants. When coated on large diameter tubing, the resulting Megabore column can be easily interfaced with a purge and a trap sampler and used to rapidly confirm the findings of the primary packed-column method. The Megabore column is efficient and has the inertness necessary to analyze the complete spectrum of compounds specified in EPA methods 501, 502, 503, 524, 601, 602, 624, and 1624, which encompass both drinking water and industrial effluents. Values are given for the 23 volatile organic compounds specified in EPA method 601: 1,1-Dichloroethylene, Methylene Chloride, trans-1,2-Dichloroethylene, 1,1-Dichloroethane, Bromochloromethane, Chloroform, 1,1,1,-Trichloroethane, Carbon tetrachloride, 1,2-Dichloroethane, Trichloroethylene, 1,2-Dichloropropane, Bromodichloromethane, trans-1,3-Dichloropropene, cis-1,3-Dichloropropene, 1,1,2-Trichloroethane, Tetrachloroethylene, Dibromochloromethane, Chlorobenzene, Bromoform, 1,1,2,2-tetrachloroethane, 1,3-Dichlorobenzene(m), 1,4-Dichlorobenzene(p), and 1,2-Dichlorobenzene(o). (Peters-PTT)
W86-04985

SEQUENTIAL FLOW-INJECTION DETERMINATIONS OF CALCIUM AND MAGNESIUM IN WATERS,

Universidad Autonoma de Barcelona (Spain). Dept. de Quimica Analitica.
J. Alonso, and J. Bartroli.
Analytica Chimica Acta, Vol. 179, p 503-508, January 31, 1986. 2 tab, 3 fig, 10 ref.

Descriptors: *Calcium, *Magnesium, *Water analysis, Flow-injection analysis, Potentiometric level, Electrodes, Ions, Chemical analysis, Detection limits.

A tubular PVC membrane electrode for calcium without inner reference solution and a device for location of the reference electrode are described. In the flow-injection system, calcium is determined potentiometrically and then magnesium is determined by atomic absorption spectrometry. The results are comparable to those of established methods, with a superior sampling frequency. Calcium may be detected in the range .00005-.1 M and magnesium in the range 0-10 mg/L. Flow rates of 3-6 ml/min are possible with a sampling frequency of 60-90/hr. (Peters-PTT)
W86-04989

DETERMINATION OF BROMIDE IN NATURAL WATERS BY FLOW INJECTION ANALYSIS,

T. Anfalt, and S. Twengstrom.
Analytica Chimca Acta, Vol. 179, p 453-457, January 31, 1986. 3 tab, 2 fig, 6 ref.

Descriptors: *Bromides, *Oil industry, *Water analysis, Flow-injection analysis, Ammonia, Cyanide, Humic substances, Baltic Sea, Brackish water, Saline water intrusion.

The phenol red method was adapted to a flow-injection system and interferences studied by using a two-channel valve. A rapid and accurate method for following the bromide/chloride ratio is of interest not only for tracing sea water in fresh water but also for monitoring pollution, e.g., from the petroleum industry. A fast means of evaluating interferences is provided. Standards are injected from one loop of the valve while the possible interferent is injected from the other. Ammonia, cyanide, and humic substances interfere. Bromide can be determined down to 2 micromolar at a rate of 80 samples per hr. The method was tested using brackish water samples from the Baltic Sea. (Peters-PTT)
W86-04990

FLOW-INJECTION POTENTIOMETRIC STRIPPING ANALYSIS - A NEW CONCEPT FOR FAST TRACE DETERMINATIONS,

Hahn-Meitner-Inst. fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.).
W. Frenzel, and P. Bratter.
Analytica Chimica Acta, Vol. 179, p 389-398, January 31, 1986. 1 tab, 4 fig, 29 ref.

Descriptors: *Flow injection analysis, *Water analysis, *Heavy metals, *Chemical analysis, *Water analysis, Zinc, Lead, Copper, Potentiometric stripping, Drinking water, Multi-element analysis.

Flow-injection potentiometric stripping analysis (f.i.p.s.a.) is suggested for use for heavy metal determinations whenever high sample throughput is required. The ability to determine simultaneously up to four elements at the mg/L level in a few seconds is an outstanding feature of f.i.p.s.a. The simple instrumentation used, with extremely short residence times (below 1 s), permits a sample throughput of 200/hr. On-line sample manipulation (e.g., dilution and matrix modification) is possible with one- and two-channel flow systems. The utility of f.i.p.s.a. was evaluated by comparing response, sensitivity, and practical aspects of four different flow-through cells. The method was successfully applied to the fast sequential measurement of zinc, lead and copper in tap water and to the direct determination of lead and cadmium in acid digests of biological samples without further treatment. Because it is a microanalytical technique, f.i.p.s.a. can be applied whenever small or rare samples have to be analyzed. (Peters-PTT)
W86-04991

RAPID DETERMINATION OF CHEMICAL OXYGEN DEMAND IN WASTE WATERS AND EFFLUENTS BY FLOW INJECTION ANALYSIS,

Loughborough Univ. of Technology (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5G.
W86-04992

COMPARISON OF MULLER-KAUFFMANN TETRATHIONATE BROTH WITH RAPPAPORT-VASSILIADIS (RV) MEDIUM FOR THE ISOLATION OF SALMONELLAS FROM SEWAGE SLUDGE,

Manchester Univ. (England). Dept. of Bacteriology and Virology.
P. Rhodes, and L. B. Quesnel.
Journal of Applied Bacteriology, Vol. 60, No. 2, p 161-167, February 1986. 4 tab, 4 fig, 18 ref.

Descriptors: *Sewage bacteria, *Sludge, *Wastewater, Salmonella, Muller-Kauffmann Tetrathionate Broth, Rappaport-Yassiliadis medium.

Inoculum size affects the efficiency of sampling and isolation of salmonellae from inoculated sewage samples by Rappaport-Vassiliadis (RV) medium kinetic data show that small inocula increase efficiency. The efficiency of RV medium and Muller-Kauffman tetrathionate broth (MKT) by conventional isolation frequency determinations were compared and the effect of the addition of a sulphamandelate supplement to brilliant green agar was evaluated. Isolation rates for RV (42 C) were higher even when MKT (43 C) performance was improved by the use of brilliant green sulphamandelate agar. Kinetic results show that the suppression of the competing flora was poorer in MKT than in RV. The use of high inoculam to medium volume ratios (e.g., 1:5000) increased the isolation rates from RV. The results indicate that the most efficient means for isolating salmonellae present in low numbers in sewage-polluted samples is as follows: 1) pre-enrich in buffered peptone water at 37 C for 20-24 hr; 2) inoculate 20 microliters into 20 ml RV, incubate at 42 C for 24 hr; 3) select for salmonellae on agar at 37 C; and 4) confirm by biochemical and serological tests. (Peters-PTT)
W86-04994

SEROTYPES OF VIBRIO PARAHAEMOLYTICUS ISOLATES FROM HYDROBIOLOGICALLY DISSIMILAR AQUATIC ENVIRONMENTS,

National Inst. of Cholera and Enteric Diseases, Calcutta (India).
G. B. Nair, B. L. Sarkar, M. Abraham, and S. C. Pal.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 724-726, September 1985. 1 tab, 18 ref.

Descriptors: *Aquatic bacteria, *Aquatic environments, *Vibrio parahaemolyticus, *Pathogenic bacteria, Public health, Human diseases, Enteric bacteria, India, Epidemiology, Estuaries, Mangrove swamps, Streams, Water pollution.

Serological analysis of the O and K antigens was performed on 324 isolates of Vibrio parahaemolyticus obtained from three hydrobiologically dissimilar aquatic environments in India. Only 50.9% of the strains could be serotyped; the largest number of untypable strains and the lowest serological diversity were observed in samples from freshwater. Three serotypes dominated among all biotopes; these were 02:K28, 05:K17, and 02:K3. A distinction was observed between serotypes of environmental and clinical origins. Serotype 01:K56, dominant among human diarrheal cases in Calcutta, was not isolated from any of the environments in this study, while the dominant environmental serotype 02:K28 was not recovered from diarrheal cases. The elusivity of enteropathogenic serotypes in the environment is noteworthy in an area such as Calcutta, where occurrence of gastroenteritis and human carriage of the organisms are high, and where there is a large-scale interaction between humans and the environment. Another significant finding was the prevalence of similar serotypes in vastly heterogeneous environments. These include not only estuarine and mangrove realms, which are brackish, but also freshwater environments where halophiles are not expected. (Doria-PTT)
W86-05062

BENCH TESTING OF ON-LINE TOTAL RESIDUAL CHLORINE ANALYZERS,

Canviro Consultants Ltd., Kitchener (Ontario).
S. G. Nutt, E. L. Jeffers, D. T. Vachon, and W. W. Schuk.
Journal of the Water Pollution Control Federation JWPFA, Vol. 57, No. 9, p 948-954, September 1985. 5 fig, 4 tab, 9 ref.

Descriptors: *Bench testing, *Residual chlorine, Bench flumes, Monitoring, Instrumentation, Design criteria, Testing procedures.

The application of automated monitoring instrumentation and process control strategies is well recognized in all areas of engineering as one of the best means of improving reliability, performance, and economics. However, there is limited acceptance is there because of a lack of confidence in the reliability of available instrumentation. In 1982, an organization to evaluate water and wastewater instrumentation was formed. Total Residual Chlorine (TRC) analyzers were selected as the first category of instrumentation and it was found that bench-scale tests are a useful screening device prior to expensive field testing, and can lead to improved instrument design and performance. The bench-test program identified significant differences in the performance of the four on-line TRC analyzers. The differences are pertinent to the procurement of a specific instrument for a particular application. All of the instruments exhibited acceptable accuracy over the normal operating span. The accuracy of one test unit was affected adversely by changes in ambient temperature. One test unit had significantly longer response times to changes in input concentration. The bench-test program also identified design flaws in the instruments tested that would affect analyzer performance in a field environment. One instrument manufacturer has acknowledged problems with the instrument and is modifying the unit. A second manufacturer may also make modifications to its analyzer. Thus, the objective of improving instrument design and performance through independent, rigorous testing is being achieved. (Khumbatta - PTT)
W86-05069

SECOND DERIVATIVE ULTRAVIOLET SPECTROSCOPY AND SULFAMIC ACID METHOD FOR DETERMINATION OF NITRATES IN WATER,

Santiago Univ. (Spain). Dept. de Analisis Quimico y Bromatologia-Toxicologia.
J. Simal, M. A. Lage, and I. Iglesias.
Journal of the Association of Official Analytical Chemists JANCA, Vol. 68, No. 5, p 962-964, September/October 1985. 2 fig, 2 tab, 14 ref.

Descriptors: *Nitrates, *Water analysis, *Second derivative ultraviolet spectroscopy, Spectroscopy, Chemical analysis.

Ultraviolet Spectroscopy is very helpful in identification and quantitation of nitrates because of its simplicity and low cost. However, similarly structured compounds such as nitrite ions show a very similar absorption spectrum and will interfere. Second derivative ultraviolet (UV) spectroscopy is used for the identification and quantitation of nitrates in water giving good precision and accuracy. Nitrite interference is eliminated with sulfamic acid (20 mg sulfamic acid/L eliminates up to 10 mg NO2(-)/L); interference from organic matter can be cancelled with the use of second derivative UV spectroscopy. The nitrites can be calculated indirectly. (Khumbatta-PTT)
W86-05072

SIMPLIFIED METHOD FOR THE EXTRACTION OF THE METALS FE, ZN, CU, NI, CD, PB, CR, CO AND MN FROM SOILS AND SEWAGE SLUDGES,

Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.
S. P. McGarth, and C. H. Cunliffe.
Journal of the Science Food and Agriculture, Vol. 36, No. 9, p 794-798, September 1985. 4 tab, 2 ref.

Descriptors: *Pollutant identification, *Atomic absorption spectrophotometry, *Metals, *Soils, *Sewage sludge, Heavy metals, Soil analysis, Trace elements, Spectral analyses, Emission spectroscopy.

The use of atomic absorption and emission spectrophotometry permits rapid measurement of many metals of agricultural, environmental and geochemical importance. This is especially true of computer-controlled, multi-element inductively-coupled plasma atomic emission spectrometry. Sample preparation and digestion processes for soils, sediments and sludges are in many cases the most time-consuming parts of such analytical procedures. The method described involves digestion of soil samples with aqua regia in tubes heated in block digesters. At least nine metals can be determined in the resulting solutions with errors of <5%. The results compare favorably with those from reflux aqua regia and averaged 88% of the certified total values for reference soils and 88% of those for referance sewage sludges. It is concluded that the proposed method is faster and more economical than the reflux methods now in use and gives results sufficiently close to the accepted values for the different soils and sludges used as reference materials to be of value in the routine monitoring of the metal content of soils and sludges. (Khumbatta-PTT)

W86-05076

SEASONALITY OF BACTERIAL QUALITY OF WATER IN A TROPICAL DEVELOPING COUNTRY (SIERRA LEONE),

United Nations Development Programme, Freetown (Sierra Leone). Rural Water Supply Programme.
R. C. Wright.
Journal of Hygiene, Cambridge, Vol. 96, No. 1, p 75-82, February 1986. 2 tab, 2 fig, 17 ref.

Descriptors: *Sierra Leone, *Tropical regions, *Bacteria, *Water quality, Drinking water, Seasonal variations, Salmonella, Clostridium, Streptococcus, Escherichia coli, Bioindicators.

The seasonal variations in water quality which might occur in tropical developing countries is identified both in general terms and with respect to specific source types. Natural water sources used as drinking water supplies by rural settlements in Sierra Leone were examined over a one year period to detect seasonal variations in bacterial quality. The 37 C colony count, levels of selected fecal indicator bacteria and the incidence of Salmonella spp. were monitored. A seasonality was demonstrated for all variables. The counts generally increased with the progression of the dry season and culminated in peaks at the transition from the dry to wet season. However, a statistically significant divergence was seen between the counts of the fecal groups (fecal coliform and fecal streptococcus (FS) and counts of the specific indicators, Escherichia coli and streptococcus faecalis, respectively, as these increased during the dry season. It is recommended that membrane filtration be used in preference to the multiple-tube test. (Peters-PTT)
W86-05106

COMPOUND-SPECIFIC DETERMINATION OF ARSENITE AT SUB-NANOGRAM CONCENTRATIONS IN FRESHWATER AND SEAWATER,

Jadavpur Univ., Calcutta (India). Dept. of Chemistry.
D. Chakraborti, F. Adams, and K. J. Irgolic.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 323, No. 2, p 340-342, February 1986. 1 tab, 18 ref.

Descriptors: *Arsenic, *Rivers, *Chemical analysis, Cadmium, Cobalt, Copper, Chromium, Iron, Manganese, Nickel, Lead, Zinc, Drinking water, Arsenic compounds, Heavy metals, Chlorine, Water analysis.

Arsenite is quantitatively and selectively extracted into carbon tetrachloride in the presence of arsenate, methylarsonic acid, and dimethylarsinic acid by 0.5% (w/v) aqueous solutions of ammonium sec-butyldithiophosphate. The organic extract is evaporated to dryness and the residue mineralized with concentrated nitric acid. The arsenic in this solution (5% oxalic acid) is reduced by sodium borohydride to arsine. The arsine is passed into a DC helium arc and the arsenic emission monitored at 228.8 nm. The detection limit of the extraction/hydride generation system is 0.6 ng As/liter (expressed as the concentration that must be present in a 500 ml sample subject to extraction), approximately 150 times better than hydride generation without extraction. Arsenic compounds other than arsenite do not interfere. The effect of heavy metals on the extraction and determination of arsenite was studied by applying the method to 500 ml of synthetic river water containing 200 ng As, 20 micrograms each of Cd, Co, Cu, Cr, Fe, Mn, Ni, Pb, and Zn chlorides or nitrates, and Na2EDTA. The recovery of arsenite was 106 + or - 4%. In the absence of EDTA only 80% of the arsenite was recovered. Seawater from the Gulf of Mexico was found to have 38 ng As per liter, a concentration similar to that in other seawater samples (50 ng/l). The low concentration of arsenite in tap water (3 ng As/l) is caused by the chlorine content of the water. Chlorine oxidizes arsenite efficiently to arsenate. (Peters-PTT)
W86-05107

IN SITU PULSE LIGHT FLUOROMETER FOR CHLOROPHYLL DETERMINATION AS A MONITOR FOR VERTICAL AND HORIZONTAL PHYTOPLANKTON DISTRIBUTION IN LAKES,

Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 2H.
W86-05175

14C-LABELLING PATTERNS OF PHYTOPLANKTON: SPECIFIC ACTIVITY OF DIFFERENT PRODUCT POOLS,

Michigan State Univ., East Lansing. Pesticide Research Center.
L. M. Jensen.
Journal of Plankton Research JPLRD9, Vol. 7, No. 5, p 643-652, September 1985. 2 tab, 3 fig, 32 ref.

Descriptors: *Algae, *Limnology, *Phytoplankton, *Carbon radioisotopes, Jutland, Denmark, Biomass, Photosynthesis, Extracellular products, Primary productivity, Eutrophic lakes, Lake Hylke, Chlorophyll.

The specific activity of different algal intracellular fractions during in situ conditions was examined. Primary production, release of extracellular products (EOC) and the distribution of 14C into primary products of photosynthesis (low mol. wt. products, lipids, polysaccarides, and proteins) were investigated during two months in spring 1983 in eutrophic Lake Hylke, which is situated in the eastern part of Jutland, Denmark. After in situ incubation for a half day, each fraction was assayed for 14C activity and the standing stock of carbon. Calculation of specific activity revealed nonequilibrium conditions in all fractions. Since the intracellular fractions act as precursors of EOC, this means that the release may be seriously underestimated (3 to 20 times) by assuming isotopic equilibrium between the inorganic carbon pool and the EOC products in the extracellular medium. However, measurements of the standing stock of carbon are complicated by inclusion of nonphytoplankton material, thereby making calculation of specific activity uncertain. It is suggested that the labelled chlorophyll A technique may give more accurate determinations of phytoplankton biomass. (Author's abstract)
W86-05176

UNUSUAL MICROORGANISMS OBSERVED IN NEW ZEALAND HOT SPRINGS,

Waikato Univ., Hamilton (New Zealand). Dept. of Biological Sciences.
B. K. C. Patel, H. W. Morgan, and R. M. Daniel.
Microbial Ecology MCBEBU, Vol. 12, No. 2, p 181-186, June 1986. 2 fig, 1 tab, 13 ref.

Descriptors: *Thermal springs, *Electron microscopy, *Structure, New Zealand, Filaments, Corrosion, Turbulence.

A method, used for incubating electron microscope grids in situ in a number of corrosive and turbulent New Zealand thermal springs, is reported. There were filaments with swollen saclike structures in many of the hot springs. The saclike structures appear to be cellular and to contain cytoplasmic material, have a regular subunit pattern, and are the typical size for bacterial cells. The swollen saclike structures are thought to be the cell proper and the filamentous region are possibly appendages. No septa were observed within the filaments. (Peters-PTT)
W86-05200

METHOD FOR ENUMERATING PROTOZOA IN A VARIETY OF FRESHWATER HABITATS,

Southampton Univ. (England). Dept. of Biology.
B. M. Baldock.
Microbial Ecology MCBEBU, Vol. 12, No. 2, p 187-192, June 1986. 2 tab, 10 ref.

Descriptors: *Microbiological studies, *Protozoa, *Rivers, *Culturing techniques, Statistical analysis, Statistical methods, Statistical models.

A method developed for enumerating protozoan populations during a study of protozoa in rivers is described. The results, using fixed material, are compared with two published techniques: a culture method based on the most probable number technique and a direct count method. Problems encountered in the technique developed here are as follows: 1) organisms could only be identified according to broad taxonomic categories based on size; 2) counting samples may be time consuming; and 3) a certain amount of practice is necessary to recognize the fixed material and classify the organisms consistently. Those drawbacks are outweighed by the following advantages: 1) it can be used where numbers of protozoa are low; 2) it is possible to take a number of replicate samples; and 3) there is no need to identify all species present. (Peters-PTT)
W86-05201

RELATIONSHIP BETWEEN MICROBIAL ACTIVITY OF STREAM SEDIMENTS, DETERMINED BY THREE DIFFERENT METHODS, AND ABIOTIC VARIABLES,

Freshwater Biological Association, Wareham (England). River Lab.
J. H. Baker.
Microbial Ecology MCBEBU, Vol. 12, No. 2, p 193-203, June 1986. 3 fig, 4 tab, 24 ref.

Descriptors: *Sediments, *Stream biota, *Microbiological studies, Glucose, Phosphates, Carbon dioxide, Mud, Sand, Radioactivity techniques, Gravel.

Three methods to determine the microbial activity of stream sediments, phosphatase levels, maximum uptake velocity of radiolabeled glucose, and carbon dioxide production rates were compared. The methods were applied to different types of sediment (mud, sand, and gravel) from the same stream and to 5 samples from two different streams. Temperature, discharge, and eight other abiotic variables for each sample were also determined. The three activity methods correlated closely with each other and were measured with a similar precision. Phosphatase activity could be predicted for all sites from bulk density. The largest proportion of the variance associated with carbon dioxide production was explained by variations in percent of organic matter, but the relationship did not hold for all streams. However, a maximum of only 52% of the variation in the maximum uptake velocity of radiolabeled glucose could be explained by the abiotic variables. (Peters-PTT)
W86-05202

ENTERIC LUMINOUS MICROFLORA OF THE POND-CULTURED MILK FISH CHANOS CHANOS (FORSKAL),

Annamalai Univ., Annamalainagar (India). Centre of Advanced Study in Marine Biology.
For primary bibliographic entry see Field 2H.
W86-05204

ANALYSIS OF VOLATILE HYDROCARBON LOSSES FROM QUIESCENT WATER SOLUTIONS,

California Univ., Los Angeles. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W86-05228

DIFFUSION THROUGH A DOUBLE-SIDED PLATE: DEVELOPMENT OF A METHOD TO STUDY ALGA-BACTERIUM INTERACTIONS,

Northern Arizona Univ., Flagstaff. Dept. of Biology.
F. S. Colwell and, and H. K. Speidel.
Applied and Environmental Microbiology, Vol. 50, No. 6, p 1357-1360, December 1985. 2 fig, 1 tab, 20 ref.

Descriptors: *Alga-bacterium interactions, Microbiological studies, Culturing techniques, Wastewater analysis, Bacteria, Algae, Wastewater treatment.

Recent studies involving the interactions of bacteria and algae stress the need for consideration of

such microbial associations. The use of solvent extracts of algal cultures in the preparation of test media has been described in several alga-bacterium association studies. These studies depend on the extraction of cellular contents which are not normally excreted and probably simulate algal cell lysis. We were interested in the effects of many coexisting, viable organisms and required a simple system which allowed the simultaneous analysis of interactions of such isolates. Bacteria and algae isolated from a wastewater oxidation pond were inoculated onto opposing surfaces of double-layer agar plates (Lutri plates) to determine the usefulness of such plates for studying microbial interactions. The altered growth characteristics of various algae depending on the species of bacteria on the adjacent medium surface indicated that there was diffusion of extracellular products through the agar. The use of Lutri plates appears to be a promising qualitative method for screening alga-bacterium interactions. This technique is most applicable when the analysis for interactions involves numerous microorganisms of unknown character. (Main-PTT)
W86-05277

DETERMINATION OF CARBONATE TRACES IN HIGH-PURITY WATER BY MEANS OF CHROMATOGRAPHY,

Gesamthochschule Paderborn (Germany, F.R.). Fachbereich Chemie und Chemietechnik.
For primary bibliographic entry see Field 5F.
W86-05281

RAPID DETERMINATION IN WATER OF CHLORIDE, SULPHATE, SULPHITE, SELENITE, SELENATE AND ARSENATE AMONG OTHER INORGANIC AND ORGANIC SOLUTES BY ION CHROMATOGRAPHY WITH UV DETECTION BELOW 195 NM,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Groundwater Research.
R.G. Gerritse, and J. A. Adeney.
Journal of Chromatography, Vol. 347, No. 3, p 419-428, November 1985. 11 fig, 13 ref.

Descriptors: *Ion chromatography, *Chlorides, *Sulfates, *Sulfites, *Selenite, *Selenate, *Arsenate, *Ultraviolet radiation, Resins, Chromatography, Chemical analysis.

Single-column ion chromatography, using silica bonded ion exchangers, with UV detection below 195 nm has great potential for direct trace analysis of many organic and inorganic anions in surface and groundwater. Detection levels at the microgram/l level or less should be attainable by improvement of the stability and energy output of UV sources below 195 nm and, if possible, concentrating the sample on a pre-column before injection. When analyzing anions that are easily oxidized, special attention must be given to both sample preservation and catalytic effects of the high performance liquid chromatography materials in contact with the sample. Especially for iodide large losses occur when the concentration is less than 0.1 mg/l. (Lantz-PTT)
W86-05302

USING ATP TO DETERMINE THE CHLORINE RESISTANCE OF FILAMENTOUS BACTERIA ASSOCIATED WITH ACTIVATED SLUDGE BULKING,

California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-05310

BEHAVIORAL ASSAY FOR ASSESSING EFFECTS OF POLLUTANTS ON FISH CHEMORECEPTION,

Saskatchewan Univ., Saskatoon. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-05325

USE OF DYES AND PROTEINS AS INDICATORS OF VIRUS ADSORPTION TO SOILS,

Arizona Univ., Tucson. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W86-05330

METHYL BROMIDE IN SURFACE DRINKING WATERS,

Azienda Comunale Elettricita ed Acque, Rome (Italy).
L. Cirilli, and A. Borgioli.
Water Research, Vol. 20, No. 3, p 273-275, March 1986. 2 tab, 8 ref.

Descriptors: *Pesticides, *Pollutant identification, *Drinking water, *Gas chromatography, Assays, Surface water, Water analysis, Fungicides, Organic compounds.

A sensitive method for the gas-chromatographic determination of methyl bromide in surface drinking water is reported. The analytical principle is based on the conversion of methyl bromide into methyl iodine by reaction with sodium iodide. Reaction parameters (amount of sodium iodide added, temperature, reaction time and salinity) are reported to provide a simple, precise and sensitive analytical method with a methyl bromide detection threshold of approximately .005 micrograms/liter. (Author's abstract)
W86-05331

DETERMINATION OF THE PERCENTAGE ADSORPTION OF UNKNOWN ORGANIC COMPOUNDS FROM WATER WITH A MULTI-COLUMN TECHNIQUE,

National Inst. for Water Research, Pretoria (South Africa).
P. G. Van Rossum.
Water Research, Vol. 20, No. 3 p 277-281, March 1986. 1 fig, 3 tab, 1 ref.

Descriptors: *Pollutant identification, *Adsorption, *Organic compounds, *Drinking water, Activated carbon, Water analysis, Dyes, Separation technique.

A technique is presented for the determination on a laboratory scale of the percentage removal from water, by an adsorption column system, of one or more organic compounds which give a linear response in the column eluate. This response may be due to a physical, chemical or biological effect. The technique is useful for situations where the concentrations of organic substances in water cannot be determined, either directly on water or in an extract of the water. Formulae for this technique were derived and evaluated with organic compounds which could be determined in water. The use of the technique is illustrated by screening a number of adsorbents for their capacity to remove mutagens from water. The technique is especially useful in situations where the percentage adsorption of unknown organic compounds, which can only be detected in the eluate, has to be determined. (Author's abstract)
W86-05332

SOME RECENT DEVELOPMENTS IN THE CHARACTERIZATION OF ESTUARINE PARTICULATES,

Ecole Normale Superieure, Paris (France). Lab. de Geologie.
J. M. Martin, J. M. Mouchel, and P. Nirel.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 83-92, 1986. 9 fig, 29 ref.

Descriptors: *Estuaries, *Particulate matter, *Chemical properties, *Physical properties, Surface area, Cation exchange, Heat of immersion, Aluminum, Trace elements.

Specific surface area (SSA), cationic exchange capacity (CEC) and heat of immersion (delta H) have been measured on native untreated suspended sediment and after oxidation with 15% H2O2. SSA and delta H have also been measured on samples leached with NaOH and Na-dithionite in order to remove amorphous aluminosilicates. Results indicated that SSA is controlled by amorphous oxides and is related to the Al content of samples and their granulometry, suggesting an almost uniform coating of the detrital core by amorphous oxides. On the other hand, CEC and delta H, which appear to be highly correlated, are controlled by both organic matter and amorphous oxides. Studies on electrophoretic mobility have provided additional data on the excess of charge at the interface between suspended matter and electrolytic medium. Particles in suspension in fresh, sea, and estuarine waters appear ubiquitously to exhibit a small range of negative surface charge. This uniformity is attributed to the presence of organic surface coatings on the particles. Finally, the significance of organic and oxide coatings as carriers of trace metal pollutants is discussed. It is shown that their importance in terms of flux is usually low despite their major role in controlling solid-liquid interactions. (Lantz-PTT)
W86-05360

MOLECULAR AND CELLULAR INDICES OF POLLUTANT EFFECTS AND THEIR USE IN ENVIRONMENTAL IMPACT ASSESSMENT,

Institute for Marine Environmental Research, Plymouth (England).
M. N. Moore, D. M. Lowe, D. R. Livingstone, and D. R. Dixon.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 223-232, 1986. 5 fig, 4 tab, 27 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Environmental assessment, *Chemical analysis, Environmental effects, Chemical properties, Biological properties.

This presentation considers the development of early-warning systems based on biological responses to cell injury at the molecular, subcellular levels of organization, with particular emphasis on the use of marine mussels and periwinkles as sentinel organisms for assessing pollutant effects. Responses discussed include those of the microsomal detoxication system to organic xenobiotics, functional and structural responses of lysosomes to organic and inorganic xenobiotics, quantitative structural alterations in the cells of the digestive and reproductive systems and finally genotoxicity measured using aneuploidy and sister chromatid exchange as indices of chromosomal damage. The systems discussed demonstrate that rapid and highly sensitive diagnostic tests of molecular and cellular reactions to pollutant-induced injury are available or well along the path of development. The advantage of the cellular techniques over others, for assessment of environmental impact lies in the greatly increased sensitivity which can be obtained by concentrating on a single cell type which may be a primary target for pollutants, such as hepatopancreatic digestive cells or oocytes. Although the objective of this work has been largely toxicological, the knowledge gained from the experimental manipulation of molecular and cellular systems has considerable ramifications for many aspects of fundamental biological function and molecular ecology. (Lantz-PTT)
W86-05375

EVALUATION OF THE TOXIC COMPONENTS OF TOXAPHENE IN LAKE MICHIGAN LAKE TROUT,

Michigan State Univ., East Lansing. Pesticide Research Center.
J. W. Gooch, and F. Matsumura.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 33, No. 5, p 844-848, September/October 1985. 4 fig, 1 tab, 25 ref. NA-80AA-D-00072.

Descriptors: *Chlorinated hydrocarbons, *Insecticides, *Trout, *Lake Michigan, *Pollutant identification, Thin layer chromatography, Gas chromatography, Spectroscopy.

Lake trout from Lake Michigan were analyzed for residues of the insecticide toxaphene and two of the primary toxic constituents, toxicants A and B. (Toxicant A: a mixture of 2,2,5-endo, 6-exo, 8,9,9,10- and 2,2,5-endo, 6-exo, 8,8,9,10-octachlorobornanes; toxicant B: 2,2,5-endo, 6-exo, 8,9, 10-heptachlorobornane.) Using various chromatographic techniques and mass spectrometric confirmation, these toxic cogeners were identified in Lake

Michigan trout residues. Levels of Toxicants A and B were roughly one order of magnitude or more less than the estimated total toxaphene residue. Mean levels (microgram/g wet weight) in four lake trout from Lake Michigan were as follows: total toxaphene, 4.3 + or - 3.7; toxicant toxicant A, 0.26 + or - 0.26; and toxicant B, 0.10 + or - 0.07. Since the environmentally derived toxaphene is extensively altered in comparison to the technical material, measurement of toxic congeners may be a more toxicalogically revelant measure of toxaphene-derived residues. (Rochester-PTT)
W86-05400

NATURE OF DICHLORVOS INTOXICATION IN A FRESHWATER PRAWN, MACROBRACHIUM LAMARREI (H. MILNE EDWARDS),
Gorakhpur Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-05412

5B. Sources Of Pollution

USING THE FECAL COLIFORM TEST FOR SEWER AND STORM DRAIN MAINTENANCE,
Rogue Valley Council of Governments, Central Point, OR.
For primary bibliographic entry see Field 5D.
W86-04687

SATELLITE THERMAL OBSERVATION OF OIL SLICKS ON THE PERSIAN GULF,
Japan Marine Science and Technology Center, Yokosuka.
For primary bibliographic entry see Field 7B.
W86-04689

ACID RAIN - A FURTHER LOOK AT THE EVIDENCE,
A. W. Katzenstein.
Power Engineering, Vol. 90, No. 3, p 32-36, March 1986. 5 fig, 3 tab, 8 ref.

Descriptors: *Acid rain, *Sulfates, *Chemistry of precipitation, *Soil chemistry, *Sulfur dioxide emissions, New York, New Hampshire, North Carolina, Lakes, Forests, Ecological effects.

Data on SO2 emissions, sulfate concentrations, and precipitation pH are presented to show that the acidity of rain is far weaker than generally supposed, and that the link between acid rain and ecological damage is even weaker, or nearly nonexistent. Data considered in this discussion include sulfur dioxide emissions, airborne sulfate, rainfall acidity, temporal variations in pH in upstate New York at Mays Point, Albany, and Hinckley, and the pH values for the organic and mineral soil horizons at nine sites in New York, New Hampshire, and North Carolina. In the author's view, the popular belief that acid rain is damaging lakes and forests in eastern North America rests on a narrow selection of the available data, and is not substantiated by the broader body of knowledge that is available. (Author's abstract)
W86-04704

DELINEATING ZONES OF CONTRIBUTION FOR PUBLIC SUPPLY WELLS TO PROTECT GROUND WATER IN NEW ENGLAND,
IEP, Inc., Barnstable, MA.
For primary bibliographic entry see Field 5G.
W86-04705

GAS CHROMATOGRAPHIC EVALUATION OF THE ORGANIC COMPONENTS PRESENT IN THE ATMOSPHERE AT TRACE LEVELS WITH THE AID OF CARBOPACK B FOR PRECONCENTRATION OF THE SAMPLE,
Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. Inquinamento Atmosferico.
For primary bibliographic entry see Field 5A.
W86-04710

BROMINATION AND GAS CHROMATOGRAPHIC DETERMINATION OF MICRO AMOUNTS OF ACROLEIN IN RAIN WATER,
Gifu Prefecture Research Inst. for Environmental Pollution, Yabuta (Japan).
For primary bibliographic entry see Field 5A.
W86-04711

SORPTION OF TRACE METALS BY HUMIC MATERIALS IN SOILS AND NATURAL WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito.
Critical Reviews in Environmental Control, Vol. 16, No. 2, p 193-229, 1986. 4 fig, 3 tab, 137 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Trace metals, *Humic materials, *Soil chemistry, *Natural waters, *Quasiparticle models, Mathematical models, Thermodynamic models, Scatchard model, Buffle model, Henderson-Hasselbalch model, Perdue-Lytle model, Polyelectrolyte model, Gamble model, Molecular structure.

The quasiparticle model description of trace metal sorption by humic substances is discussed from a unified perspective, with a demonstration of the richness and flexibility of the model in its most common variants and a clear definition of its inherent limitations and advantages as an approach to the chemistry of humic materials in relation to trace metals. Topics include: thermodynamic models of trace metal sorption (proton exchange reaction, exchange selectivity coefficients), quasiparticle models (Scatchard model, Buffle model, Henderson-Hasselbalch model, Perdue-Lytle model, polyelectrolyte model, Gamble model, and conditional equilibrium constants). The conclusion is drawn that ordinary sorption experiments are not sensitive to the detailed features of trace metal-humic substance interactions. By their very nature, these experiments provide data only on the average sorption process and the parameters in the quasiparticle models that describe them reflect quasiparticle properties, i.e., averages in some sense over the properties of the many actual modes of metal-humic substance association. These parameters have no intrinsic molecular significance in themselves. That interpretation can be imposed only on the basis of ancillary molecular data. The quasiparticle parameters cannot inherently advance knowledge in the molecular structure of humic substances, but they can provide a basis for accurate metal specification calculations of great environmental importance. (Rochester-PTT)
W86-04715

SINGLET OXYGEN IN SURFACE WATERS. 3. PHOTOCHEMICAL FORMATION AND STEADY-STATE CONCENTRATIONS IN VARIOUS TYPES OF WATERS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2K.
W86-04720

MEASUREMENT OF THE WATER-OCTANOL PARTITION COEFFICIENT OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Syntex Research, Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5A.
W86-04722

DENITRIFICATION IN A LIMESTONE AQUIFER IN RELATION TO THE SECURITY OF LOW-NITRATE GROUNDWATER SUPPLIES,
British Geological Survey, Wallingford (England). Hydrogeology Research Group.
A. R. Lawrence, and S. S. D. Forster.
Institution of Water Engineers and Scientists, Journal, Vol. 40, No. 2, p 159-172, April 1986. 6 fig, 3 tab, 15 ref.

Descriptors: *Limestone aquifers, *Nitrates, *Denitrification, *Groundwater pollution, Dissolved organic carbon, United Kingdom, Jurassic limestone, Thermonuclear Tritium, Oxygen, Bitumen, Bacterial physiology.

Hydrogeological, hydrochemical, and bacterial research on a small unconfined Jurassic limestone aquifer in Lincolnshire, United Kingdom, were undertaken because a severe groundwater nitrate problem exists in this system. Clear evidence of bacteriological denitrification removing nitrate from circulating groundwater: an apparent mass imbalance for nitrate; the presence of thermonuclear tritium, indicating a significant component of post-1963 recharge in the matrix pore-water despite the absence of nitrate; and the existence of substantial populations of potentially denitrifying bacteria on, or close to, fissure walls. The hydrogeological-biochemical model considered most likely to be operative involves: (1) diffusion of dissolved oxygen and nitrate from the mobile water into the limestone matrix pore-water of the fissure walls; (2) consumption of this oxygen or, under microaeroophilic conditions, denitrification by part of the 'standing attached' bacterial population; and (3) utilization of the dissolved organic carbon of the matrix pore-water for bacterial metabolism and the continual replacement of this carbon from the 'bitumen fraction' of the limestone rock itself, possibly through the activity of other related bacteria. (Rochester-PTT)
W86-04751

COPPER (2+), ZINC (2+), AND NICKEL (2+) UPTAKE BY ACTIVATED SLUDGE,
Universidad Complutense de Madrid (Spain). Dept. de Quimica Industrial.
For primary bibliographic entry see Field 5D.
W86-04755

OCCURRENCE OF CADMIUM IN CRABS (CANCER PAGURUS) AND THE ISOLATION AND PROPERTIES OF CADMIUM METALLOTHIONEIN,
Institute of Marine Biochemistry, Aberdeen (Scotland).
For primary bibliographic entry see Field 5A.
W86-04756

CADMIUM-BINDING PROTEIN (METALLOTHIONEIN) IN CARP,
Gifu Pharmaceutical Univ. (Japan). Dept. of Environmental Hygiene.
For primary bibliographic entry see Field 5C.
W86-04757

COPPER-BINDING PROTEINS IN LIVER OF BLUEGILLS EXPOSED TO INCREASED SOLUBLE COPPER UNDER FIELD AND LABORATORY CONDITIONS,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-04758

CADMIUM ACCUMULATION AND PROTEIN BINDING PATTERNS IN TISSUES OF THE RAINBOW TROUT, SALMO GAIRDNERI,
University Coll., Cardiff (Wales). Dept. of Biochemistry.
For primary bibliographic entry see Field 5C.
W86-04759

TRANSITION METAL-BINDING PROTEINS FROM THREE CHESAPEAKE BAY FISH SPECIES,
Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
For primary bibliographic entry see Field 5C.
W86-04760

NMR STUDIES OF CRAB AND PLAICE METALLOTHIONEINS,
Birkbeck Coll., London (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5C.
W86-04761

CADMIUM-BINDING PROTEINS IN THE SCALLOP PECTEN MAXIMUS,

Institute of Marine Biochemistry, Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W86-04764

ENVIRONMENTAL FATE AND AQUATIC TOXICOLOGY STUDIES ON PHTHALATE ESTERS,

Exxon Chemical Co., Baton Rouge, LA.
For primary bibliographic entry see Field 5C.
W86-04765

BENEFITS OF MICROPROCESSOR CONTROL OF CURING OVENS FOR SOLVENT-BASED COATINGS.

Centec Corp., Reston, VA.
Capsule Report EPA 625/2-84-031, September 1984. 13 p, 6 fig, 4 tab.

Descriptors: *Volatility, *Organic solvents, *Solvents, *Industrial wastes, Air pollution, Industrial development, Industrial production, Manufacturing wastes, Metal finishing wastes, Economic aspects.

Various aspects of controlling curing oven emissions are discussed. The development of a microcomputer-based system to control curing oven ventilation by continually monitoring and controlling operating parameters, such as solvent concentrations and pressure, is emphasized. The results of the program, the performance of a prototype system, and applications for other curing operations are highlighted. Results indicate that the microcomputer control system can reduce the total installed investment cost for volatile organic compounds emission control, while at the same time reducing the total fuel coasts for curing and incineration. (Halterman - PTT)
W86-04818

SIMULATED TRANSPORT OF POLYCYCLIC AROMATIC HYDROCARBONS IN ARTIFICAL STREAMS,

Oak Ridge National Lab., TN.
S. M. Bartell, P. F. Landrum, J. P. Giesy, and G. J. Leversee.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE82-013446, Price codes: A03 in paper copy, A01 in microfiche. CONF-810488--4 (1982). 31 p, 4 fig, 2 tab, 36 ref. EPA-79-d-X0290-1. CONF-810488--4, (1982). 31 p, 4 fig, 2 tab, 36 ref. EPA-79-d-X0290-1.

Descriptors: *Aromatic compounds, *Path of pollutants, *Model studies, *Hydrocarbons, Transport, Ecosystems, Simulation analysis, Aquatic environment, Anthracene, Naphthalene, Benzo(a)pyrene.

A model was constructed to predict transport of three polycyclic aromatic hydrocarbons (anthracene, napthalene, and benzo(a)pyrene) in artificial streams. Model processes included volatilization, photolysis, sorption to sediments and particulates, and net accumulation by biota. Simulations of anthracene transport were compared to results of an experiment conducted in the streams. The model realistically predicted the concentration of dissolved anthracene through time and space. Photolytic degradation appeared to be a major pathway of anthracene flux from the streams. (Author's abstract)
W86-04824

BIOACCUMULATION AND EFFECTS ON REPRODUCTION IN AQUATIC ORGANISMS: AN ASSESSMENT OF THE CURRENT LITERATURE,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
T. M. Dillon, and A. B. Gibson.
Miscellaneous Paper D-85-2, September 1985. Final Report. 34 p, 6 tab, 71 ref.

Descriptors: *Bioaccumulation, *Biological magnification, Aquatic animals, Aquatic environment, Water pollution, Water pollution effects, Sublethal effects, Bioassay.

An analysis of results of a literature search conducted to examine the effects on reproduction in aquatic animals is presented in narrative and tabular form. A method is described whereby tissue concentrations can be estimated (using published bioconcentration factors) from data reported in the literature where reproductive effects, but not tissue residue data, were reported. An initial compilation of information is provided for decisionmakers who seek general guidance in interpreting bioaccumulation results, as well as for decisionmakers with site-specific concerns. (Authors's abstract)
W86-04825

FATE OF TRACE METALS IN THE SEDIMENTS OF THE NEW YORK BIGHT,

Wesleyan Univ., Middletown, CT. Dept. of Earth and Environmental Sciences.
M. D. Krom, K. K. Turekian, and N. H. Cutshall.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE83-001896, Price codes: A05 in paper copy, A01 in microfiche. Publication No. 2035, 1982. 74 p, 6 fig, 9 tab, 26 ref. NOAA Agreement Number NA79AA01382.

Descriptors: *Trace metals, *Metals, *Heavy metals, *Fate of pollutants, *New York Bight, Path of pollutants, Sediments, Zinc, Chromium, Copper, Lead, Nickel, Iron, Mercury, Cadmium, Path of pollutants.

In the New York Bight apex there is a very (often > 0.9) high correlation of the concentrations of zinc, chromium, copper, lead, nickel, iron, mercury and cadmium with measures of organic matter concentrations in the silt-plus-clay percentage of the sediment. The sediment is composed principally of two components: a sand with low organic matter and leachable trace metal content and a fine fraction silt or clay that is high in organic matter and leachable trace metals. The latter component contains most of the pollutants. The dredged material dumpsite in the New York Bight apex, the Christiansen Basin, and the Hudson Shelf Valley had especially high concentrations of acid-leachable trace metals. The best estimates for metal fluxes to the sediment suggest that sewage sludge may be the most important source, though all three sources (sewage sludge, dredged material, and airborne particualtes) have fluxes that are of a similar order of magnitude. (Halterman - PTT)
W86-04834

WIND AND WATER EROSION OF WASTE HEAPS AT CONCENTRATION PLANTS FOR POTASSIUM PRODUCTION,

Akademiya Nauk SSSR, Moscow. Soviet Geophysical Committee.
G. V. Bogomolov, V. P. Klementyev, and N. I. Turenkov.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 513-519, 5 ref.

Descriptors: *Erosion, *Water pollution sources, *Spoil banks, Water pollution effects, Fate of pollutants, Mine wastes, Potassium mining, Waste dumps, Wind erosion, Salt, Byelorussia, Brines, Halite, Potassium chloride, Slaine soils, Groundwater pollution, Karst, Cation exchange.

Erosion of potassium mining waste dumps in Byelorussia is a source of water pollution. These are 60-80 m high piles of material, mostly in the 0.25 to 1.0 mm diameter particle size range with a chemical composition of 91-29% halite, 2-4% potassium chloride, and a mixture of insoluble minerals. The wastes consolidate, forming three zones: upper--density of 1.6 g/cu m, porosity of up to 30-35%, and filtratin coefficient of dozens of meters per day; middle--density of 1.75-1.85 g/cu m, porosity up to 20-25%, and filtration coefficient up to 10-0.05 cm/day; and lower--density of 1.85-2.0 g/cu m, porosity up to 10-12%, and filtration coefficient of zero. Karst development at depth and relief forms on the surface are the result of precipitation. Common features include furrows, canals, honeycombs, small alveoles, cones, cirques, V-like depressions, oval wells, and interconnected galleries. Calculated erosion rates reveal that, on a 1 ha plot, brine is produced at 25 cu m/day, and solutional erosion amounts to 3.6 cu m/day. Wind erosion amounts to less than 6 tons/ha/year. Environmental damage from the brines and wind-liberated salt include salinization of agricultural lands, salt infiltration into groundwater, disturbance of soil cation exchange mechanisms, changes in balances of free vs. complexed humic acids. (See also W86-04843) (Cassar - PTT)
W86-04894

SEDIMENT QUALITY RELATED TO DISCHARGE IN A MINERALIZED REGION OF WALES,

University Coll. of Wales, Aberystwyth. Dept. of Geography.
S. B. Bradley.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 341-350, 3 fig, 2 tab, 18 ref.

Descriptors: *Suspended sediments, *Heavy metals, *Rivers, *Sediment transport, *Sediment characteristics, X-ray fluorescence, Wales, Lead, Zinc, Iron, Phosphorus, Sulfur, Copper, Chemical analysis, Magnetic studies.

The characteristics of sediments are determined in an area of known, and previously exploited, mineralization (the River Ystwyth in Wales). To evaluate relationships between sediment levels and associated metal concentrations on their surfaces under various flow conditions, analyses for metals on alluvial sediments in several floods are considered. Analysis for metals has been conducted by X-ray fluorescence spectrometry to determine concentrations of Pb, Zn, Fe, P, and S on suspended sediments, and Pb, Zn, and Cu on channel sediments. This technique is more useful than atomic absorption spectrophotometry, as analysis of surface concentrations is important to determine bioavailability, and exchange between the sediment and dissolved load. Magnetic characteristics of the sediment have also been determined and complement heavy metal analysis. It was found that surface coatings of Pb, Zn, and Cd vary with discharge. (See also W86-04896) (Halterman - PTT)
W86-04929

INFLUENCE OF SEASON, SOURCE AND DISTANCE ON PHYSICAL AND CHEMICAL PROPERTIES OF SUSPENDED SEDIMENT,

National Water Research Inst., Winnipeg (Manitoba).
E. D. Ongley.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 371-383, 5 fig, 2 tab, 37 ref.

Descriptors: *Erosion, *Suspended sediments, *Seasonal variation, Water quality, Water quality management, Sediment transport, Chemical properties, Heavy metals, Nutrients, Sediment load, Organic compounds.

A variety of issues pertinent to suspended solids within fluvial systems are explored. Implications for sampling, and the influence of source, seasonality and distance upon geochemical characteristics are discussed. The geochemically active fraction of the suspended sediment load concentrates nutrients, metals and organic contaminants by several orders of magnitude above ambient water concentrations. Because this sediment fraction tends to be flow dependent, is not depth dependent nor adequately characterized by bottom sediments, collection of suspended sediment for geochemical purposes requires new sampling strategies. Mineralology and major element analysis together with systematic seasonal changes in physical characteristics of suspended matter can assist in identifying seasonally variant source area. Changes in sediment chemistry during downstream transport reflect a suite of biogeochemical processes which should be explicitly considered when assessing the

environmental relevance of sediment quality. Examples from ongoing research projects are presented. (See also W86-04896) (Author's abstract)
W86-04932

PARTICLE SIZE CHARACTERISTICS OF FLUVIAL SUSPENDED SEDIMENT,

Exeter Univ. (England).
M. R. Peart, and D. E. Walling.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 397-407, 6 fig, 1 tab, 24 ref.

Descriptors: *Sediment yield, *Particle size, *Suspended sediment, *Drainage area, Temporal distribution, Nutrients, Fluvial sediments, Erosion Soil types, Water quality, Devon, England.

The role of suspended sediment in the transport of nutrients and contaminants and as a non-point pollutant is discussed, and the importance of data on particle size characteristics of the sediment is emphasized. There is a need for further work on the 'effective' particle size of suspended sediment in transit, on the relationship between the particle size characteristics of suspended sediment, and those of the source material, and on temporal variation in particle size. The relationship between the particle size characteristics of source and sediment is investigated by considering data from a number of small drainage basins in the USA and from two small basins in Devon, England. These demonstrate the importance of soil type and catchment characteristics in controlling this relationship. Temporal variations in the particle size distribution of suspended sediment are considered by highlighting the varied evidence presented in existing studies and by considering in detail data from the two small drainage basins in Devon which exhibit markedly different responses. (See also W86-04896) (Halterman - PTT)
W86-04934

TEMPORAL VARIATION OF SUSPENDED SEDIMENT PROPERTIES,

Exeter Univ. (England).
D. E. Walling, and P. Kane.
IN: Recent Developments in the Explanation and Prediction of Erosion and Sediment Yield, IAHS Publication No. 137, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 409-419, 4 fig, 5 tab, 14 ref.

Descriptors: *Suspended sediment, *Erosion, *Temporal distribution, Water quality, Nutrients, Pollutants, England, Sediment yield, Water sampling, Storm water, Sediment-water interfaces, Exe River, Devon.

Increasing awareness of the role of suspended sediment in the transport of nutrients and contaminants, of the significance of water-sediment interactions as an influence on river water quality and of the importance of sediment in nonpoint pollution, requires an improved understanding of spatial and temporal variations in suspended sediment properties. A study of suspended sediment yields in the basin of the River Exe, Devon, United Kingdom, has attempted to provide information on the nature and extent of of temporal variations in sediment geochemistry. Bulk storm water samples were collected and analysed, and automatic pumping samplers were installed at the measuring stations. Results from four measuring stations relating to major element composition, clay mineralology and organic constituents are presented. Detailed patterns of storm-period variation in sediment properties are illustrated. Certain suspended sediment properties (such as Si, Al, Fe, Ti, and K concentrations) may remain relatively constant over a range of hydrological conditions, but others (particularly those associated with the organic fraction) may exhibit considerable variation. (See also W86-04896) (Halterman - PTT)
W86-04935

CONFIRMATION OF THE WATER QUALITY MODEL CE-QUAL-R1 USING DATA FROM EAU GALLE RESERVOIR, WISCONSIN,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. H. Wlosinski, and C. D. Collins.
Final Report. Technical Report E-85-11, October 1985. 72 p, 19 fig, 3 tab, 33 ref, 3 append.

Descriptors: *Model studies, *CE-QUAL-R1, *Water quality, *Reliability, *Wisconsin, Index, Computer models, Computer programs, Data collections, Reservoirs, Eau Galle Reservoir, Model confirmation.

A one-dimensional model (CE-QUAL-R1) of water quality for reservoirs was evaluated using data collected on the Eau Galle Reservoir, in west-central Wisconsin. Data collected in 1981 were used for calibration; data collected in 1982 were used for confirmation. Graphical and statistical comparisons were made for over 6,500 samples representing 21 variables. The statistical test used for comparing measured versus predicted values was the Reliability Index (RI). The average RI for each variable indicated that precision was always better than a half-order of magnitude, even for variables that ranged over more than three orders of magnitude. Graphs are presented for all variables, including profiles for the date with the poorest predictions (according to the RI). In addition, comparisons of measured and predicted flux values were satisfactory, helping to ensure that reasonable predictions were made for the correct reasons. (Author's abstract)
W86-04941

DISTRIBUTION OF CARBOFURAN IN A RICE-PADDY-FISH MICROECOSYSTEM,

Science and Education Administration, Beltsville, MD. Pesticide Degradation Lab.
A. R. Isensee, and N. Tayaputch.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 6, p 763-769, May 1986. 2 tab, 1 fig, 7 ref.

Descriptors: *Pesticides, *Fish, *Carbofuran, *Rice, *Soil, Ecosystems, Path of pollutants, Toxicity.

The usefulness of a rice-paddy-fish microecosystem to study the fate and behavior of carbofuran in a simulated rice-paddy-fish environment was determined. The potential effects of carbofuran residues on fish were studied. In a glass chamber (45 by 40 by 25 cm, containing 14 liters of water and untreated soil) a top layer of soil treated with 14 C-carbofuran was added at either 6 or 12 ppm to cover rice seeds to a depth of 1 cm. Two weeks after treatment, 50% of the C14 in the treated soil had leached into the untreated soil. After 25 days, <20% of the 14C remained in the untreated soil. At 18 days 14 L of water were added to each tank and 1 day later 14 mosquito fish were added. Two fish samples were taken 1, 3, 7, 15 and 30 days after they were added. The fish analysis is of limited value due to unexplained mortality in both the treated and control specimens. The 14C extracted from fish with acetonitrile accounted for 60% of the total 14C in fish on day 3 and then decreased to about 10% by 30 days. This indicates that 14C was being incorporated into the fish tissue. The total 14C levels increased continuously with time to 30 days. The maximum concentration of carbofuran accounted for 5 to 14% of the total 14C in the fish extracts. The identity of the unextractable 14C is unknown. (Peters-PTT)
W86-04966

HEXABROMOBENZENE AND ITS DEBROMINATED COMPOUNDS IN RIVER AND ESTUARY SEDIMENTS IN JAPAN,

Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 778-784, May 1986. 1 tab, 4 fig, 10 ref.

Descriptors: *Water pollution, *Water analysis, *Sediments, *Rivers, *Estuaries, *Hexabromobenzene, Japan, Osaka, Flame retardants, Halides, Organic compounds, Benzenes, Chemical analysis, Solubility.

A new method for the extraction of hexabromobenzene (HBB) in sediment was used in an attempt to determine more accurately HBB in sediments in Japan. The decomposition products of HBB in the environment were examined. The efficiency of the shake method for the extraction of HBB from sediment was not considered satisfactory. HBB was found in all river sediments collected from Osaka and ranged from 5.6 to 60 microgram/kg. HBB was also found in the estuarine sediments. However, its occurrence and residue levels were much lower than those in river sediments. The brominated benzenes (pentabromobenzene, tetrabromobenzene, and tribromobenzene) were also found in river sediments collected from Osaka. Sediment pollution by HBB was confined to the rivers. The extremely low solubility of HBB may be one of the reasons for this. (Peters-PTT)
W86-04968

CAUSTIC WASTE MENACES JAMAICA,

For primary bibliographic entry see Field 5C.
W86-04970

EVALUATING MATURITY AND METAL TRANSFER OF MSW COMPOST,

Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).
For primary bibliographic entry see Field 5E.
W86-04972

ESTIMATING RISK TO HUMAN HEALTH,

Environmental Protection Agency, Washington, DC. Office of Drinking Water.
C. R. Cothern, W. A. Coniglio, and W. L. Marcus.
Environmental Science and Technology ESTHAG, Vol. 20, No. 2, p 111-116, February 1986. 2 fig, 4 tab, 16 ref.

Descriptors: *Trichloroethylene, *Drinking water, *Risks, *Regulations, *Carcinogens, Public health, Water use, Human physiology, Standards.

The procedure involved in estimating risk to human health posed by a chemical in the environment is discussed, using trichloroethylene (TCE) in drinking water as an example. Approximately 23 million persons are exposed to TCE levels ranging from 0.5 micrograms/liter to 5 micrograms/ liter. The level of exposure to any pollutant present in drinking water is the result of many personal daily choices and several factors over which one has very little direct control, such as age or residence location. Cancer risks projected for TCE are based on assumed lifetime ingestion of 0.03 liter of drinking water for each kilogram of body weight and on the assumption that 100% of the ingested chemical is absorbed. Adults in tropical areas consume twice as much water as the average, as may adults engaged in strenuous activity. Estimates of individual risk rates are based on bioassay data from animal experiments. These data are converted to a continuous human equivalent exposure for use in risk estimates. The population risks of health damage due to TCE were estimated as the product of the number of people affected and the individual risk rate. If a drinking water standard, i.e., maximum contaminant level, for TCE were established at 7.5 microgram/liter, nationwide compliance would result in the avoidance of anywhere from < 1 to 4,000 cases of cancer. (Rochester-PTT)
W86-04977

TIRE FIRE OIL: MONITORING A NEW ENVIRONMENTAL POLLUTANT,

Virginia Dept. of General Services, Richmond. Div. of Consolidated Lab. Services.
For primary bibliographic entry see Field 5A.
W86-04979

CONTROLLING TOXICITY: AN INTEGRATED STRATEGY,

For primary bibliographic entry see Field 5G.
W86-05013

ORGANIC CONTAMINATION: WHISTLING PAST THE GRAVEYARD,

For primary bibliographic entry see Field 5G.
W86-05014

VOLATILE ORGANIC CHEMICAL CONTAMINATION OF GROUNDWATER RESOURCES IN THE U.S.,

J. Barbash, and P. V. Roberts.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 343-348, May 1986. 33 ref.

Descriptors: *Volatile organic compounds, *Groundwater pollution, Drinking water, Path of pollutants, Water pollution sources, Water quality control, Legislation, Organic compounds, Heavy metals, Radioactive wastes.

The severity and extent of groundwater-derived drinking waters by volatile organic compounds (VOCs) in the U.S. are reviewed. A broad range of chemical contaminants have been, or are likely to be, detected in groundwaters, including synthetic and petrogenic organic compounds, toxic metals and radionuclides. A focus on VOCs in this regard is motivated by several factors. First and foremost, many of these compounds show evidence of animal or human carcinogenicity, mutagenicity, or teratogenicity. Second, these compounds are quite persistent in groundwater, because of their relatively low biological and chemical reactivity. This persistence is assisted by low temperatures, absence of light and of contact with the atmosphere, and comparatively low microbial concentrations typical of groundwater environments. Third, by comparison with other organic compounds, VOCs may be tranported for relatively long distances in groundwater, as a result of their relatively weak sorption affinity and their resistance to degradation. Fourth, VOCs are widely used in both domestic and industrial applications that result in subsurface environment dispersion such as degreasing operations, septic system cleaning, pest and weed control, dry cleaning and fumigation. The combination of all of these factors is largely responsible for the frequent occurrence of VOCs in contaminated groundwaters. The severity of this problem, however measured, is likely to get worse before it gets better. Because effective governmental regulation for VOC and other toxic substance disposal has just recently been implemented, VOC entry into the sub-surface has followed a pattern of increase similar to their growth in manufacture and use. Because of the long residence times, which characterize organic solute transport in most groundwater systems, the full impact of the effects of these practices on water supplies has yet to be felt. Even if present efforts to achieve source control are successful, the legacy of past carelessness will prevail for years to come. (Lantz-PTT)
W86-05028

EVOLVING CONCEPTS OF SUBSURFACE CONTAMINANT TRANSPORT,

Robert S. Kerr Environmental Research Lab., Ada, OK.
F. Keely, D. Piwoni, and T. Wilson.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 349-357, May 1986. 2 fig, 4 tab.

Descriptors: *Groundwater movement, *Groundwater pollution, *Path of pollutants, Water analysis, Water quality control, Cost analysis.

The evolution of concepts pertinent to investigating and predicting the movement of contaminants in the subsurface is reviewed. This was done for two reasons. There seems to be widespread overconfidence among those not directly involved in groundwater quality research regarding the ability to predict transport and fate of contaminants in the subsurface. The preceding discussion should place in proper perspective the advances that have been made in recent years, by illustrating the practical implications of conceptual uncertainties that remain unresolved. There is also far too little emphasis on obtaining detailed information about the potential pathways and mechanisms that affect transport at any given site. Additional effort devoted to site-specific characterizations of natural process parameters, rather than relying almost exclusively on chemical analyses of groundwater samples, can significantly improve the quality and cost-effectiveness of the remedial actions at such sites. To underscore this point, condensed summaries are provided of the prinicipal activities, benefits, and shortcomings of three possible site characterization approaches: conventional, state of the art, and state of the science. To furthur illustrate this, a qualitative assessment of desired tradeoffs between characterization and clean-up costs is presented. As illustrated, some investments in specialized equipment and personnel will be needed to make the transition to more sophisticated approaches, but those investments will be more than paid back in reduced clean-up costs. The maximum return on increased investments is expected for the state-of-the-science approach is reached because highly specialized equipment and personnel are not widely available. It is vitally important that this philosophy be considered because the probable benefits in lowered total costs, health risks, and time can be substantial. (Lantz-PTT)
W86-05029

ACID RAIN IN WESTERN EUROPE AND NORTHEASTERN UNITED STATES – A TECHNICAL APPRAISAL,

Ford Motor Co., Dearborn, MI. Chemistry Dept.
W. R. Pierson, and T. Y. Chang.
Critical Reviews in Environmental Control, Vol. 16, No. 2, p 167-192, 1986. 3 tab, 123 ref.

Descriptors: *Acid rain, *Europe, *United States, *Acid deposition, Sulfuric acid, Nitric acid, Acidity, Leaching.

Rain in and downwind of industrial areas in Europe and the northeastern U.S. is acidic. It is more acidic than in remote areas. Acid dry deposition may be at least as important, in terms of amount of acid deposited, as is acid rain. Evidence that acid deposition is causing biological environmental damage is largely circumstantial. Evidence that the acidification of soils and waters is caused primarily by acid deposition is not conclusive. Soil formation (or recovery) is by nature an acidifying process. There is evidence that acid deposition is providing a critical perturbation to acidity of waters in geologically sensitive areas. The forest decline in West Germany and the eastern U.S., the object of much current attention, bears the symptoms of a stress related disease; but the still unidentified stress(es) could be natural, man made, or a combination. Acidity levels in rain are high enough to warrant genuine concern and acid deposition effects on materials are well documented. Motor vehicles contribute about 10% to the European NOx and SOx emissions from which are formed the HNO3 and H2SO4 responsible for rain acidification. Motor vehicles might have a larger role in acidic dry deposition and in the spring snowmelt acidity. The acid rain phenomenon is regional in character because the acidic species and their precursors can be transported through the atmosphere for many hundreds of kilometers before removal by rain. (Peters-PTT)
W86-05039

LEACHING TESTS OF HEAVY METALS STABILIZED WITH PORTLAND CEMENT,

New Hampshire Univ., Durham.
For primary bibliographic entry see Field 5E.
W86-05054

GROUNDWATER PROTECTION STARTS BELOW THE SURFACE,

For primary bibliographic entry see Field 5G.
W86-05063

RELIABLE OZONE DISINFECTION USING OFF-GAS CONTROL,

Canviro Consultants Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5D.
W86-05068

FIELD VALIDATION OF THE GEOHYDROLOGY SIMULATION MODEL, FEWA,

Miami Univ., Coral Gables, FL. Coll. of Engineering.
K. V. Wong, G. Yeh, and E. Davis.
Applied Mathematical Modelling, Vol. 9, No. 5, p 347-352, October 1985. 9 fig, 13 ref.

Descriptors: *Simulation, *Path of pollutants, *Groundwater pollution, *Groundwater pollution, *Geohydrology, *Aquifers, Finite elements, Mathematical models, Computer programs, Love Canal, Conesville, Ohio, Sludge disposal.

The finite element model of water flow through aquifers (FEWA) was validated using field data from the Love Canal area, NY and from the Conesville, Ohio area where the leaching and potential groundwater contaminaiton by disposal of flue gas desulfurization sludge was studied. An equation to predict the distribution of pressure head in an aquifer can be derived, based on the following factors: the continuity of fluid, the continuity of solid, the motion of media and the compressibility of water. The equation describes an initial and boundary value problem and hence the initial hydraulic head values have to be prescribed. The computed data for both cases investigated compare well with the field data, indicating that FEWA provides accurate results. The program FEWA is suitable for use in microcomputers with a user memory of <200 k words. The run time for the Love Canal case was 18 CPU seconds and for the Conesville case, 25 CPU seconds. (Khumbatta-PTT)
W86-05071

SIGNIFICANCE AND DEGREE OF ABIOSESTON CONSUMPTION IN THE FILTER-FEEDER DAPHNIA GALEATA SARS AM. RICHARD (CLADOCERA) IN LAKE BALATON,

Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
L. G. Toth, K. V. Balough, and N. P. Zankai.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 1, p 45-60, 1986. 10 fig, 4 tab, 39 ref.

Descriptors: *Abioseston, *Daphnia, *Lake Balaton, Hungary, Calcium, Magnesium, Lake morphology, Limnology, Biosedimentation, Carbonates, Crustaceans, Chemical analysis, Atomic adsorption spectrophotometry.

In Lake Balaton calcium and magnesium content of gut contents and other tissues of Daphnia galeata SARS am. RICHARD (Cladocera) were investigated with dry weight measurements and atomic absorption spectrophotometry. The mineral matter consumption was estimated, and effect of abioseston on the filtering rate was studied in different seasons. The quantity of seston including calcium and magnesium carbonate strongly depends on weather conditions (e.g. the sediments are stirred up by the waves) and usually high. The abioseston consumption of Daphnia galeata is significant, a 1,000 to 10,000 times enriching of the two metals in the gut contents has happened. The mineral matter content of the guts reached 12.22 to 43.7% of the whole dry weight of the animals. An adult individual depending on its length and on the seston content of the water filtered and defecated 0.100 to 0.425 mg calcium- and magnesium-carbonate, a total of 0.101 to 1.750 mg dry weight inorganic matter a day. Thus Daphnia populations may play an important role in biosedimentation in Lake Balaton. Increases in abioseston content of the water decreases the filtering intensity and feeding of animals, and increases the defecation. 70 to 80% of calcium and magnesium content in the intact animal is due to its gut content. This fact should be taken into account in the studies regarding the accumulation of elements in zooplankton. (Lantz-PTT)
W86-05085

INVESTIGATIONS ABOUT THE FATE OF HEAVY METALS IN LAKES: II. THE ROLE OF IRON AND MANGANESE REMOBILIZATION TO THE HYPOLIMNIC ENRICHMENT OF HEAVY METALS (UNTERSUCHUNGEN ZUM VERHALTEN VON SCHWERMETALLEN IN GEWASSERN: II. DIE BEDEUTUNG DER EISEN- UND MANGAN-REMOBILISIERUNG

FUER DIE HYPOLIMNISCHE ANREICHERUNG VON SCHWERMETALLEN),

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
V. G. Gunkel, and A. Sztraka.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 1, p 91-117, 1986. 9 fig, 1 tab, 11 ref.

Descriptors: *Heavy metals, *Lakes, *Iron, *Manganese, *Hypolimnion, Path of pollutants, Water pollution, Chemical analysis, Oxidation-reduction reactions, Schafersee, Plotzensee, Berlin, West Germany, Chemical reactions, Sediments.

Concentrations of heavy metals in water as well as in the area of sediment and overlying water are given for two urban lakes in Berlin (West) with different man made charges. Water samples as well as undisturbed sediment cores were analyzed using a dialysis sampler to investigate microstratifications of dissolved heavy metals as a consequence of redox chemical reactions. The comparison of Schafersee and Plotzensee indicates an increase of heavy metals (Fe, Mn, Cr, Pb, Zn as well as Al) in the anoxic hypolimnion of the Schafersee during periods of lake stratification in the summer. During this period, a significant coprecipitation of heavy metals with iron oxidizing bacteria was demonstrated elsewhere. Consequently redox chemical reactions with a simultaneous mobilization of coprecipitated heavy metals seem to be important for the hypolimnic enrichment of heavy metals. Investigations of the sediment-overlying water area indicated the occurrence of microstratifications of dissolved heavy metals in the range of the redox decline. The position of these 1.5 cm large enrichment-horizons is dependent on redox potential. During periods of total circulation in Schafersee, concentrations of heavy metals are nearly homogeneous without any stratification of dissolved heavy metals in the sediment-overlying water area. A significant concentration gradient of iron and manganese is built up between sediment and hypolimnion, which leads to corresponding fluxes from the sediments to hypolimnion. Comparisons of heavy metal concentrataions in water during periods of ice cover indicated significantly higher concentrations of heavy metals in the Schafersee. Residue values of sediments also showed a higher charged sediment in Schafersee than in Plotzensee. The mean concentrations of heavy metals in sediment interstial water is not correlated to heavy metal concentrations in the hypolimnion. These results confirm a redox chemical remobilization of iron and manganese, as well as of coprecipitated heavy metals, which leads to a small enrichment-horizon of dissolved heavy metals in the sediment-overlying water area. (Lantz-PTT)
W86-05088

TWO-DIMENSIONAL POLLUTANT MIGRATION IN SOILS OF FINITE DEPTH,

University of Western Ontario, London. Geotechnical Research Centre.
R. K. Rowe, and J. R. Booker.
Canadian Geotechnical Journal CGJOAH, Vol. 22, No. 4, p 429-436, November 1985. 1 tab, 8 fig, 14 ref.

Descriptors: *Path of pollutants, *Aquifers, *Landfills, *Leaching, Analysis, Soil, Diffusion, Advection, Sorption, Desorption, Clays, Groundwater pollution.

A technique for analyzing two-dimensional migration of contaminant from a landfill into a homogeneous clayey layer takes account of the fact that the concentration of contaminant in the landfill will decrease as contaminant is transported into the soil. The analysis also allows for advective-dispersive transport within a permeable stratum (aquifer), which underlies the homogeneous layer. Consideration is given to chemical retardation arising from sorption/desorption of contaminant in the clayey layer. Some of the more important effects arising from the use of a two dimensional analysis are illustrated by means of a limited parametric study. The diffusion of contaminant from the aquifer into the clayey layer substantially reduces the concentrations of contaminant in the groundwater away from the landfill. This phenomenon may be used in specifying the buffer zone required around a landfill to ensure that the groundwater quality outside the buffer is not degraded below allowable levels. There is a critical velocity in the aquifer at which the maximum concentration at a point occurs. At greater or lesser velocities, significantly smaller concentrations may result; thus design for limiting velocities is not necessarily conservative. A lvection is the predominant mechanism for mass transport within the aquifer. (Peters-PTT)
W86-05102

IMPACT OF PHYSIO-CHEMICAL STRESS ON THE TOXIGENICITY OF VIBRIO CHOLERAE,

London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
C. J. Miller, B. S. Drasar, R. G. Feachem, and R. J. Hayes.
Journal of Hygiene, Cambridge, Vol. 96, No. 1, p 49-57, February, 1986. 4 tab, 8 ref.

Descriptors: *Toxigenicity, *Vibrio, *Aquatic bacteria, *Physico-chemical stress, Salinity, Cholera, Hydrogen ion concentration, Human diseases, Chemical properties, Water properties.

The effect of environmental stress on the toxigenicity of Vibrio cholerae 01 was investigated. The expression of toxigenicity by V. cholerae, before and after exposure to various conditions of salinity, pH and cation composition and concentration, has been measured. Exposure to these conditions did not select for hyper- or hypo-toxigenic strains. This suggests that toxigenic V. cholerae 01 are unlikely to lose their toxigenicity when exposed to environmental stress and that V. cholerae toxin production is not a response to the stresses included in this study. These results are consistent with an aquatic reservoir for toxigenic V. cholerae 01, which may be the mechanism for the maintenance of endemic cholera. (Peters-PTT)
W86-05105

IN-SITU STUDY OF THE OCCURRENCE AND RATE OF DENITRIFICATION IN A SHALLOW UNCONFINED SAND AQUIFER,

Research Council of Alberta, Edmonton. Terrain Sciences Dept.
M. R. Trudell, R. W. Gillham, and J. A. Cherry.
Journal of Hydrology, Vol.83, No. 3/4, p 251-268, March 1986. 9 fig, 32 ref.

Descriptors: *Groundwater pollution, *Path of pollutants, *Dentrification, *Sand qquifers, *Groundwater, Rodney, Ontario, Canada, Dissolved oxygen, Nitrate, Bromide, Unconfined aquifers, Tracers, Geochemistry, Organic carbon, Nitrate, Soil bacteria.

Evidence is provided for the occurrence of denitrification in shallow groundwater flow systems; the rate at which denitrification can proceed in the saturated zone was determined; and the effects of denitrification on groundwater chemistry are described. Denitrification in shallow groundwater flow systems has been inferred from the observation of declining nitrate concentrations below the water table, and corresponding decline in dissolved oxygen concentrations. An in situ injection experiment was conducted using a speciallv designed injection-withdrawal-sampling drive point. Nitrate and a conservative tracer (bromide) were added to natural groundwater and injected at 3 m depth into a shallow, unconfined sand aquifer near the town of Rodney, in an agricultural region of southwestern Ontario, Canada. The relative changes in concentration were observed with time. After 356 hours, the concentration of nitrate-N in the injected water declined from the initial 13 g/cu m to less than 0.1 g/cu m. The decrease in nitrate concentration was much greater than the corresponding decrease in the concentration of bromide, confirming a preferential loss of nitrate. The loss of nitrate was preceded by a decline in dissolved oxygen concentration to less than 0.1 g/cu m, and coincided with an increase in bicarbonate concentration of 142 g/cu m. The production of bicarbonate observed in the injection experiment, 2.59 mmol HCO3 (-)/mmol nitrate denitrified, agreed with that calculated using an equilibrium geochemical model of the denitrification process. An increase in the population of denitrifying organisms from 1 to 23 organisms/gram of soil was detected in core samples collected at the depth of injection 169 hours after the start of the experiment. The measured rate of denitrification ranged from 0.0078 to 0.13 g/cu m NO3(-). Nh1(-), and is in reasonable agreement with published rates for saturated soils. The organic carbon source required for denitrification is either dissolved organic carbon or soil organic carbon. Soil organic carbon, at 0.08-0.16% by weight, is adequate to denitrify large amounts of nitrate. (Peters-PTT)
W86-05112

LEACHING OF HERBICIDES THROUGH UNDISTURBED CORES OF A STRUCTURED CLAY SOIL,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
R. E. White, J. S. Dyson, Z. Gerstl, and B. Yaron.
Soil Science Society of America Journal, Vol. 50, No. 2, p 277-283, March/April 1986. 9 fig, 20 ref.

Descriptors: *Clays, *Leaching, *Herbicides, *Path of pollutants, Adsorption, Bromacil, Desorption, Napropamide, Preferential flow, Transfer function, Transport volume, Mathematical analysis, Soil structure, Moisture, Tracers.

The leaching of the herbicides bromacil and napropamide through large undisturbed cores of a structured Evesham clay (Aquic Eutrochrept) was studied under continuous and discontinuous watering regimes and at different initial moisture contents. A greater proportion of both herbicides was leached from initially dry cores than from prewet cores. This was consistent with differences in the amount of herbicide retained in the soil, most of which was retained in the top 0.05 m. Continuous leaching resulted in greater herbicide breakthrough than did the discontinuous treatment. At a continuous input rate of 12 mm/h to initially dry soil, 85% of the applied napropamide and almost 100% of the bromacil were leached out of the soil by one pore volume of water. Chloride was used as a tracer for water flow through the soil. Chloride breakthrough curves were analyzed using a transfer function equation, which yielded the median travel time of a solute molecule in the soil. For an undisturbed structured soil in which water flows preferentially down cracks and channels, even strongly adsorbed chemicals are vulnerable to leaching. (Peters-PTT)
W86-05125

PRACTICAL APPLICATIONS OF GEOLOGICAL METHODS AT THE WEST VALLEY LOW-LEVEL RADIOACTIVE WASTE BURIAL GROUND, WESTERN NEW YORK,

New York State Geological Survey/State Museum, Albany.
For primary bibliographic entry see Field 5E.
W86-05138

ANALYSIS OF GROUNDWATER QUALITY DATA OBTAINED FROM PRIVATE INDIVIDUAL WATER SYSTEMS IN PENNSYLVANIA,

Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 2F.
W86-05140

CONTAMINATION OF FIRN LAYERS BY RADIOACTIVE FISSION PRODUCTS FROM ATMOSPHERIC FALLOUT,

Innsbruck Univ. (Austria). Inst. of Medical Physics.
W. Ambach, and W. Rehwald.
Health Physics, Vol. 49, No. 6, p 1173-1176, December, 1985. 3 fig, 19 ref.

Descriptors: *Water pollution sources, *Meltwater, *Firn, *Radioisotopes, *Drinking water, *Water pollution effects, *Fallout, Tritium, Fate of pollutants, Glaciers, Air pollution, Nuclear explosions, Path of pollutants, Radioactive wastes, Monitoring, Water pollution.

Measurements of gross beta activity and H3 concentrations of firn samples from different regions

can be used to determine environmental contamination by radioactive fallout from nuclear weapons tests in the atmosphere since 1952. The exposure dose to the population due to radioactive fission products in the drinking water supply from glacierized areas is compared to maximum acceptable concentrations derived from ICRP annual limits of intake. Even from heavily contaminated layers, the risk to the population is acceptable for Sr90, Cs137, Pm147, and H3. It was concluded that there exists no major risk to the population from drinking water obtained from activity levels from 1963 due to radioactive decay. In addition, it is suggested that the drinking water supply for the population does not originate from these firn layers only but from a mixture of melt-water from different firn layers. (Geiger-PTT)
W86-05141

TIME VARIATION OF RN 222 PROGENY CONCENTRATIONS IN RAINWATER,

Fukui Univ. (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 2B.
W86-05142

RELATION BETWEEN DRINKING WATER NITRATE AND TOTAL NITRATE INTAKE,

Central Public Health Lab., London (England). Communicable Disease Surveillance Centre.
For primary bibliographic entry see Field 5G.
W86-05149

DETRITUS IN THE LITTORAL OF SEVERAL MASURIAN LAKES (SOURCES AND FATES),

Warsaw Univ. (Poland). Dept. of Hydrobiology.
E. Pieczynska, D. Balcerzak, A. Kolodziejczyk, Z. Olszewski, and J. I. Rybak.
Ekologia Polska, Vol. 32, No. 3., p 387-440, 1984. 19 fig, 17 tab, 139 ref.

Descriptors: *Littoral environment, *Detritus, *Masurian lakes, *Poland, Algae, Mollusks, Leaves, Reeds, Decomposition, Chemical analysis, Ecosystems.

In the littoral of five Masurian Lakes (northern Poland) the origin, quantity, chemical composition, and particle size of detritus were studied. Total decomposition of various plant and animal materials vary from less than 10 days (mollusk tissues and algae) to over 2 years (tree leaves and reed stalks). Animals play an important role in detritus production and transformation (feces production and shredder activity are of greatest significance). (Peters-PTT)
W86-05189

HEAVY METALS IN RAIN WATER COLLECTED OVER THE RESERVOIRS AT KOZLOWA GORA AND GOCZALKOWICE,

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Ekologia Polska, Vol. 32, No. 4, p 679-691, 1984. 2 fig, 4 tab, 21 ref.

Descriptors: *Heavy metals, *Pollutants, *Precipitation, *Path of pollutants, *Reservoirs, Kozlowe Gora Reservoir, Goczalkowice Reservoir, Zinc, Lead, Cadmium, Iron, Silesia, Poland, Manganese, Nickel, Copper, Cobalt, Rainfall, Air pollution.

The level of heavy metals in rainfall samples collected above the surface of the Kozlowa Gora and Goczalkowice reservoirs is discussed. Their content in rain water was regarded as an indicator of environmental pollution. An estimation was made of the metal load brought with the precipitation to the surface of the two bodies of water. A high-degree of pollution with Zn, Pb, Cd, Mn, and Fe metals was determined. The levels in dust emissions in Silesia have also risen for the same metals. Rain water collected above the surface of Kozlowa Gora Reservoir was more heavily contaminated (Zn reached the level of 6375, Pb–420, Cd–72 micrograms/ cu decimeters) than that collected above Goczalkowice Reservoir (Zn up to 967, Pb–63, Cd–24 micrograms/cu decimeter), which is further from plants emitting dusts. At Kozlowa Gora, the load per 1 ha of reservoir area of metals falling with rain was twice as high, and of Zn as much as 7 times higher than that estimated for Goczalkowice Reservoir. (Peters-PTT)
W86-05195

SECOND-ORDER APPROACH FOR THE MODELING OF DISPERSIVE TRANSPORT IN POROUS MEDIA: 1. THEORETICAL DEVELOPMENT,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
A. F. B. Tompson, and W. G. Gray.
Water Resources Research WRERAO, Vol. 22, No. 5, p 591-599, May 1986. 1 fig, 49 ref. DOE Contract No. DE-AC02-83ER60170.

Descriptors: *Path of pollutants, *Dispersion, *Model studies, *Water transfer, *Porous media, Capillary water, Theoretical analysis, Mathematical models, Mathematical studies, Physical properties, Darcy's law, Viscosity.

A new mathematical formulation to represent dispersive transport in porous media has been developed. The new approach is based solidly upon physical principles and avoids the direct constitutive description of dispersion as a purely diffusive phenomenon. For simplicity, the new model was developed for an idealized, two-phase, isotropic porous medium characterized by a constant porosity, fluid viscosity and density, and molecular diffusivity, and it did not include any interphase mass transport. The new equation is a more general representation, which avoids the complications and questions that arise concerning the coefficients associated with the Fickian approximation for dispersion. The approach regards the dispersion term in the macroscopic mass transport equation as a new independent variable f, for which a separate, coupled balance equation is derived. Constitutive relationships are developed for a number of the source terms arising in the averaged dispersion equation. The coupled transport and dispersion equations along with Darcy's law and the macroscopic continuity equation constitute a closed, second-order model for dispersion in a porous medium. (see also W86-05206)(Lantz-PTT)
W86-05205

SECOND-ORDER APPROACH FOR THE MODELING OF DISPERSIVE TRANSPORT IN POROUS MEDIA: 2. APPLICATION TO SOLUTE MOTION IN PIPES AND CAPILLARY TUBES,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
A. F. B. Tompson, and W. G. Gray.
Water Resources Research WRERAO, Vol. 22, No. 5, p 601-614, May 1986. 13 fig, 6 tab, 17 ref, 2 append. DOE Contract No. DE-AC02-83ER60170.

Descriptors: *Path of pollutants, *Dispersion, *Model studies, *Water transfer, *Porous media, *Solute transport, Capillary water, Pipes, Mathematical models, Mathematical studies, Physical properties, Peclet number.

The second-order dispersion model, previously developed was reduced to a one-dimensional form, used to simulate the transport of a solute through a pipe or capillary tube. Such a simplification allowed the model, its coefficients, and its performance to be more easily understood. The equations are fewer and simpler, the microscopic velocity profile is known exactly, and solutions for the mean solute movement, are easily found for comparison of the model results. Numerical experiments allow the dimensionless constitutive coefficients appearing in the model to be evaluated under several flow regimes. Simple functional relationships for these coefficients in terms of the Peclet number, are developed. The model performs well using these scale independent coefficients, even at early times and short travel distances, when the traditional first-order Fickian model is inadequate. (see also W86-05205)(Lantz-PTT)
W86-05206

ROLE OF SUSPENDED SEDIMENT IN IRRIGATION RETURN FLOW CHEMISTRY, SOUTHERN ALBERTA,

Department of Energy, Mines and Resources, Ottawa (Ontario).
H. C. Joseph, and E. D. Ongley.
Water Resources Research WRERAO, Vol. 22, No. 5, p 643-654, May 1986. 5 fig, 5 tab, 32 ref.

Descriptors: *Suspended sediments, *Irrigation-return flow, *Chemical analysis, *Alberta, Water pollution, Path of pollutants, Phosphorus, Heavy metals, Irrigation water, Water quality.

Chemical impact of irrigation return flows upon receiving waters has focused on salt and sediment production. Transport of other agricultural pollutants which are preferentially associated with suspended sediment is largely unknown in western Canada and poorly addressed elsewhere because of the traditional emphasis upon whole and filtered water chemistry. This study examines the role of suspended sediment in the flux of phosphorus and metals from large-scale irrigation in semiarid southern Alberta. It establishes temporal patterns of chemical flux over the irrigation season, identifies the chemical species of phosphorus and metals, and assesses the potential for phosphorus and heavy metal impact from irrigation return flows, upon receiving riverine systems. Suspended sediment plays a major role in transport of phosphorus and heavy metals. Evidence from parent materials, prairie soils, chemical speciation, statistical relationships for metals and for phosphorus, and comparative data for suspended sediment during spring high flow in receiving rivers, when sediments originate from eroding diffuse sources, all indicate that sediment-associated phosphorus and metals in irrigation return flows are not anthropogenically enriched and do not represent an impact beyond that which is naturally occurring in receiving rivers. (Lantz-PTT)
W86-05211

CURVILINEAR FINITE ELEMENT MODEL FOR SIMULATING TWO-WELL TRACER TESTS AND TRANSPORT IN STRATIFIED AQUIFERS,

GeoTrans, Inc., Reston, VA.
For primary bibliographic entry see Field 2F.
W86-05213

SOURCES AND SINKS OF IONS IN A SOFT WATER, ACIDIC LAKE IN FLORIDA,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
L. A. Baker, P. L. Brezonik, and E. S. Edgerton.
Water Resources Research WRERAO, Vol. 22, No. 5, p 715-722, May 1986. 4 fig, 3 tab, 36 ref.

Descriptors: *Acid rain, *Ions, *Acid water, *Florida, *Lakes, *Path of pollutants, McCloud Lake, Precipitation, Chemical analysis, Nitrites, Sulfates, Minerals, Neutralization, Groundwater, Ammonium, Chemical properties.

Fluxes and storage of water and major ions were measured for McCloud Lake, a small, acidic, soft water lake in north-central Florida, that receives 90% of its water input from direct precipitation. Wet precipitation had a volume-weighted pH of 4.5, and accounted for a H(+) flux of 420 eq/ha/yr. The deposition of SO2, NO2, and HNO3 contributed an additional 150-300 eq H(+)/ha/yr. Although precipitation passing through the sandy soils and littoral sediment was neutralized by mineral weathering, sulfate reduction or adsorption, and nitrate immobilization, groundwater was only 10% of the total water input to the lake and neutralized only about 30% of precipitation H(+) input. Compared to atmospheric deposition, lake water shows little enrichment of cations, but is depleted in SO4(2-), NO3(-), and NH4(+), while > 80% of precipitation H(+) is neutralized. The major H(+) neutralization processes within the lake are sulfate reduction (26-34 milliequivalents SO4(2-)/sq m/yr) and NO3(-) immobilization (17-20 milliequivalents NO3(-)/sq m/yr), while NH4(+) immobilization is a small internal source of H(+). Sinks and sources of cations could not be reliably calculated because of uncertainties in

groundwater inputs. Internal H(+)-consuming processes are important in lakes with no surface inlets or outlets, and which receive most of their water from direct precipitation. For these lakes, the rate and extent of acidification is largely determined by a balance between H(+) inputs and H(+) consumption by internal processes. (Lantz-PTT)
W86-05217

FIELD STUDY OF NAPROPAMIDE MOVEMENT THROUGH UNSATURATED SOIL,

California Univ., Riverside. Dept. of Earth Sciences.
W. A. Jury, H. Elabd, and M. Resketo.
Water Resources Research WRERAO, Vol. 22, No. 5, p 749-755, May 1986. 6 fig, 4 tab, 24 ref.

Descriptors: *Napropamide, *Soil water, *Solute transport, *Field tests, *Path of pollutants, Chlorides, Herbicides, Leaching, Chemical analysis, Soil tests, Adsorption, Mathematical analysis.

A pulse of chloride and napropamide, a moderately absorbed herbicide, was applied to a 1.44 ha loamy sand field and leached for 2 weeks with 23 cm net applied water. Thirty-six soil cores were taken on a 6 X 6 grid with a 12-m spacing to a depth of 3 m, and were analyzed for napropamide concentration. Prior to the field leaching experiment, 36 undisturbed soil columns taken on a 6 X 6 grid 1-m adjacent to the field samples were removed and taken to the laboratory for controlled leaching experiments. Subsamples of soil at each site were used to determine adsorption distribution coefficients by the batch equilibrium method. Distribution coefficients were also calculated from the column leaching experiments by fitting the chloride and napropamide breakthrough curves to the solution of the convection dispersion equation. Although these two methods produced similar field average absorption coefficient values and variances, they were uncorrelated. Both the field cores and the laboratory leaching experiments showed evidence of some napropamide movement without apparent adsorption. This was particularly evident in the field experiments, where 73% of the chemical was found above 10-cm, but trace concentrations reached depths down to 180 cm. (Lantz-PTT)
W86-05221

SIMULATION OF FLUID FLOW AND ENERGY TRANSPORT PROCESSES ASSOCIATED WITH HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL IN UNSATURATED ALLUVIUM,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5E.
W86-05223

USE OF STREAM CHEMISTRY TO ESTIMATE HYDROLOGIC PARAMETERS,

Risk Science International, Washington, DC.
For primary bibliographic entry see Field 2K.
W86-05227

ANALYSIS OF VOLATILE HYDROCARBON LOSSES FROM QUIESCENT WATER SOLUTIONS,

California Univ., Los Angeles. Dept. of Chemical Engineering.
V. L. Vilker, and R. S. Parnas.
Water Resources Research WRERAO, Vol. 22, No. 5, p 812-818, May 1986. 6 fig, 1 tab, 16 ref.
EPA Agreement No. CR-807864-02.

Descriptors: *Volatile hydrocarbons, *Fate of pollutants, Path of pollutants, *Water solutions, *Evaporation, Condensation, Mass transfer, Chemical analysis, Carbon tetrachloride, Naphthalene.

An unsteady multicomponent mass transfer analysis is presented for describing the effect of water flux (evaporation or condensation) on trace hydrocarbon losses from quiescent water bodies. For convenience, the analysis is restricted to hydrocarbons for which the Henry's constant is large enough to indicate liquid-phase control of the volatilization process. The analysis shows that the magnitude and direction of water flux, as well as water-air exposure time, determine when water flux increases, decreases, or does not affect volatilization rates. Sample calculations are given for carbon tetrachloride and naphthalene volatilization with simultaneous water evaporation. In these cases, the coupling between volatilization rate and water evaporation becomes important when exposure time is > or = 1 hr and water flux is > 10 mol/h/sq m (5 mm/d evaporation). (Lantz-PTT)
W86-05228

DISPERSION IN FRACTAL FRACTURE NETWORKS,

Disposal Safety, Inc., Washington, DC.
B. Ross.
Water Resources Research WRERAO, Vol. 22, No. 5, p 823-827, May 1986. 1 fig, 8 ref.

Descriptors: *Dispersion, *Geologic fractures, *Fractal fracture network, *Path of pollutants, *Fracture permeability, Solute transport, Mathematical analysis, Transmissivity, Groundwater.

The solute transport equation describes dispersion as a diffusion-like process characterized by a constant dispersivity, which implies that small pulses of contaminants grow as the square root of distance traveled. Measured dispersivities tend to be proportioned to the scale of the measurement, suggesting that the pulses grow in linear proportion to distance. An exponent r, defined by the relationship d is approximately equal to L to the r, where d is the standard deviation of the position of a contaminant particle, and L is the distance traversed, may be used to characterize dispersion. It takes a value 1/2 in the first case and 1 in the second. The movement of a contaminant particle is analyzed here as a random walk through a fracture network composed of fissures of varying transmissivity. If large-transmissivity fractures are sufficiently few, then one calculates r = 1/2. If large-transmissivity fractures are numerous, one obtains 2r = q + 1, where q is an exponent that describes the relationship between fracture spacing and transmissivity. Inserting the reasonable value q = 1 gives r = 1. This theory thus provides a physical basis for the observed scale-dependence of dispersivity. (Lantz-PTT)
W86-05230

DRAINAGE REQUIRED TO MANAGE SALINITY,

Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W86-05232

CHEMICAL REACTIONS WITHIN ROOT ZONE OF ARID ZONE SOILS,

California Univ., Davis. Water Science and Engineering Section.
J. D. Oster, and K. K. Tanji.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 207-217, September 1985. 6 fig, 1 tab, 24 ref.

Descriptors: *Chemical reactions, *Root zone, *Arid zone, *Soil types, *Salinity, Soil water, Chemical precipitation, Adsorption, Irrigation, Leaching, Salts, Irrigation-return flow, Path of pollutants.

The quality of an irrigation water, with respect to total salinity and individual constituents, influences the chemical character of the soil solution and irrigation return flows, including drainage waters. Dissolution, precipitation, adsorption and exchange reactions modify the salt load and composition of return flows. The effects of these reactions can be manipulated by varying the leaching fraction. A change from significant increase in total salts to substantial precipitation of calcite (soil lime) and gypsum can occur as the leaching fraction is reduced. Such a reduction in leaching fraction and the concomitant reduction in applied water will also reduce the rate at which native salts in the return flow pathway are displaced into receiving waters. Methodology exists, as illustrated by several examples, to evaluate the potential consequences of reduced leaching and chemical reactions on soil solution composition, and on the salt loads of irrigation return flows. (Lantz-PTT)
W86-05233

SALT PROBLEMS FROM INCREASED IRRIGATION EFFICIENCY,

Agricultural Research Service, Riverside, CA. Salinity Lab.
J. D. Rhoades.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 218-229, September 1985. 1 fig, 1 tab, 25 ref.

Descriptors: *Salinity, *Irrigation efficiency, *Irrigation effects, Arid zone, Root zone, Saline soils, Sodium, Infiltration, Leaching, Irrigation practices.

To sustain irrigated agriculture, dissolved salts cannot be permitted to build up, in the root zone, to a level which depresses crop growth. Irrigation in arid and semi-arid regions is always associated with salinity. In general, with increased on-farm irrigation efficiency higher concentrations of soluble salts occur in the root zone, but since more salt precipitation occurs within the porous soil matrix the mass of soluble salts is reduced, exchangeable sodium builds up on the cation exchange complex, available water within the soil reservoir decreases, conventional irrigation scheduling techniques become less adequate, and the need for salinity monitoring is increased. In this paper, increased efficiency is taken to mean reducing the amount of infiltrated water that is not used in evapotranspiration and which passes beyond the root zone as deep percolation, i.e., is lost through leaching. These problems are analyzed in this paper. Generally, however, the potential benefits of increasing irrigation efficiency outweigh the potential problems. (Lantz-PTT)
W86-05234

EFFECT OF IRRIGATION EFFICIENCIES ON NITROGEN LEACHING LOSSES,

Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W86-05235

BASIN-WIDE IMPACTS OF IRRIGATION EFFICIENCY,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 3F.
W86-05236

PREDICTING PH, ALKALINITY, AND TOTAL ACIDITY IN STREAM WATER DURING EPISODIC EVENTS,

Pennsylvania State Univ., University Park. School of Forest Resources.
J. A. Lynch, C. M. Hanna, and E. S. Corbett.
Water Resources Research WRERAO, Vol. 22, No. 6, p 905-912, June 1986. 3 fig, 6 tab, 19 ref.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Alkalinity, *Streams, Water pollution effects, Chemical analysis, Headwaters, Pennsylvania, Precipitation chemistry, Acidic water, Model studies, Watersheds, Snowmelt.

Acid precipitation was found to influence significantly the chemistry of a small headwater stream in central Pennsylvania. Stream discharge during 18 storms was sampled and analyzed for pH, bicarbonate alkalinity, and titratable acidity levels. The precipitation events varied considerably in their amounts, durations, and intensities and also produced highly variable hydrologic responses from the watershed. Stream pH and alkalinity levels reacted inversely to stream discharge during storm flow periods, their lowest levels occurring almost simultaneously with peak flow. In comparison, storm flow acidity was directly related to the discharge rate. Models predicting the fluctuations in storm flow pH, alkalinity, and total acidity were developed. These models, which explained 88, 91,

and 80% of the variations in stream pH, alkalinity, and acidity, respectively, used as their independent variables such hydrometeorological parameters as antecedent flow rate, time to peak, peak flow rate, quick flow volume, and storm precipitation amounts. These results suggest strongly that the hydrologic response of a watershed has potential application as an index of stream sensitivity to changes in pH, alkalinity, and acidity during acid precipitation/snowmelt events. (Lantz-PTT)
W86-05250

EQUIVALENT FORMULATIONS FOR SOLUTE AND WATER MOVEMENT IN SOILS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
For primary bibliographic entry see Field 2G.
W86-05251

VELOCITY EFFECTS ON DISPERSION IN POROUS MEDIA WITH A SINGLE HETEROGENEITY,

Purdue Univ., Lafayette, IN. School of Chemical Engineering.
M. A. Cala, and R. A. Greenkorn.
Water Resources Research WRERAO, Vol. 22, No. 6, p 919-926, June 1986. 13 fig, 1 tab, 11 ref.

Descriptors: *Porous media, *Heterogeneity, *Path of pollutants, *Dispersivity, *Flow velocity, Simulation analysis, Permeability.

Regime changes during multifluid miscible displacement through a porous medium, containing a single heterogeneity were simulated. At very low fluid velocities (approximately 0.00005 cm/s), the displacement is predominantly controlled by diffusion. Increasing the fluid velocity caused inter-pore convection to become a factor. The third regime is at even higher velocities (0.00005 to 5000 cm/s) and is predominantly controlled by mechanical dispersion. Analysis of simulations for heterogeneous flow fields reveals a fourth regime where flow is governed by megascopic dispersion caused by heterogeneity. Flow in this regime appears to be non-Fickian. A maximum Fickian velocity was determined for various parameters of the heterogeneous flow field. The simulations show that dispersion increases significantly in a porous medium containing a single heterogeneity relative to a homogeneous medium. This heterogeneous effect is apparent in all four regimes: molecular, microscopic, macroscopic, and megascopic. The permeability ratio has the most effect, causing dispersion to increase by up to two orders of magnitude relative to the homogeneous case. Length ratio has some effect although it is not as significant as permeability ratio. Size ratio has the least effect. At fluid velocities greater than 0.001 cm/s, megascopic convection dominates and dispersion appears to be non-Fickian for permeability ratios less than 0.8 or greater than 2. (Lantz-PTT)
W86-05252

ORTHOGONAL-UPSTREAM FINITE ELEMENT APPROACH TO MODELING AQUIFER CONTAMINANT TRANSPORT,

Oak Ridge National Lab., TN. Environmental Sciences Div.
G. T. Yeh.
Water Resources Research WRERAO, Vol. 22, No. 6, p 952-964, June 1986. 6 fig, 3 tab, 35 ref.
DOE Contract No. DE-AC05-840R21400.

Descriptors: *Finite element method, *Aquifers, *Groundwater pollution, Model studies, *Groundwater movement, *Path of pollutants, Mathematical studies, Peclet numbers.

An orthogonal-upstream weighting (OUW) finite element scheme, which will result in a matrix amenable to point successive overrelaxation (SOR) solution strategies, is presented for approximating the aquifer contaminant-transport equation. This scheme differs from the standard Galerkin weighting (GW) and nonorthogonal-upstream weighting (NUW) schemes in that the set of weighting functions is required to be orthogonal to the set of basis functions. These weighting functions are referred to as OUW functions and are developed for line, quadrilateral, and triangular elements. Application of those OUW functions to aquifer contaminant-transport equations results in matrix equations that can be solved using the SOR iteration technique to yield convergent solutions under all Peclet numbers. Three simple problems are used to test numerical performance and computational efficiency of the OUW finite element scheme. The proposed scheme yields comparable accuracy as the NUW finite element schemes. However, the proposed scheme is the only one among four options presented in this paper that leads to convergent SOR simulations under all transport conditions. Because the SOR iteration requires much less CPU memory and CPU time than the direct elimination solution for large problems, the OUW scheme, being susceptible to the SOR iteration, provides an alternative to solve large scale aquifer contaminant-transport problems. (Lantz-PTT)
W86-05256

SYNOPSIS OF ANALYTIC SOLUTIONS FOR THE TEMPERATURE DISTRIBUTION IN A RIVER DOWNSTREAM FROM A DAM OR RESERVOIR,

Alaska Univ., Fairbanks. Geophysical Inst.
J. P. Gosink.
Water Resources Research WRERAO, Vol. 22, No. 6, p 979-983, June 1986. 1 fig, 2 tab, 22 ref.

Descriptors: *Thermal pollution, *Rivers, *Dams, *Reservoirs, Temperature distribution, Mathematical equations, Convection, River flow, River depth, Heat transfer.

A synopsis of analytic solutions for river temperature downstream from a dam is presented. Transient, convective, and diffusive effects are considered as well as periodic and spatially varying surface heat exchange. Two new solutions of the transient equation for heat transport in a river with fluctuating surface heat exchange have been developed. The first describes the transient-convective temperature response in a river subjected to a combination of fluctuating and spatially varying surface heat transfer. The second new solution represents a complete transient-convective-diffusive solution to the equation for river temperature when surface heat exchange is dependent upon periodically varying meteorological conditions. In both of these new solutions the effects of the time varying atmospheric conditions are apparent. The river response lags behind the atmospheric forcing, with the lag increasing with river depth and forcing frequency, and decreasing with the heat exchange coefficient. The amplitude of the river thermal response to atmospheric forcing decreases with forcing frequency and surface heat exchange coefficient, and with river depth. (Lantz-PTT)
W86-05258

RESIDUES OF ORGANOCHLORINE INSECTICIDES IN FISH FROM POLLUTED WATER,

Biological Research Center, Baghdad (Iraq).
M. A. Al-Omar, N. H. Al-Ogaily, and D. A. Shebil.
Bulletin of Environmental Contamination and Toxicolology, Vol 36, No. 1, p 109-113, January 1986. 1 tab, 16 ref.

Descriptors: *Organochlorine insecticides, *Water pollution effect, *Fish, Gas chromatography, Iraq, *Path of pollutants, Toxicity, Diyala River, Baghdad, Tissue analysis, Chlordane, DDT.

Before they were banned in 1976, organochlorine (OC) insecticides were extensively used in Iraq in a malaria control program and agricultural practices. The purpose of the present work is to find out the OC residue levels in different fish species collected from a polluted region in Diyala River where the largest sewage treatment plant in Baghdad discharges treated water. Seventy fish 1-3 years old, of 11 different species were collected from the lower part of Diyala River. Muscular tissue and fat were analyzed by gas chromatography. All OC residues showed high percentage of occurance 90-100%. Concentrations detected were also high especially those of chlordane and DDT where exceptionally high average levels of these two insecticides were detected particularly in low fat content group. Generally speaking higher levels of all insecticide residues were detected in low fat content fish. (Main-PTT)
W86-05264

IMPAIRMENT OF THYROID ACTIVITY IN SAROTHERODON MOSSAMBICUS DUE TO DDT TREATMENT,

Government Coll., Sendhwa (India). Dept. of Zoology.
L. Shukla and, and A. K. Pandey.
Bulletin of Environmental Contamination and Toxicology, Vol. 36, No. 1, p 132-139, January 1986. 14 fig, 2 tab, 17 ref.

Descriptors: *Thyroid activity, *Sarotherodon mossambicus, *DDT, Tissue analysis, Fish physiology, Toxicity, Water pollution effects, Insecticides.

Involvement of fish thyroid in the altered metabolic rate and reproduction in response to organochlorine insecticide has not been well documented. This study was undertaken to know the histology and histochemical responses of the thyroid gland of Sarotherodon mossambicus to DDT at low concentration. Fifty healthy and sexually mature Sarotherodon mossambicus were brought from the local fisheries pond. The DDT (1,1,1-Trichloro-2,2-bis(p-chlorophenyl)ethane) 50% Tafarol was dissolved in acetone and added to 20 liters of dechlorinated water making 0.001 ppm. The test solution was renewed on every third day. On the 10th day, the fish were decapitated. The thyroid diameter (follicular and nuclear) were determined, and the E/T ratio (Height of thyroid epithelium/diameter of thyroid follicles) was calculated. The different thyroid follicles (THF) in DDT treated fish exhibited well marked changes in their organization and structure. DDT appears to produce the antagonistic effects in the thyroid in this fish. The results have similarity to the characteristics of thyroidectomy, therefore it is evident that DDT interferes with the thyroid physiology. (Main-PTT)
W86-05267

IN VIVO METABOLISM OF FENITROTHION (0,0-DIMETHYL-0-(4-NITRO-M-TOLYL) PHOSPHOROTHIOATE) IN FRESH WATER TELEOST (TILAPIA MOSSAMBICA),

Regional Research Lab., Hyderabad (India). Entomology and Toxicology Div.
F. Anjum and, and S. S. H. Qadri.
Bulletin of Environmental Contamination and Toxicology, Vol. 36, No. 1, p 140-145, January 1986. 4 fig, 2 tab, 8 ref.

Descriptors: *Fenitrothion, *Teleosts, *Metabolism, Chromatography, Tissue analysis, Toxicity, Biotransformation, Flour beetles.

Fenitrothion is widely used against insect pests leading to the exposure of non-target organisms as well. It was decided to study fenitrothion metabolism in Tilapia mossambica (teleost) in order to understand the metabolic processes involved in the biotransformation of fenitrothion. Prestarved teleosts were divided into seven batches of ten. Six batches were exposed to 200 mg/kg body weight of fenitrothion for 24 hours. The liver, kidney and brain were dissected out. Fenitrothion and its metabolites were extracted and the number of metabolites were determined by analytical TLC. Fenitrothion was separated from its metabolites by HPLC and solvent extract was loaded on preparative silica gel TLC for separation of metabolites. Flour beetles were used to test the toxicity of fenitrothion and its metabolites extracted. The present data on in vivo metabolism of fenitrothion is indicative of oxidative-desulfuration, O-demethylation, cleavage of P-O-aryl linkage and amino derivatives acetyl fenitrothion and fenitrooxon as routes of metabolic pathway in liver, brain and kidney. (Main-PTT)
W86-05268

BIOGEOCHEMISTRY OF PCBS IN INTERSTITIAL WATERS OF A COASTAL MARINE SEDIMENT,

Woods Hole Oceanographic Institution, MA.

Dept. of Chemistry.
B. J. Brownawell, and J. W. Farrington.
Geochimica et Cosmochimica Acta, Vol. 50, No. 1, p 157-169, January 1986. 5 fig, 3 tab, 74 ref.

Descriptors: *Geochemistry, *Marine sediments, *Polychlorinated biphenyls, *Interstitial water, Fate of pollutants, Organic compounds, Pollutants, Sediment-water interface, Sediments, Sorption, New Bedford Harbor, Massachusetts, Arochlor, Path of pollutants, Dissolved solids, Microbial degradation.

Polychlorinated biphenyls (PCBs) were measured in pore waters and sediments at a site in New Bedford Harbor, Massachusetts to study partitioning processes of hydrophobic organic compounds in marine sediments. Interstitial water concentrations of total PCBs, expressed as Aroclor 1254, increased with depth in the sediments with a maximum concentration of 17.1 micrograms/L at 9-11 cm. Apparent distribution coefficients of individual chlorobiphenyls decreased with depth and were related to dissolved organic carbon levels. Results from this site suggest that most of the PCBs in pore waters are sorbed to organic colloids. A simple three-phase equilibrium sorption model can explain many features of the data, for example the decrease of the apparent distribution coefficients with depth in the sediments for all of the chlorobiphenyls measured. Changes in the composition of individual chlorobiphenyls in the sediments were also apparent. Microbial degradation appears to be responsible for large relative depletions of several PCBs with depth in the core (Mason-PTT).)
W86-05292

MEASUREMENT OF IMPORTANT PARAMETERS DETERMINING AQUEOUS PHASE DIFFUSION RATES THROUGH CRYSTALLINE ROCK MATRICES,

UKAEA Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
M. H. Bradbury, and A. Green.
Journal of Hydrology, Vol. 82, No. 1/2, p 39-55, November 1985. 6 fig, 3 tab, 13 ref.

Descriptors: *Diffusion rates, *Crystalline rocks, *Rock matrices, Radioactive waste disposal, Porous media, Iodide ion diffusion, Path of pollutants, Groundwater movement, Granite, Porosity, Solute transport.

Theoretical studies on the migration of radionuclides in groundwater circulating through fissure networks have indicated the importance of diffusion into the rock matrix as a retardation mechanism. Matrix diffusion will retard all radionuclides but has particular relevance to those exhibiting little or no sorption and which would otherwise migrate at or near groundwater velocity. Diffusion measurements were made with four types of granite and a discrepancy between experiment and theory was observed. Two types of porosity are believed present: through-transport porosity, which carries the diffusion flux across the sample, and dead-end porosity, comprised of cross-linking pores and pores closed at one end. (Author's abstract)
W86-05297

TRACE METALS IN MARINE SURFACE SEDIMENTS OF THE PALOS VERDES SHELF, 1974 TO 1980,

Los Angeles County Sanitation Districts, Whittier, CA.
J. K. Stull, and R. B. Baird.
Water Pollution Control Federation Journal, Vol. 57, No. 8, p 833-840, August 1985. 12 fig, 2 tab, 31 ref.

Descriptors: *Trace metals, *Marine sediments, *Continental shelf, Organic nitrogen, Wastewater treatment, Heavy metals, Suspended solids, Benthic fauna, Water pollution effects, Pacific Ocean.

Wastewater treatment for 4 million people in Los Angeles County, California yields 350 million gallons of effluent, containing 250 metric tons of suspended solids per day. The effluent is discharged into the Pacific Ocean through two submarine outfalls equipped with multiport diffusers 3 km offshore at a depth of 60 m. Between 1973 and 1979 emission rates and sediment concentrations were substantially lowered. Chemical, physical, and biological oceanographic processes appear to have played important roles in the changes. (McFarlane-PTT)
W86-05307

CHEMICAL QUALITY OF PERCHED SEPTIC TANK EFFLUENT FOR PLANT USE AND RECHARGE,

Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 5D.
W86-05311

EVIDENCE FOR MOVEMENT OF HEAVY METALS IN A SOIL IRRIGATED WITH UNTREATED WASTEWATER,

Chile Univ., Santiago. Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5E.
W86-05322

BIOCONCENTRATION OF LIPOPHILIC COMPOUNDS BY SOME AQUATIC ORGANISMS,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. W. Hawker, and D. W. Connell.
Ecotoxicology and Environmental Safety, Vol. 11, No. 2, p 184-197, April 1986. 7 fig, 2 tab, 35 ref.

Descriptors: *Fate of pollutants, *Biological magnification, *Bioaccumulation, *Fish, *Mollusks, *Crustaceans, Organic compounds, Water pollution effects, Path of pollutants, Aquatic animals, Pesticides, Aromatic hydrocarbons, Hydrocarbons, Daphnia, Mathematical studies, Theoretical analysis.

Prediction of the bioconcentration of persistent chemicals from water by various aquatic organisms has important applications in the management of hazardous chemicals. The parameter usually used in assessing this behavior is the bioconcentration factor which is defined as the ratio of the concentration of the chemical in the organism to the concentration in the surrounding water. The bioconcentration factor has been found to correlate well with the octanol/water partition coefficient (P) for nondegradable lipophilic organic chemicals which have achieved equilibrium between the biotic and aqueous phases. With nondegradable, lipohilic compounds having log P values ranging from 2 to 6, direct linear relationships have been found between the logarithms of the equilibrium bioconcentration factors, and also reciprocal clearance rate constants, with log P for daphnids and molluscs. These relationships permit calculation of the times required for equilibrium and significant bioconcentration of lipophilic substances. Compared with fish, these time periods are successively shorter for molluscs, then daphnids. The equilibrium biotic concentration decreased with increasing chemical hydrophobicity for both molluscs and daphnids. In addition, new linear relationships between the logarithm of the bioconcentration factor and log P were found for compounds not attaining equilibrium within finite exposure times. (Geiger-PTT)
W86-05324

EFFECT OF AL AND HUMIC ACIDS ON THE 241 AM ADSORPTION ON THE EXOSKELETON OF THE CRAYFISH ASTACUS LEPTODACTYLUS ESCHSCHOLTZ,

Antwerp Univ., Wilrijk (Belgium).
J. Bierkens, J. H. D. Vangenechten, S. Van Puymbroeck, and O. L. J. Vanderborght.
Health Physics, Vol. 50, No. 2, p 277-280, February 1986. 1 fig, 1 tab, 13 ref, EEC Contract BIO-329-B.

Descriptors: *Fate of pollutants, *Humic acids, *Adsorption, *Bioaccumulation, *Aluminum, *Crayfish, Crustaceans, Water pollution effects, Radioisotopes, Radioactive wastes, Ecological Accumulation.

The effect of Al and humic acids on the adsorption of Am 241 by the crayfish exoskeleton (carapace) was studied in plastic containers filled with 1 liter each of exposure. The composition of these media was chosen to study the effects of humic acids in boglake sediments alone in varying concentrations and in combination with varying concentrations of Al. The radioactivity associated with the carapaces after eight days exposure to Am 241 was measured on a gamma spectrophotometer. Results indicated that when Al or humic acid are added to demineralized water, they both cause decreased adsorption. When both Al and humic acid are in solution, the concentration of the Al determines the level of Am 241 adsorption on the exoskeleton parts. In the case of Al, a conglomeration and precipitation of hydrolyzed Al and Am 241 is supposed resulting in a low radioactivity in the water, a high Am 241 particulate formation and low Am 241 adsorption. The presence of humic acid on the other hand, results in an apparently higher solubility of Am 241 in the water, a decreased percentage of Am 241 particulates and also a decreased adsorption on the carapaces. (Geiger-PTT)
W86-05328

USE OF DYES AND PROTEINS AS INDICATORS OF VIRUS ADSORPTION TO SOILS,

Arizona Univ., Tucson. Dept. of Microbiology.
S. N. Singh, M. Bassous, C. P. Gerba, and L. M. Kelley.
Water Research, Vol. 20, No. 3, p 267-272, Mar 1986. 6 tab, 12 ref.

Descriptors: *Viruses, *Tracers, *Path of pollution, *Adsorption, *Groundwater pollution, *Water pollution sources, *Soil types, Dyes, Proteins, Fate of pollutants, Indicators, Septic tanks.

Outbreaks of viral diseases have been associated with contamination of groundwater sources by viral migration from septic tanks. A better understanding of virus adsorption to soils might help elucidate the possible mechanism of subsurface virus migration and ultimate contamination of groundwater sources. The present investigation sought a simple test that could predict virus adsorption to soils. Two dyes, methylene blue (positively charged) and amaranth (negatively charged), and three proteins, ferritin, myoglobin and cytochrome-c, were evaluated as potential indicators of virus adsorption to 20 different soils. The results indicated that no single indicator could predict the adsorption pattern for the different viruses which were evaluated with their similarities to adsorption of ferritin and cytochrome-c to soils. The other three indicators, myoglobin, methylene blue and amaranth did not significantly correlate with virus adsorption. Therefore, it is proposed that a two protein indicator system could be used to evaluate soils to predict virus adsorption. (Author's abstract)
W86-05330

MICROBIAL TRANSFORMATIONS OF ARSENIC IN LAKE OHAKURI, NEW ZEALAND,

Waikato Univ., Hamilton (New Zealand). Dept. of Biological Sciences.
M. C. Freeman, J. Aggett, and G. O'Brien.
Water Research, Vol. 20, No. 3 p 283-294, 8 fig, 1 tab, 48 ref.

Descriptors: *Arsenic, *Arsenic compounds, *Microbial degradation, *Fate of pollutants, *Lakes, Lake sediments, Biodegradation, Organic compounds, Phytoplankton, Fungi, Aquatic fungi, Yeasts.

The concentration and chemical speciation of arsenic in the waters and sediments of Lake Ohakuri, New Zealand were examined. Mixed microbial populations from the sediments were tested in vitro for their ability to mediate redox transformation of inorganic arsenic. Under aerobic conditions the mixed microbial cultures were found to be able to reduce arsenic (V) to arsenic (III) and also to oxidize arsenic (III) to arsenic (V). Under anaerobic conditions only reduction of arsenic (V) to

arsenic (III) was observed. Four species of sediment fungi were isolated, grown aerobically and all were found capable of reducing arsenic (V) to arsenic (III). The role of microbial heterotrophs in determining the observed mobility and specification of arsenic in Lake Ohakuri is discussed. (Author's abstract)
W86-05333

EFFECTS OF NATURAL AND SYNTHETIC SURFACE ACTIVE SUBSTANCES ON THE ELECTROCHEMICAL REDUCTION OF CADMIUM IN NATURAL WATERS,

Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
Z. Kozarac, B. Cosovic, and V. Vojvodic.
Water Research, Vol. 20, No. 3 p 295-300, March 1986. 3 fig, 5 tab, 24 ref.

Descriptors: *Fate of pollutants, *Cadmium, *Surfactants, *Organic compounds, *Electrochemistry, Electrodes, Decomposition, Oxidation-reduction potential, Heavy metals, Industrial wastewater, Seawater, Rivers.

Effects of surface active substances, natural and synthetic, in selected samples of seawater, river water and industrial effluents on the oxidation-reduction processes of cadmium have been studied by electrochemical methods and compared with the behavior of different model compounds. Kinetic parameters, transfer coefficient alpha and apparent standard rate constant of the cadmium electrode reaction have been estimated from the shape and the height of the corresponding differential pulse voltammograms using theoretical curves obtained by digital simulation of the electrode process. The measure of the inhibition effect of surface active substances on the electrode reaction of cadmium was expressed in terms of the ratio of the rate constants determined in the presence and in the absence of surface active substances. It was found that the degree of inhibition depends on the concentration and type of surface active substances and on the pH of solution. (Author's abstract)
W86-05334

REGIONAL PH-ALKALINITY RELATIONSHIP,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W86-05338

NTA BIODEGRADATION AND REMOVAL IN SUBSURFACE SANDY SOIL,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
N. H. Baek, and N. L. Clesceri.
Water Research, Vol. 20, No. 3, p 345-349, March 1986. 5 fig, 10 ref.

Descriptors: *Biodegradation, *Detergents, *Sand, *Separation techniques, *Septic tanks, Soil columns, Fate of pollutants, Path of pollutants, Subsoil, Microbial degradation, Soil bacteria, Microorganisms, Degradation, Adsorption.

This lab-scale study examined the biodegradation and removal of nitrilotriacetic acid (NTA) in the subsurface environment, mainly sandy soils. Batch tests indicated that NTA adsorption on the sandy soils played a minor role in its removal in these soils. Removal of NTA was investigated in 50.5 mm (in diameter) by 1.17 m long soil columns under unsaturated conditions at 15 degrees. Septic tank effluent containing 20 mg NTA/1 was dosed to soil columns four times a day at an overall loading rate of 1 gpd/sq ft for a 43-day period. This feed NTA concentration was routinely reduced to a steady-state concentration of 0.1 mg/1 by passage through the 1.17 m of soil, after an indigenous soil microflora became sufficiently established over a 25 day period. In addition, the results of samples taken on day 21 demonstrated that greater than 75% removal of NTA can be expected in a soil depth of less than one-third meter. (Author's abstract)
W86-05339

TEMPORAL AND SPATIAL TRENDS IN METAL LOADINGS TO SEDIMENTS OF THE TURKEY LAKES, ONTARIO,

Department of Fisheries and Oceans, Owen Sound (Ontario). Great Lakes Fisheries Research Branch.
M. G. Johnson, L. R. Culp, and S. E. George.
Canadian Journal of Fisheries and Aquatic Science, Vol. 43, No. 3, p 754-762, March 1986. 5 fig, 5 tab, 23 ref.

Descriptors: *Core samples, *Bottom sediments, *Pollution loads, *Metals, *Turkey Lakes, *Ontario, *Sediments, Temporal distribution, Spatial distribution, Sault Ste. Marie, Aluminum, Iron, Manganese, Copper, Nickel, Zinc, Lead, Cadmium, Chromium, Mercury, Water pollution, Lakes, Accumulation, Precipitation.

Sediment core profiles of metal concentration and 210-Pb activity were used to calculate metal loadings of five small Precambrian Shield lakes of the Turkey Lakes system near Sault Ste. Marie, Ontario. Background, natural concentrations (pre-1900) of Al, Fe, Mn, Cu, Ni, Zn, Pb, Cd, Cr, and Hg reflected concentrations in local bedrock. Surface loading rates of Al, Cu, Ni, and Cr were not significantly greater than background rates. Fe and Mn enrichment of surface sediment and the downstream accumulation in the five lakes indicated the mobility of these elements. Four metals, Pb, Cd, Hg, and Zn, had significant anthropogenic inputs, which averaged 18, 1.7, 1.4, and 0.6 times background loadings, respectively. Precipitation loadings of Pb and Hg were several times greater than background accumulation in lake sediments. Precipitation loadings of Cu, Ni, Zn, and Cd were the same order of magnitude as background inputs to sediments. (Author's abstract)
W86-05346

STANDARDIZATION OF WATER QUALITY INFORMATION IN A TIDAL RIVER,

Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
T. Kusuda, T. Futawatari, Y. Awaya, K. Koga, and K. Furumoto.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 43-52, 1986. 17 fig, 5 tab, 2 ref.

Descriptors: *Water quality standards, *Tidal rivers, Japan, *Water sampling, *Monitoring, Water analysis, Rokkaku River, Water depth.

The objectives of this study were to clarify the defects of the current tidal river monitoring method and to propose a better method for obtaining water quality data (of high quality) for tidal rivers. In Japan, the Water Quality Standards for rivers also apply to tidal rivers. The method indicates that water should be sampled from 20% of the water depth below the water surface at an arbitrary time once a month. Since this method was apparently inappropriate to understand the dynamics and water profiles in tidal rivers, field surveys were conducted at different times in the River Rokkaku, which is well mixed. The results showed that the turbidity maximum moved up- and down-stream more than 10 km due to the tide. Based on this fact, a new monitoring method was proposed, which required water samples to be taken with a certain time lag from a high tide at a station. This newly proposed method improved the quality of information on water quality and made data available for ascertaining long term trends. Modifications to the new method are suggested to further improve the quality of water quality data for tidal rivers. (Lantz-PTT)
W86-05356

MONITORING EFFECTS OF CATCHMENT MANAGEMENT PRACTICES ON PHOSPHORUS LOADS INTO THE EUTROPHIC PEEL-HARVEY ESTUARY, WESTERN AUSTRALIA,

Western Australia Dept. of Conservation and Environment, Perth.
P. B. Birch, G. G. Forbes, and N. J. Schofield.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 53-61, 1986. 4 fig, 2 tab, 12 ref.

Descriptors: *Catchment areas, *Monitoring, *Phosphorus, *Peel-Harvey estuary, *Australia, Eutrophication, Non-point source pollution, Fertilizers, Agricultural runoff, Algae, Statistical models, Beaches.

Early results from monitoring runoff suggest that the program to reduce application of superphosphate to farmlands in surrounding catchments has been successful in reducing input of phosphorus to the eutrophic Peel-Harvey estuary. In the estuary this phosphorus fertilizes algae which grow in abundance and accumulate and pollute once clean beaches. The success of the program has been judged by the application of an empirical statistical model, which was derived from 6 years of data from the Harvey Estuary catchment prior to a major change in fertilizer practices in 1984. The model relates concentration of phosphorus with rate of flow and time of year. High phosphorus concentrations were associated with high flow rates, and flows early in the high runoff season (May-July). The model predicted that the distribution of flows in 1984 should have resulted in a flow-weighted concentration of phosphorus near the long-term average, when in fact the observed concentration was 25% below the long-term average. This means that the amount of phosphorus discharged into the Harvey Estuary could have been about 25% less than expected from the volume of runoff which occurred. However, several more years of data are required to confirm this trend. (Lantz-PTT)
W86-05357

ORGANIC MICROPOLLUTANTS IN DUTCH COASTAL WATERS,

Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands).
D. van de Meent, H. A. den Hollander, W. G. Pool, M. J. Vredenbregt, and H. A. M. van Oers.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 73-81, 1986. 5 fig, 2 tab, 6 ref.

Descriptors: *Organic compounds, *Micropollutants, *Coastal waters, *Holland, North Sea, Chlorobenzenes, Nitrotoluenes, Halogenated aromatic hydrocarbons, Alkylbenzenes, Polycyclic aromatic hydrocarbons, Statistical analysis, Rhine/Meuse estuary.

During six cruises from August 1983 to July 1984, water samples were collected at nine locations in the Southern North Sea, to assess the level of contamination with some classes of organic micropollutants, for which presently little information is available. Thirty-one individual compounds (chlorobenzenes, chloronitrobenzenes, nitrotoluenes, halogenated aliphatic hydrocarbons, alkylbenzenes, polycyclic aromatic hydrocarbons) were measured. Concentration levels were found to be in the lower ng/l (ppt) range (frequently close to the blank levels or below the limits of detection). Statistical analysis revealed that both spatial and temporal variations were significant for nearly all parameters, and that nearly all parameters were significantly correlated with each other as well as with the salinity. Using principal components analysis, variations in the contamination with trace organics can be semi-quantitatively described with one component only. The highest concentrations were observed in the coastal waters north of the Rhine/Meuse estuary. Concentrations gradually decreased in a northerly direction, and fell sharply in the seaward direction. It is proposed that the observed concentration levels are the result of two physical phenomena: (1) mixing of relatively uncontaminated water from the Atlantic Ocean with polluted water from the Rhine/Meuse estuary, and (2) air-sea exchange by volatilization-, dry- and wet deposition processes. (Lantz-PTT)
W86-05359

SOLUTE DISPERSION AND SEDIMENT TRANSPORT IN ESTUARIES,

Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, I. Guymer, Y. Sangodoyin, and K. O. K. Oduyemi.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 93-100, 1986. 5 fig, 10 ref.

Descriptors: *Estuaries, *Solute transport, *Sediment transport, *Path of pollutants, Flow velocity, Conwy estuary, Mathematical studies, Density gradients, Mathematical equations, Flow profile, Suspended solids, Salinity.

Synoptic measurements of velocity and salinity at several points on up to five vertical profiles at a cross-section in the Conwy estuary, show that solute dispersion coefficients are affected by secondary flow induced by the interaction of transverse shear and the salinity induced longitudinal density gradient. It is concluded that both solute and suspended solids transport are strongly influenced by the density fields induced in unsteady non-uniform estuarine flows by the presence of a solute-induced longitudinal density gradient. Recent advances in fieldwork methodology have shown that a better understanding of these transport processes should be possible in the near future and hence predictive procedures may be developed for spatially and temporally varying coefficients. (Lantz-PTT)
W86-05361

INVESTIGATION OF MATERIAL TRANSPORT AND LOAD IN TIDAL RIVERS,

GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik.
H. -U. Fanger, H. Kuhn, W. Michaelis, A. Muller, and R. Riethmuller.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 101-110, 1986. 15 fig, 17 ref.

Descriptors: *Tidal rivers, *Solute transport, *Sediment transport, *Suspended load, Particulate matter, Heavy metals, Path of pollutants, Water analysis, Model studies, Water quality control.

The transport of suspended particulate matter and of heavy metals in tidal rivers is of both ecological and economic relevance. But temporal variabilities and spatial heterogeneities considerably complicate its quantitative treatment by numerical simulation and the acquisition of representative field data for systematic investigations. As a contribution to the potential solution of this problem, a methodology has been developed which combines theoretical and experimental techniques in an effective way. A novel measuring system on board a ship allows the fast determination of hydrographic parameters, and water samples are taken in parallel from different depths. Various analytical techniques are applied for quantitative trace-element detection. The experimental data are used as boundary conditions in hydrodynamic and transport model calculations. This paper describes the experimental equipment, techniques, and numerical models. Calculated currents in the river area investigated and calculated (cross-averaged) concentrations and transports of suspended matter and heavy metals agree, so far, quite well with the experimental data, although the extent of the river section was somewhat small for a critical test of the parametrization and empirical constants assumed in the models. Therefore, the measuring basis has to be enlarged in subsequent experiments. In order to obtain long term trends from studies of this kind, the experiments have to be repeated at identical sites but under different meteorological and discharge conditions, and the temporal interpolation should be performed with the aid of permanent measuring and sampling stations at sites being representative for the cross-section of interest. (Lantz-PTT)
W86-05362

SEDIMENT MOBILITY AND ITS CONTRIBUTION TO TRACE METAL CYCLING AND RETENTION IN A MACROTIDAL ESTUARY,

Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, A. J. Bale, R. J. M. Howland, G. E. Millward, and D. R. Ackroyd.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 111-119, 1986. 7 fig, 19 ref. Department of the Environment Contract No. PECD 7/7/076.

Descriptors: *Sediment transport, *Trace metals, *Estuaries, Estuarine environment, Tamar Estuary, Path of pollutants, Iron, Manganese, Cadmium, Zinc, Chemical reactions, Metals, Pore water.

Measurements of trace metals in the dissolved, suspended particulate and sediment phases of the Tamar Estuary have been combined with observations of sediment and suspended particle mobility in an interpretation of metal cycling and retention processes within the system. Dissolved Fe, Mn, Cu and Zn distributions in the Tamar Estuary indicate substantial internal metal cycling. Appreciable proportions of the riverine dissolved metal influxes are scavenged by tidally resuspendable sediment particles within the very low salinity, high turbidity zone. Net return to the water column occurs within the mid-estuary and probably involves desorption and dissolution from tidally resuspended sediment particles in addition to direct pore water infusion. Although this metal cycling involves a particle-water metal exchange and is driven by internal cycling of resuspendable sediment, it is not evidenced by spatial variations in the metal content of suspended and superficial sediment particle populations. This is because the magnitude and rapidity of internal suspendable particle fluxes severely restrict metal concentration changes effected by chemical reactivity. The observed temporal and spatial variations in the composition of the suspended particulate material and the superficial sediment are attributable to physical processes. (Lantz-PTT)
W86-05363

CHEMICAL FRACTIONATION OF HEAVY METALS IN ANOXIC ESTUARINE AND COASTAL SEDIMENTS,

Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
M. Kersten, and U. Forstner.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 121-130, 1986. 2 fig, 4 tab, 22 ref. BMFT Grant MFU 05438.

Descriptors: *Chemical analysis, *Heavy metals, *Estuaries, *Sediments, Coastal waters, Nickel, Lead, Copper, Zinc, Cadmium, Iron, Manganese, Suspended sediments, Hamburg, West Germany, Aeration, Chemical reactions.

Chemical extraction experiments for estimating characteristic particulate binding forms of heavy metals in anoxic marine and freshwater sediments were carried out under both the presence and absence of atmospheric oxygen during the analytical procedure. Storage methods, including aeration of anoxic sediments, do not preserve the initial fractionation patterns of heavy metals and may both increase (Ni, Pb, Cu, Zn, Cd) and decrease (Fe, Mn) their mobility. Elutriate tests of methanogenic freshwater sediments from Hamburg harbor basins, show that metals with increased carbonatic fractions (Fe, Mn), and those with predominantly sulphidic/organic fractions (Zn, Cu, Cd), are particularly sensitive to sample aeration. Transformations of oxidizable Ni (11%), Zn (62%), and Cd (67%) predominantly lead to easily reducible associations. Drying of the sediments decreases the proportion of the sulphidic/organic fraction of the metals to a stronger degree. Oxidized Zn and Cd is then found in the least stable exchangeable fraction. If pretreatment of sediment samples is done adequately, the chemical leaching approach may provide information on diagenetic effects and reaction kinetics, which influence the mobility of contaminants in highly complex matrices. (Author's abstract)
W86-05364

CADMIUM AND LEAD CYCLING BETWEEN WATER, SEDIMENT, AND BIOTA IN AN ARTIFICIALLY CONTAMINATED MUD FLAT ON BORKUM (F.R.G.),

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
D. H. Loring, and F. Prosi.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 131-139, 1986. 5 fig, 4 tab, 7 ref. Canada/German Scientific and Technological Agreement, Medium Scale Experiment: Project 1.0.0.9.

Descriptors: *Cadmium, *Lead, *Cycling, *Sediments, *Coastal waters, *Borkum, West Germany, Mud flats, Water pollution effects, Path of pollutants, Fate of pollutants, Chemical reactions, Mussels, Benthic fauna, Heavy metals.

A 'Bremerhaven caisson' was used to investigate the interactions of cadmium (Cd) and lead (Pb) with sea water, particulate matter (SPM), sediments, and biota, in an enclosed (13 sq m) tidal mud flat area on the island of Borkum (FRG). Artificial contamination was accomplished by injecting Cd as a chloride and Pb as a nitrate into the caisson so as to maintain metal concentrations of 100 micrograms/L in the inflowing water of each tidal cycle for 25 days. Each component of the system was sampled at selected intervals inside and outside the caisson. Results indicate that most (85%) of the injected Cd remained in the soluble phase while most (90%) of the Pb was transferred to the particulate phase. Cyclic changes in particulate Cd and Pb concentrations occur and indicate that Cd is progressively taken up by the SPM over each tidal cycle. However, after an initial rapid uptake, particulate Pb concentrations remain relatively constant in the system. In the sediments, Cd concentrations decrease with depth while increasing with time, with the highest increases occurring in the surface sediment layers. Lead concentrations initially remain constant with depth, but eventually Pb becomes enriched in the top 3 cm of the sediments. Biota show an exponential increase in Cd and Pb during the experiment. Lead is enriched relative to Cd by a factor of 2 in mussels, despite its low level in the dissolved phase. Infaunal benthic species have lower metal concentrations than the filter feeders. (Lantz-PTT)
W86-05365

DISTRIBUTION OF MERCURY IN THE SEDIMENTS AND FISHES OF THE LAGOONS OF AVEIRO, PORTUGAL,

Aveiro Univ. (Portugal). Dept. de Quimica.
M. F. Lucas, M. T. Caldeira, A. Hall, A. C. Duarte, and C. Lima.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 141-148, 1986. 2 fig, 4 tab, 8 ref. Junta Nacional de Investigacao Cientifica e Tecnologica (JNICT) Research Contract No. 305.81.15.

Descriptors: *Mercury, *Sediments, *Fish, *Lagoons, *Aviera, Portugal, Sieve analysis, Coastal waters, Water pollution sources, Path of pollutants, Industrial wastewater, Estuaries, Heavy metals, Chemical analysis, Bioaccumulation.

Dry and wet sieving were compared on their suitability for the size fractionation of bottom sediment samples, collected from a brackish water coastal lagoon, prior to flameless atomic adsorption analysis of the sediment concentration of total mercury. The work is aimed at identifying the most important point sources of mercury to the lagoon waters, and assessing the distribution throughout the ecosystem, of the mercury discharged. The results reported in this paper refer to the lagoon sediments and fishes. A chlor-alkali plant proved to be the most important source of mercury but its contribution has not yet been disentangled from those orginating at a pyrite roasting facility and a PVC factory operating in the same industrial park. Sewage discharges from the bankside communities are the other significant point sources of Hg. Concentrations of Hg in the superficial sediments ranged from 850 mg/kg, near the chlor-alkali sewer outlet, to 0.05 mg/kg in the intertidal sands of the coastal beaches. Sewage-affected sediments have concentrations of Hg in the range of 1 to 2 mg/kg. The concentrations observed in the water samples and superficial sediments suggest that some of the Hg historically discharged into the lagoon may have been exported to the Atlantic Ocean coastal waters. Bioaccumulation of Hg in fish tissues show the usual dependence on species' territoriality, feeding habits and size. Concentrations as high as 25 mg/kg fresh weight, have been observed but the average values do not exceed the EEC quality objective of 0.3 mg/kg. (Lantz-PTT)
W86-05366

BACILLUS PHAGES AS TRACERS OF WATER MOVEMENT,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.

R. N. Purdy, B. N. Dancer, M. J. Day, and D. J. Stickler.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 149-153, 1986. 1 fig, 3 tab, 14 ref.

Descriptors: *Bacillus phages, *Tracers, *Flow profiles, *Bioindicators, Bacteria, Path of pollutants, Wastewater, Viruses, Culturing techniques, Escherichia coli, Filtration.

Vegetative bacterial cells, bacterial spores and bacteria viruses have all been used to trace the dispersion of sewage from coastal outfalls. The phages are considered to have advantages over other microbial tracers in that they can be prepared in high titres (10 to the 13th particles/ml) and can be assayed in less than 8 hours. Furthermore, because these viruses only infect bacteria they represent no health risk. This paper describes the selection of five Bacillus phages for their potential use as tracers. Each phage has a clear plaque morphology, and specific hosts have been shown to be suitable for use as tracers of water movement, thereby enabling them to be used in studies where concurrent labelling of several sources is required. The stability of these phages in comparison to that of E. coli has been established in sea water. These data could be used in the analysis of dispersion data to predict E. coli concentrations at sites where changes in sewage disposal policy might be under consideration. A simple and robust filtration method requiring no complex or expensive equipment, has been devised which permits the efficient recovery and enumeration of phage tracers from 100 mg water. The increased sensitivity of the membrane filtration technique allows large scale tracer studies to be performed on phage preparations from lysates of less than 10 L of infected host bacterial culture. (Lantz-PTT)
W86-05367

MERCURY CONTAMINATION IN COMPONENTS OF AN ESTUARINE ECOSYSTEM,

Forth River Purification Board, Queensferry (Scotland).
For primary bibliographic entry see Field 5C.
W86-05369

MERSEY ESTUARY (U.K.) BIRD MORTALITIES - CAUSES, CONSEQUENCES AND CORRECTIVES,

North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5C.
W86-05370

CHEMICAL FORMS OF ARSENIC IN MARINE ORGANISMS, WITH EMPHASIS ON HEMIFUSUS SPECIES,

Environmental Protection Agency, Kowloon (Hong Kong).
D. J. H. Phillips, and M. H. Depledge.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 213-222, 1986. 5 fig, 1 tab, 68 ref.

Descriptors: *Arsenic, *Marine animals, *Chemical composition, Spindle shells, Tissue analysis, Chemical analysis, Gastropods, Chemical reactions, Algae, Public health.

Investigations of arsenic in spindle shells (Hemifusus tuba and H. ternatanus) in Hong Kong, have revealed moderate to high concentrations of total arsenic in soft tissues. Levels of inorganic arsenic vary considerably between the tissues in these gastropods, being very high in the gill, but much lower in the foot. The significance of these data in terms of public health is discussed. In addition, the uptake of inorganic arsenic from solution by H. tuba is described. The importance of the precise chemical speciation of arsenic in marine biota is emphasized, and the forms of the element reported to date in marine environments are reviewed. A novel hypothesis is described to account for the derivation of all forms of arsenic found in marine organisms to the present. It is proposed that each of these arsenic-containing compounds is produced by a single anabolic/catabolic pathway concerned with the synthesis and turnover of phosphatidylcholine. This phospholipid (which is a major component of cell membranes) may be synthesized by most organisms either directly from choline or by the (triple) methylation of phosphatidylethanolamine. If both the initial substrates of these pathways (choline and ethanolamine) were to exist in biota as their arsenic analogues (As(+) replacing N), the biosynthesis would proceed. Such a proposal accounts not only for the reported existence of arsenolipids, arsenocholine and arsenobetaine, but might also explain the derivation of arseno-sugars in algae. The methylation of phosphatidylethanolamine is a 3-stage process involving S-adenosylmethionine (SAM) as a methyl group donor and the enzyme phosphatidylethanolamine methyltransferase. It is hypothesized that in algae, the presence of the arsenic atom in the substrate analogue causes steric interference between the second and third methylation steps. As a result, the reaction could proceed by attack of the S-CH2 bond between the methionine and the sugar moieties, rather than the S-CH3 bond normally attacked. This would give rise to a complex intermediate. The relationship of this intermediate to documented arseno-sugars is apparent. Oxidation of the diacylglycerophosphate-containing and replacement of the adenine moiety by alternative groups (related to substrates used in phospholipid biosynthesis) would give rise to the arseno-sugars as reported in kelp and giant clams. (Lantz-PTT)
W86-05374

TRANSPORT AND WATER QUALITY MODELLING IN THE SOUTHERN NORTH SEA IN RELATION TO COASTAL POLLUTION RESEARCH AND CONTROL,

Waterloopkundig Lab. te Delft (Netherlands).
J. A. van Pagee, H. Gerritsen, and W. P. M. de Ruijter.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 245-256, 1986. 11 fig, 1 tab, 10 ref.

Descriptors: *Water quality, *Model studies, *North Sea, *Coastal zone management, Heavy metals, Nutrients, Marine environments, Distribution pattern, West Germany, Holland, Pollution load, Rhine River, Weser River, Elbe River, Mathematical models, Cadmium, Mercury, Copper, Lead, Zinc, Chromium.

Mathematical modelling techniques are used to quantify the transport of pollutants originating from various inputs in the southern part of the North Sea. Special attention was given to the anthropogenic increase in local concentrations of nutrients (N,P) and heavy metals (Cd, Hg, Cu, Pb, Zn, Cr), and their potential impact on marine organisms. A depth-averaged hydrodynamic model is used to calculate tidal and wind driven velocities and water levels. By averaging, residual flows are calculated, forming the basis for advective transports in a water quality model. Dispersive transports are derived from a comparison of simulated and observed salinity distributions. Water mass distributions and age functions for various inflowing water types are determined with the model. Transports of nutrients and heavy metals in the southern part of the North Sea are calculated using annual pollution inputs for 1980. Although interactions with bottom sediments are not considered, the calculated and measured concentrations show good similarities. The water quality in the Dutch coastal zone and German Bight area is shown to be highly determined by local pollution loads from the rivers Rhine, Weser and Elbe, respectively. Comparison of simulated concentrations for 1980 with those resulting from simulations with estimated natural river inputs, shows that more than 50% nutrients and heavy metal concentrations originate from human activities in large coastal zone areas. From toxicological information and standards, it is concluded that Cd, Hg, and Cu are substances that need special attention in pollution research and control for the Dutch coastal waters. (Lantz-PTT)
W86-05377

STEADY STATE AND TIME-VARYING WATER QUALITY MODELS FOR THE HOOGHLY ESTUARY, INDIA,

Calcutta Metropolitan Development Authority (India).
S. K. Bose, and B. K. Dutta.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 257-265, 1986. 4 fig, 13 ref.

Descriptors: *Water quality, *Model studies, *Hooghly Estuary, *India, Time series analysis, Channel flow, Biological oxygen demand, Dissolved oxygen, Estuaries.

Steady state and time-varying water quality models for the Hooghly estuary have been developed for the 92.5 km stretch from Tribeni to Mayapur. An hydraulic model of the estuary was previously developed in this connection, based on a simulated channel of trapezoidal cross-section, gradually increasing downstream, and with uniform ground slope. The estuary has also been assumed to be sectionally homogeneous in each of the thirty-seven sections. The advection-diffusion equations have been numerically integrated to compute the instantaneous and time-averaged distribution of biological oxygen demand (BOD) and dissolved oxygen (DO). The monthly averages of the quantities over the year have also been determined. The different system parameters have been estimated using available equations and correlations. The computed results show that the BOD level lies in the range 0.75 - 3 mg/L, and the range of DO was found to be 5 - 7.5 mg/L. The computed results are generally in agreement with the field data available. Thus computations based on simulated channel characteristics may be useful for prediction of water quality. However, the model needs to be tested with more field data in other seasons before it is put to use in any decision-making process. (Lantz-PTT)
W86-05378

DISTRIBUTION OF HEAVY METALS IN WASTE DRILLING FLUIDS UNDER CONDITIONS OF CHANGING PH,

Shell Development Co., Houston, TX.
G. M. Deeley, and L. W. Canter.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 108-112, April-June 1986. 6 tab, 25 ref.

Descriptors: *Heavy metals, *Drilling fluids, *Hydrogen ion concentration, Distribution patterns, Arsenic, Barium, Chromium, Lead, Oil wastes, Chemical analysis, Drilling, Waste disposal.

A laboratory study was conducted to determine the influence of pH on the distribution of arsenic (As), barium (Ba), chromium (Cr), and lead (Pb) in three different oil and gas well drilling fluid wastes. Samples were obtained from disposal pits and equilibrated in the laboratory under controlled conditions of pH. A sequential extraction procedure was then used to fractionate the selected elements into the fractions of aqueous, KNO2-extractable, H2O3-extractable, H2O-extractable, NaOH-extractable, EDTA-extractable, and HNO3-extractable phases. The chemical fractions present at each pH were then compared, providing insight into the potential of mobilization of As, Ba, Cr, and Pb into ground- or surface waters. The majority of each of the elements studied was found in the NaOH-extractable, EDTA-extractable or HNO3-extractable fractions except for one waste which contained a major portion of the total barium in the KNO3-extractable fraction. Generally, a decrease in pH caused a shift from the more stable HNO3-extractable fraction to the less stable EDTA-extractable, NaOH-extractable, or KNO3-extractable fractions. In no case was there a substantial release to the aqueous phase with changing pH. The significance of these results is that with pH changes to be expected in the natural environment, there is not likely to be a major release of As, Ba, Cr, and Pb from drilling fluid waste disposal pits. The lower pH values (<4) which might produce some impact, are unlikely to occur in the environment because the wastes themselves have a large neutralizing capacity. (Lantz-PTT)
W86-05384

PERMETHRIN WASHOFF FROM COTTON PLANTS BY SIMULATED RAINFALL,

Agricultural Research Service, Baton Rouge, LA.
G. H. Willis, L. L. McDowell, S. Smith, and L. M. Southwick.

Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 116-120, April-June 1986. 3 fig, 5 tab, 11 ref.

Descriptors: *Permethrin, *Washoff, *Simulated rainfall, *Cotton plants, *Pesticides, *Path of pollutants, Suspended sediments, Agricultural runoff, Rainfall intensity, Rainfall rate.

The development of models for predicting amounts of pesticide transported in runoff and suspended sediment from agricultural land to aquatic habitats has been hampered for foliarly-applied pesticides a lack of knowledge about the processes of pesticide washoff from plants by rainfall. A multiple-intensity rainfall simulator was used to determine the effects of rain intensity and amount on permethrin ((3-phenoxyphenyl)methyl(+)cis, trans-3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropanecarboxylate) concentrations and amounts washed from mature cotton (Gossypium hirsutum L.) plants. Permethrin concentration in plant washoff was independent of rain intensity when 25 mm of simulated rain was applied at 6.6, 13.0, 25.7, and 51.3 mm/h, 2 h after permethrin was applied at 0.224 kg/ha. Concentrations were less when the same amount of simulated rain was applied at 106.4 mm/h. Permethrin concentrations in plant washoff decreased rapidly during the early phases of washoff. About 35% of the permethrin load on the plants 2 h after application was washed off by 25 mm of rain. An additional 76 mm of rain removed only 11% more of the permethrin from the plants. Rainfall amount had greater influence than rainfall intensity on the amount of permethrin washed from the cotton plants. (Lantz-PTT)
W86-05385

POTASSIUM LOSSES IN RUNOFF AND DRAINAGE WATERS FROM CROPPED, LARGE-SCALE LYSIMETERS,

Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
R. L. Jones, and T. D. Hinesly.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 137-140, April-June 1986. 4 tab, 10 ref.

Descriptors: *Potassium, *Agricultural runoff, *Digested sludge, *Drainage water, Lysimeters, Wastewater farming, Irrigation, Corn plants.

Losses of total recoverable potassium (K) were measured in runoff and percolate waters from field lysimeter plots of Blount silt loam (fine, illitic, mesic Aeric Ochraqualfs) from May 1972 through April 1974. Six plots were irrigated annually with digested sewage sludge, while another six plots which had been treated with a complete fertilizer were irrigated with well water. Each year all plots were fertilized with KCl in amounts that supplied 269 kg K/ha prior to the preparation of a seedbed for corn (Zea mays L.). For the 2 years of record, combined K losses in runoff and drainage waters from sludge-treated plots averaged 41.9 and 8.2 kg/ha, respectively. For the same years, losses from plots irrigated with well water averaged 23.3 and 10.5 mg K/ha in runoff and drainage waters, respectively. The differences between treatments within each year were not significant between years within treatment. Large K losses occurred in runoff during heavy summer rains and in winter when rapid snow melt and rain events took place. Consistently higher K losses were observed in drainage waters during late winter and spring periods for both years. Median concentrations of total recoverable K in runoff and drainage waters from sludge-treated plots were, respectively, 7.5 and 4.8 mg/L in the first year, and 7.8 and 2.4 mg/L during the second year. Respective data for water-irrigated lysimeters were 6.0 and 2.9 mg K/L in 1972 through 1973, and 7.5 and 1.8 mg K/L in 1973 through 1974. Potassium losses were small when compared to amounts supplied as constituents of sludge and fertilizer, and to soil levels of total native and acid-extractable K. In the drier year, 1973 through 1974, total K losses in runoff and drainage from plots receiving conventional fertilizers were similar to weights of K removed in grain. (Author's abstract)
W86-05388

COMPARISON OF METHODS FOR ESTIMATING SULFATE EXPORT FROM A FORESTED WATERSHED,

Pennsylvania State Univ., University Park. School of Forest Resources.
M. S. Dann, J. A. Lynch, and E. S. Corbett.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 140-145, April-June 1986. 1 fig, 6 tab, 17 ref.

Descriptors: *Sulfates, *Solute transport, *Forest watersheds, *Estimating equations, Model studies, Pennsylvania, Flow pattern, Regression analysis, Statistical analysis, Ion transport, Nutrient removal.

Seven methods of estimating sulfate export from a forested watershed in central Pennsylvania were compared. One method involved simple linear regression of discharge and concentration data, two methods were based on regression models in which the concentration data were stratified by flow frequency or duration, two methods weighted the mean concentration by discharge, one method used a simple unweighted mean concentration, and one weighted export according to the length of the sampling period interval. The regression models produced the highest export estimates but were considered statistically invalid because the data set did not adhere to the statistical requirements of independence, normality, and linearity. Weighted and unweighted mean concentration methods gave the lowest estimates of export because they gave less emphasis to high flows during which the majority of sulfate was exported from the watershed. The period-weighted method gave intermediate to high export estimates because it took into consideration the large export of sulfate during high flows, and appeared to offer the best estimate of sulfate export from the watershed studied within the conditions and limitations of the data set. Although limited to sulfate export from a forested watershed, these results would appear to be applicable to any ion, particularly if the solute concentration of the ion is flow related. (Lantz-PTT)
W86-05389

ONE-DIMENSIONAL MODEL OF CHEMICAL DIFFUSION AND SORPTION IN SATURATED SOIL AND AQUATIC SYSTEMS,

Morrison-Knudsen Engineers, Inc., Denver, CO.
D. L. Corwin.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 173-182, April-June 1986. 9 fig, 2 tab, 27 ref.

Descriptors: *Models studies, *Chemical diffusion, *Sorption, *Saturated soils, *Path of pollutants, Aquatic environment, Adsorption, Chemical reactions, Physicochemical properties, Simulation analysis, Solute transport, Boron, Diquat, Bromacil.

A one-dimensional model for chemical diffusion in saturated porous media systems is presented. The model provides for adsorption-desorption reactions, either Freundlich or Langmuir, and both solid and liquid phase first-order chemical degradation under isothermal, water-saturated conditions. Finite-difference solutions to the model which simulate the one-dimensional diffusion of an inorganic/organic chemical from the sediment of an aquatic system into the overlying water are provided for a variety of initial and boundary conditions. Analogous applications to flow processes within a structured soil can be made for the diffusion of an inorganic/organic chemical into and out of saturated planar soil aggregates. The initial and boundary conditons are designed to simulate a variety of aquatic situations: ponds, lakes, streams, rivers and oceans. Both explicit and implicit finite-difference schemes are presented for four different saturated systems. The model provides a means of assessing the physicochemical dynamics of chemical-sediment-water interactions and of assessing the pollution potential of chemicals to plants and animals as determined by their propensity to migrate to different compartments of the aquatic environment. The models can also determine the influence of diffusion processes within planar soil aggregates upon solute flow in saturated structured soils. Various simulations are presented for boron (B), diquat (1,1'-ethylene-2,2'dipyridilium dibromide), and bromacil (5-bromo-3-sec-butyl-6-methyluracil). (Lantz-PTT)
W86-05390

PHOTOCHEMICAL AND MICROBIAL DEGRADATION OF 2,4,5-TRICHLOROANILINE IN A FRESHWATER LAKE,

Georgia Univ., Athens. Dept. of Microbiology.
H. -M. Hwang, R. E. Hodson, and R. F. Lee.
Applied and Environmental Microbiology, Vol. 50, No. 5, p 1177-1180, November 1985. 4 tab, 22 ref.

Descriptors: *Biodegradation, *Path of pollutants, *Fate of pollutants, *Chlorinated hydrocarbons, *Microbial degradation, *Photochemical degradation, *Eutrophic lakes, Lakes, Georgia, Algae, Bacteria, Mineralization.

Surface waters from a eutrophic lake, Lago Lake, in northern Georgia were incubated with 14-C labeled 2,4,5-trichloroaniline to study the disappearance of the parent compound and production of 14-CO2. There was no degradation of the compound in the dark. Under 12 h of sunlight and 12 h of darkness, 28% of the trichloroaniline was degraded. Mineralization after 24 h in poisoned (abiotic; 1 mg/l mercuric chloride added) and untreated lake water was 5.5 and 6.8% respectively. Thus, 81% of the mineralization was attributable to photochemical processes, and 19% was attributable to microbial processes. Most biological mineralization was due to microbes of bacterial size (<1.0 micrometers). Approximately 90% of the trichloroaniline bioaccumulated was associated with organisms larger than 1.0 micrometers, e.g., algae. When algae were removed by filtration, the amount of trichloroaniline mineralized increased to 9.4%, compared with 6.8% in the presence of algae. The excretion of organic compounds by algae may have inhibited bacterial mineralization of photoproducts. These results indicate that microbial degradation kinetics and rates of other physical and chemical processes must be assessed together to predict the persistence of organic compounds in aquatic environments. (Peters-PTT)
W86-05392

BACTERIAL PROFILE OF PETROCHEMICAL INDUSTRY EFFLUENTS,

Baroda Univ. (India). Dept. of Biochemistry.
For primary bibliographic entry see Field 5D.
W86-05393

ROLE OF SPECIATION IN MERCURY METHYLATION IN SEDIMENTS AND WATER,

Leicester Polytechnic (England). School of Chemistry.
P. J. Craig, and P. A. Moreton.
Environmental Pollution (Series B), Vol. 10, No. 1, p 141-158, 1985. 1 fig, 5 tab, 20 ref.

Descriptors: *Mercury, *Speciation, *Path of pollutants, *Estuaries, *Sediments, Methylmercury, Methylation, Kinetics, Chemical reactions, Solubility.

Nine inorganic mercury (II) complexes were prepared and reacted with a series of methyl donors in abiotic reactions in distilled water to determine inherent methylation capacity. These complexes were also incubated in sediments capable of methylation to determine the role of mercury configuration and speciation in the environmental production of methyl mercury. The rate and extent of the methylation of inorganic mercury depended markedly on the chemical speciation of the mercury and the methylating agent. The presence of mercury (II) - chlorine covalent bonding had an inhibitory effect on methylation by methyl cobalamin (CH3CoB12) and in natural sediments. The role of radical and carbonium ion methylation mechanisms was also investigated. In a typical estuarine sediment the extent of mercury methylation is as follows: Hg(OAc)2 > Hg(cyst)2 > Hg(cyst)(Hcyst)Cl > Hg(meth)2(2+) > Hg(eth)2(2+) > Hg(Hcyst)Cl2 > (HgCl2)2pen, where OAc = acetate, Hcyst = cysteine, meth = methionine, eth = ethionine and pen = penicillamine. This is consistent with mercury methylation

arising by attack of a methyl carbanion (CH3(-) on inorganic mercury (II) ions derived by microbial breakdown of the original mercury compounds added. (Peters-PTT)
W86-05395

HEADWATER STREAM LOSSES OF NITROGEN FROM TWO COASTAL PLAIN WATERSHEDS,

North Carolina State Univ. at Raleigh. Dept. of Soil Science.
T. C. Jacobs, and J. W. Gilliam.
Journal of Environmental Quality, Vol. 14, No. 4, p 467-472, October-December 1985. 3 fig, 5 tab, 23 ref.

Descriptors: *Denitrification, *Agricultural watersheds, *Path of pollutants, *Coastal plains, *Nitrogen compounds, Soil solution, Fertilizers, North Carolina, Eutrophication, Nonpoint pollution sources, Flood plain, Headwaters, Forest soils, Surface runoff, Oxidation-reduction potential.

Nitrogen concentrations and water flow were measured for a 3-yr period from two watersheds of the Atlantic Coastal Plain in North Carolina to assess sinks for NO3-N. From the Middle Coastal Plain watershed with 1299 ha of predominantly well- to moderately well-drained soils, the losses of NO3-N and total N in surface drainage water were 2.5 and 4.5 kg/ha/yr, repectively. The Lower Coastal Plain watershed with 6998 ha of somewhat poorly- to poorly-drained soils had NO3-N and total N losses of 0.5 and 2.5 kg/ha/yr, respectively. These values were much lower than expected based on agricultural production, fertilizer used, and crop efficiency. Denitrification between the field and stream is the primary reason for these low values. However, the concentrations of NO3-N in streams near the field outlets decreased significantly as N enriched water moved through the transport system. Comparing changes in nitrate and chloride concentrations and the reducing oxidation-reduction potential in the stream and floodplain sediments suggest denitrification as the loss mechanism in the stream transport system. Ostensibly the stream is responsible for the loss rather than the riparian area; however, the area inundated by the stream is small compared to the flood plain. The Middle and Lower Coastal Plain watersheds have 2.5 and 94 ha inundated by the stream while confined to the channel, but in a moderate flood, these values increase to 20 and 250 ha, respectively. While instream losses of NO3-N are important in this region to maintain water quality, they are not sufficient to completely counter heavy loading by nonpoint sources. (Author's abstract)
W86-05398

ORGANIC MICROPOLLUTANTS AND THE PROTECTION OF WATER SUPPLIES,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. Perry, and A. E. McIntyre.
Effluent and Water Treatment Journal, Vol. 26, No. 1, p 15-18, January 1986. 3 tab, 14 ref.

Descriptors: *Organic matter, *Environmental protection, *Groundwater protection, *Micropollutants, *Water reuse, *Water treatment, Groundwater pollution, Water pollution control, Surface water, Pollutants.

Contamination of surface and ground waters is briefly reviewed and appropriate treatment technology for the production of acceptable quality drinking water was considered. Health risks were evaluated in a comparison between surface water with ground water, and chlorinated water compared with non-chlorinated water. The presence of trihalomethane (THM) in drinking water was also evaluated in terms of potential risk to health. Both immediate and remote hydrological cycle inputs were found to be of concern. In the latter case, on-site treatment of industrial effluents prior to discharge to foul sewers or surface waters was found to be the most desirable option to effect protection of re-use rivers. In the former case, it was found to be important that progress in developing new water treatment processes is matched by progress in the perception of problems and the need to apply new technology. (Master-PTT)
W86-05405

OCCURENCE OF RADIOACTIVITY IN PUBLIC WATER SUPPLIES IN THE UNITED STATES,

Environmental Protection Agency, Washington, DC. Office of Drinking Water.
C. T. Hess, J. Michel, T. R. Horton, H. M. Prichard, and W. A. Coniglio.
Health Physics, Vol. 48, No. 5, p 553-586, May 1986. 8 fig, 17 tab, 91 ref.

Descriptors: *Water supply, *Radioactivity, *Groundwater, *Geohydrology, *Surface water, *Radon, United States, Cancer, Geologic formations, Radium, Radium isotopes, Uranium, Uranium isotopes, Radioisotopes, Surface water records, Geology, Public health, Surveys, Distribution patterns.

State and national surveys of radionuclide levels in public water supplies are reviewed, with emphasis on the influence of geological setting (Rock type and nature of the ground water flow system). More than 51,000 measurements for gross alpha-particle and/or Ra activity; 89,000 measurements for U; and 9,000 measurements for Rn were considered in terms of 11 geological provinces comprising the contiguous United States. The highest level of Ra were found in the Upper Coastal Plain, Glaciated Central Platform, and Colorado Plateau provinces. The highest levels of U were in the Colorado Plateau, West Central Platform, and Rocky Mountains. The highest levels of Rn were in the New England and Appalacian Highlands/Piedmont provinces. Surface waters had low levels of Ra and Rn compared to groundwater, but comparable levels of U. Utilities serving small populations had the highest concentrations of earth radionuclide and also the least sampling records. Risk estimates are presented in terms of excess fatal cancers per 70.7-year lifetime. A principle conclusion is that geological setting can serve as an indication of the need for careful monitoring of radioactivity in public water supplies. Specific conclusions regarding distribution and transport and recommendations on regulation and monitoring are presented. (Robinson-PTT)
W86-05407

DISTRIBUTION OF ACID DEPOSITION IN GERMANY,

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
P. Valenta, V. D. Nguyen, F. Wagner, and H. W. Nurnberg.
Experientia EXPEAM, Vol. 42, No. 4, p 330-339, April 1986. 11 fig, 5 tab, 34 ref.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Sulfuric acid, Germany, Ruhr, Sampling network, Acid distribution, Acid deposition, Precipitation amount, Rain, Snow, Wet deposition.

The distribution of acid deposition by atmospheric precipitations in the Federal Republic of Germany is discussed, based on investigations of the wet H(+)-deposition during 1980-1984, using a network of 16 automated samplers located in various categories of ecosystems. An increase of the H(+)-concentration and H(+)-deposition values was observed from 1980 onwards with a maximum in 1981 and a slow decrease in the next two years. In the more significantly polluted regions, the removal of H(+)-ions by wash-out is more effective than in the rural regions. In the Ruhr region, the hydrogen ion concentration is shifted to more acid values, due to the wash-out of acid particles and aerosols. In regions with metallurgical industry, the hydrogen ion concentration is shifted to more alkaline values due to the wash-out of alkaline particles. The free acid in rain and snow is rather uniformly distributed over the whole area as a result of mesoscalic transport of the acid precursors SO2 and NOx and the concomitant formation of acid in the cloud droplets leading to acid deposition by rain-out. (Peters-PTT)
W86-05413

ATMOSPHERIC AMMONIUM SULPHATE DEPOSITION AND ITS ROLE IN THE ACIDIFICATION AND NITROGEN ENRICHMENT OF POORLY BUFFERED AQUATIC SYSTEMS,

Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. A. A. R. Schuurkes.
Experientia EXPEAM, Vol. 42, No. 4, p 351-357, April 15, 1986. 5 fig, 6 tab, 31 ref.

Descriptors: *Acid rain, *Ammonium, *Hydrogen ion concentration, Norway, Sweden, Denmark, Scotland, Belgium, Germany, Britain, Europe, Nitrogen, Sulphuric acid, Nitric acid, Manure, Cropland, Air pollution, Cattle.

Acidification of aquatic environments is one of the phenomena linked to the problems of acid precipitation. An analysis of the hydrogen ion concentration in the Netherlands revealed that most of the acidic waters are in the middle, southern, and eastern parts of the country. In Scandinavian countries, it is assumed that acidification is the result of increased deposition of strong acids like sulphuric and nitric acid. In the rainwater of northern Britain and Norway, there is a correlation between the H(+) concentration and the excess of sulfate ions. The atmospheric transport of NH(3+), emitted from breeding farms and strongly manured cropland, causes severe loading of neighboring nonagricultural environments. The wet deposition of ammonium sulphate is enhanced, while the hydrogen ion concentration of rainwater is only slightly acidic. Due to the variation of gaseous pollutants over the Netherlands large differences are noticed in the relative contribution of each acidifying component in rainwater. In areas with high atmospheric NH(3) concentrations, ammonium sulfate contributes the major part to the potential acidifying influence of wet deposition. Preliminary experiments show a casual relation between ammonium sulfate and water acidification, ammonium enrichment and the expansion of ammonium tolerant shore macrophytes. In the Netherlands, the deposition of NH(3) and SO(2) derived compounds has provided the major contribution to acidification and N-enrichment of hydrologically isolated, poorly buffered pools. (Peters-PTT)
W86-05414

EFFECTS OF ACID DEPOSITION ON CROPS AND FORESTS,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
J. N. B. Bell.
Experientia EXPEAM, Vol. 42, No. 4, p 363-371, April 15, 1986. 5 fig, 4 tab, 82 ref.

Descriptors: *Acid rain, *Forests, *Cropland, *Sulfur dioxide, *Nitrogen oxide, Pine trees, Germany, England, Ohio, Pennsylvania, Tree canopy, Beans, Carrots, Maize, Green pepper, Strawberry, Alfalfa, Mustard green, Species diversity, Hardwood, Conifers, Soil types.

Acid deposition includes the gases, sulfur dioxide and nitrogen oxides, and their derivative acids which are dissolved in various forms of precipitation. The effects of both dry and wet deposition on crops and forests are reviewed, including interactions between these two categories of pollutant. The effects of SO2 and NO2 on conifers (Pinus sylvestris, Scots pine) were studied in the Rurh region of Germany. This species was absent from sites where the mean annual SO2 concentration exceeded 75 ppb. A similar investigation in industrial regions of the southern Pennine hills in northern England found a significant negative correlation between mean winter SO2 levels and the frequency of occurrence of P. sylvestris. It appears that hardwoods are less susceptible to SO2 than are conifers. A study of changes in species composition of a forest subjected to different levels of SO2 and NOx in the Ohio River Valley suggested that air pollution caused both primary and secondary effects; the tree canopy showed increased mortality, but this permitted an increase in sub-canopy and shrub species density, which in turn suppressed diversity in the herb layer. A similar study in Pennsylvania showed that greater adverse effects occurred on the sub-canopy, shrub, and herb layers. The net response of agricultural crops to

acidic deposition is the result of the interaction between the positive effects of sulphur and nitrogen fertilization, the negative effects of acidity, and the interaction between these factors and other environmental conditions such as soil type and the presence of other pollutants. (Peters-PTT)
W86-05415

EFFECT OF AIRBORNE SULPHUR AND NITROGEN DEPOSITION ON AQUATIC AND TERRESTRIAL HEATHLAND VEGETATION,

Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. G. M. Roelofs.
Experientia EXPEAM, Vol. 42, No. 4, p 372-377, April 15, 1986. 1 fig, 6 tab, 40 ref.

Descriptors: *Acid rain, *Aquatic vegetation, *Ammonium, *Pine trees, *Sulphur, *Nitrogen, Netherlands, Heather, Grass, Oligotrophic lakes, Carbon dioxide, Peat, Pine trees, Conifers, Cattle, Nutrients, Carbonate.

Heathlands and peatlands are often neglected areas in the acid rain research, probably due to the low economic value of these areas. During the last decades, dramatic changes have taken place in the plant communities of these areas. The number of moorland pools and small lakes in which Littorellion species occur has declined; heathlands have turned into grasslands and particularly in areas with intensive stockbreeding, the condition of the pine forests is bad. The change from heather into grass dominated heathlands appeared to be caused by the high atmospheric nitrogen enrichment. Acidification of oligotrophic, poorly buffered pools in heathland areas, results in the disappearance of all submerged plant species, caused by the too low CO2 levels in the water layer. The vitality of the pine forests decreases; apart from the premature shedding of needles as a result of nutrient deficiencies, they become more susceptible to secondary stress factors such as NH3, O3, drought and fungal diseases. Acidification of poorly buffed heathland soils as a result of acid or acidifying precipitation leads to a strong decline in the number of plant species. Acidification of a water body above a carbonate-free sediment leads to disappearance of all submerged macrophytes due to lack of carbon dioxide. Acidification of a water body above a sediment containing little carbonate, as a result of ammonium-containing acidifying precipitation, leads to a suppression of the isoetid plant community by luxuriant growth of Juncus bulbosus and/or Sphagnum species as a result of increased carbon dioxide and ammonium levels in the water layer. Airborne ammonium deposition on acidic heathland soils leads to a succession from heather-dominated into grass-dominated heathlands. (Peters-PTT)
W86-05416

5C. Effects Of Pollution

FROM SWAMP TO LAKE: RECENT CHANGES IN A LOWLAND TROPICAL SWAMP,

Papua New Guinea Univ., Port Moresby. Dept. of Biology.
P. L. Osborne, and N. V. C. Polunin.
Journal of Ecology, Vol. 74, No. 1, p 197-210, March 1986. 9 fig, 19 ref.

Descriptors: *Lakes, *Swamps, *Papua New Guinea, *Waigani Lake, Sediment profiles, Organic matter, Water content, Sediment cores, Phosphorus, Nitrogen, Diatom stratigraphy, Aquatic plants.

Sediment cores from Waigani Lake, close to Port Moresby, Papua New Guinea, were analyzed to relate the sediment record to the vegetation changes known to have taken place and to assess reasons for the changes. Aerial photographs show freshwater vegetation changes since the 1950s. Records of diatom assemblages and plant seeds in sediment cores confirm that the lake was at one time dominated by a mixed emergent swamp, that this was replaced by floating-leaved plants and that the latter were replaced by the present open water. This is characterized as a partial reversal of a hydrosere. Marked variations in organic and moisture content, and phaeopigments, total nitrogen and total phosphorus concentrations with depth in the sediment cores indicate substantial changes in the aquatic environment. Increases in both nitrogen and phosphorus concentrations closely predate the major vegetation changes. Water level change is an obvious cause but cannot expl. in all features of the vegetational changes observed. Evidence is presented to show that nutrient enrichment could have been influential. These two influences cannot be separated easily in the present record because the same cause, increase in sewage and urban runoff with human development in the catchment, has led to both. (Peters-PTT)
W86-04697

NITROGEN CYCLING IN A FRESHWATER MARSH OF PANICUM HEMITOMON ON THE DELTAIC PLAIN OF THE MISSISSIPPI RIVER,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W86-04698

WATER RELATIONS OF CHROMIUM VI TREATED BUSH BEAN PLANTS (PHASEOLUS VULGARIS) L. CV. CONTENDER) UNDER BOTH NORMAL AND WATER STRESS CONDITIONS,

Universidad Autonoma de Barcelona (Spain). Faculty of Sciences.
J. Barcelo, C. Poschenrieder, and B. Gunse.
Journal of Experimental Botany, Vol. 37, No. 175, p 178-187, February 1986. 3 fig, 5 tab, 34 ref.

Descriptors: *Water pollution effects, *Water stress, *Beans, *Plant water potential, *Chromium, Water potentials, Solute potential, Agriculture, Leaves, Turgidity, Plant Physiology, Drought.

The effect of different Cr VI concentrations on leaf water potential, solute potential, turgor potential and relative water content of bush bean plants was studied in the presence of an adequate water supply and under water stress conditions. Plants were grown on perlite with nutrient solution containing 0, 1.0, 2.5, or 10.0 micrograms per cc Cr. The effect of Cr on water relations was concentration dependent, and primary and first trifoliate leaves were affected differently. The growth reducing concentrations of Cr generally decreased leaf water potential and solute potential and increased turgor potential in primary leaves. The 1.0 microgram per cc Cr treatment did not affect growth, but altered water relations substantially: in primary leaves, leaf water potential and turgor potential were increased and solute potential decreased, while in trifoliate leaves the effect was the opposite. All Cr treated plants resisted water stress for longer than control plants. The higher water stress resistance may be due to the lower solute potential, and to the increased cell wall elasticity observed in Cr VI treated plants. (Peters-PTT)
W86-04701

ACID RAIN - A FURTHER LOOK AT THE EVIDENCE,

For primary bibliographic entry see Field 5B.
W86-04704

SCREENING COMPLEX HAZARDOUS WASTES FOR MUTAGENIC ACTIVITY USING A MODIFIED VERSION OF THE TLC/SALMONELLA ASSAY,

Health Effects Research Lab., Research Triangle Park, NC. Genetic Bioassay Branch.
For primary bibliographic entry see Field 5A.
W86-04709

DETERGENT PHOSPHATE BANS AND EUTROPHICATION,

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W86-04719

CADMIUM-BINDING PROTEIN (METALLOTHIONEIN) IN CARP,

Gifu Pharmaceutical Univ. (Japan). Dept. of Environmental Hygiene.
H. Kito, Y. Ose, and T. Sato.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 117-124, March 1986. 2 tab, 8 fig, 28 ref.

Descriptors: *Carp, *Cadmium, *Protein, Metals, Metallothionein, Toxicity, Kidneys, Amino acids, Tolerance, Chromatography, Zinc, Tissue analysis, Detoxification.

The induction of metallothionein (MT) in carp exposed to Cd was studied. When carp were exposed to 5 and 30 ppm Cd in the water, the contents of low molecular weight Cd binding protein increased in the hepatopancreas, kidney, gills and gastrointestinal tract with the duration of exposure. This Cd-binding protein was purified from hepatopancreas, kidney, gill, and spleen of carp administered 2 mg/kg Cd as CdC12, intraperitoneally for 6 days. Two Cd-binding proteins were separated by DEAE-Sephadex A-25 column chromatography. These proteins had Cd-mercaptide bonds, high cystein contents (29-34%), but no aromatic amino acids or histidine. From these characteristics the Cd-binding proteins were identified as MT. In the Cd-treated group (2 mg/kg IP daily for 3 days), MT was present in the nuclei, sinusoids, and extracellular space of hepatopancreas, in addition to the acinar cells. In the non-treated group, MT was present in the acinar cells of hepatopancrease and renal convoluted tubules. Carps were bred in 1 ppm Cd, 5 ppm Zn, and tap water for 14 days followed by transfer to a 15 ppm Cd solution for 18 hr. The survival ratio was highest in the Zn group followed by Cd-treated and control groups, indicating a developement of tolerance to Cd toxicity after exposure to a lower concentration of Cd and Zn. The MT contents increased in hepatopancreas and kidney in the order: Zn>Cd>control group. (Peters-PTT)
W86-04757

COPPER-BINDING PROTEINS IN LIVER OF BLUEGILLS EXPOSED TO INCREASED SOLUBLE COPPER UNDER FIELD AND LABORATORY CONDITIONS,

Lawrence Livermore National Lab., CA. Environmental Sciences Div.
F. L. Harrison, and J. R. Lam.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 125-132, March 1986. 1 tab, 5 fig, 50 ref.

Descriptors: *Bluegills, *Copper, *Proteins, *Toxicity, Detoxification, Metals, Hydrogen ion concentration, Livers, Cadmium, Zinc, Electric powerplants, Effluents, Mortality, Fish, Tissue analysis.

The quantities of copper associated with metalloproteins were determinedin the livers of bluegills exposed to different concentrations of soluble copper under field and laboratory conditions. The effect of the pH of the water on the amounts present and the distribution among metalloprotein fractions was assessed. Analyses were performed on bluegills collected from the impoundment of the H. B. Robinson Steam Electric Plant (Florence, SC) near the effluent discharge of the power plant, near the water intake in the cooling system, and from a control pond as well as on bluegills exposed under controlled laboratory conditions. Metalloproteins were separated into low molecular weight (LMW), intermediate molecular weight (IMW) and high molecular weight (HMW) fractions by using high-performance liquid chromatography. In the field-exposed bluegills, Cu concentrations in the LMW, IMW, and HMW fractions were highest in bluegills from the discharge site and lowest in those from the control pond. In the laboratory-exposed bluegills, Cu concentrations in the fractions increased with exposure concentration and time. Concentrations of Cu in the LMW protein fraction and pellet of bluegills exposed to 160 micrograms Cu/L appeared to plateau with long exposure times, whereas those in the HMW fraction continued to increase. Bluegills maintained in 90 micrograms Cu/L at pH 5.5 accumulated lower concentrations of Cu in the LMW and pellet fractions and higher amounts in the HMW than those maintained in 80 micrograms Cu/L at pH 7.0.

Mortality was dependent on exposure concentration and duration and was higher in bluegills maintained in water at pH 5.5 than at pH 7.0. (Peters-PTT)
W86-04758

CADMIUM ACCUMULATION AND PROTEIN BINDING PATTERNS IN TISSUES OF THE RAINBOW TROUT, SALMO GAIRDNERI,

University Coll., Cardiff (Wales). Dept. of Biochemistry.
J. Kay, D. G. Thomas, M. W. Brown, A. Cryer, and D. Shurben.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 133-139, March 1986. 3 tab, 3 fig, 16 ref.

Descriptors: *Cadmium, *Trout, *Proteins, Toxicity, Body burden, Metallothionein, Detoxification, Metals, Chromatography, Liver, Kidneys, Gills, Zinc, Copper.

Rainbow trout and brown trout were exposed to environmentally relevant concentrations of cadmium by inhalation. A variety of concentrations and times of exposure were investigated and the accumulation of the metal in the tissues and organs of each species was determined. The gills, liver and kidney together accounted for 99% of the accumulated load of body cadmium in the fish. The cadmium in all three organs was bound by two low molecular weight proteins distinct in character from metallothionein. The isoforms of metallothionein were also present but were found to bind only zinc and copper. When trout were injected with cadmium intraperitoneally, most of the metal accumulated in the liver where it was sequestered by the two isoforms of metallothionein. Pre-exposure of the trout to either a low concentration of cadmium (for several months) or to an elevated concentration of zinc (for 5 days) allowed the animals to survive a subsequent exposure to a high, otherwise lethal concentration of cadmium. The proteins responsible for sequestration of the two metals were identified, but two different mechanisms seemed to be involved in the protection of the animals. (Peters-PTT)
W86-04759

TRANSITION METAL-BINDING PROTEINS FROM THREE CHESAPEAKE BAY FISH SPECIES,

Johns Hopkins Univ., Baltimore, MD. School of Hygiene and Public Health.
R. Andersen, J. Frazier, and P. C. Huang.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 149-156, March 1986. 1 tab, 7 fig, 20 ref.

Descriptors: *Proteins, *Heavy metals, *Chesapeake Bay, *Fish, Cadmium, Copper, Zinc, Metal-binding, Catfish, Bass, Perch, Estuaries, Metallothionein, Liver, Chromatography, Tissue analysis, Electrochemistry, Detoxification.

Defense mechanisms against toxicity of metals, particularly transition IB and IIB metals, copper, zinc, and cadmium were studied in striped bass and other fish species. Similar binding proteins exist in the fish species examined. Their constitutive levels and inducibility differ, with striped bass showing only about 10% as much of this protein as white perch. Livers from freshly caught fish were extracted and chromatographed on Sephade G-75 to resolve metal binding protein (MBP) in the 5 to 20 kdalton range. Upon induction with cadmium, the total MBP content increased in both catfish and striped bass, with significant amounts of cadmium bound to the protein. In white perch, induction of MBPs with cadmium could not be demonstrated due to the large amount of constitutive Cu-BP present, although significant quantities of cadmium were bound to MBP. Electrochemical analysis of the MBPs by polarography indicated that the wave properties of the fish MBPs resemble those of rat metallothionein. These studies indicate that MBPs are present in estuarine fish from the Chesapeake Bay, concentrations of BMPs and their inducibility by exogenous cadmium vary with species, and fish MBPs may be related to mammalian metallothionein. (Peters-PTT)
W86-04760

NMR STUDIES OF CRAB AND PLAICE METALLOTHIONEINS,

Birkbeck Coll., London (England). Dept. of Chemistry.
D. P. Higham, J. K. Nicholson, J. Overnell, and P. J. Sadler.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 157-165, March 1986. 1 tab, 9 fig, 16 ref.

Descriptors: *Crabs, Heavy metals, *Spectroscopy, Zinc, Detoxification, Copper, Cadmium, Fish, Metallothionein, Plaice, Nuclear magnetic resonance.

Cd113-NMR spectroscopy was used to characterize the cadmium-binding sites in crab metallothionein and proton NMR to investigate the reactivity of the bound metal ions towards EDTA. The kinetics of metal removal from proteins such as metallothionein by EDTA can be followed by measuring the intensities of the separate H1 resonances due to the metal-EDTA complexes. This approach allows simultaneous observations of changes in the proton NMR spectrum of the proteins themselves, which are related to changes in the tertiary structure of the protein. Metallothioneins isolated from the hepatopancreas of the edible crab and the plaices after cadmium injection are predominantly cadmium proteins containing only small amounts of zinc and traces of copper. Nearly all the zinc present in the protein was extracted by EDTA relatively rapidly, whereas only 10 to 20% of the total cadmium was removed in at least three steps. The total (Cd + Zn) metal removed at equilibrium was 1.2 to 1.8 gram-ions/mole protein. The coordination environments of the cadmium ions in crab metallothionein were investigated by using Cd113-NMR, and compared with Cd113-NMR spectra of rabbit liver and Scylla serrate metallothioneins. The metal binding sites in the crab metallothioneins are as closely related to the rabbit metallothionein as to that from the Scylla serrata. (Peter-PTT)
W86-04761

HG- AND CU-INDUCED HEPATOCELLULAR CHANGES IN THE MUMMICHOG, FUNDULUS HETEROCLITUS,

New Jersey Medical School, Newark. Dept. of Anatomy.
P. Weis, J. D. Bogden, and E. C. Enslee.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 167-173, March 1986. 2 tab, 4 fig, 20 ref.

Descriptors: *Killifish, *Copper, *Mercury, Heavy metals, Methylmercury, New Jersey, Liver, Tissue analysis, Detoxification, Fish physiology.

A morphological approach was employed in the analysis of the liver of the mummichog in the course of examining possible mechanisms that enable the fish to tolerate heavy metals. The liver was chosen because it is the source of metal binding proteins. Less than 10% of the hepatic copper and none of the mercury were associated with metallothionein in the cytosol. Substantial differences were noted among liver of Hg(2+)- and Cu(2+)-treated and untreated fish. The changes observed may be related to the species' ability to tolerate these metals. In earlier work, protein analysis of liver indicated that most of the cytosolic Cu is bound to the sulfhydryl rich metallothionein, but that Hg is not associated with cytosolic proteins. Morphometric analysis indicates the Hg-treatment increases the lipid compartment of hepatocytes. This lipid increase is correlated with the Hg content of individual liver samples. Cu treatment causes a reduction in the lipid compartment, reduces cytoplasm in general, and an increased lysosome count. X-ray microanalysis locates Cu in secondary lysosomes, but not in other organelles. Results of treatment with both Hg(2+) and Cu(2+) are similar to those of Hg(2+) alone. Concentrations of Cu in liver varied too much to allow assessment of correlations with cytoplasmic changes. Usual mechanisms for handling toxic heavy metals include binding to metallothionein and sequestering in lysosomes. Fish, however, can methylate Hg. Increased cellular lipid may be a mechanism for sequestering the lipid-soluble methylmercury. (Peters-PTT)
W86-04762

METAL-BINDING PROTEINS AS METAL POLLUTION INDICATORS,

National Research Inst. for Oceanology, Stellenbosch (South Africa).
H. F. - K. O. Hennig.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 175-187, March 1986. 2 tab, 12 fig, 30 ref.

Descriptors: *Fish, *Metals, *Proteins, *Pollutant identification, *Bioindicators, Cadmium, Zinc, Copper, Crayfish, Hermit crabs, Shrimp, Mussel, Limpets, Bullia, Grass, Heavy metals, Amino acids, Toxicity.

Metal-binding proteins were isolated from different marine animals that were kept under identical enriched conditions. The animals used differed in phyla, size, mass, age, behavior, food, and life stages and included: crayfish, hermit crabs, shrimp, mussels, limpets, bullia, and grass. The metals that were determined were: zinc, cadmium, and copper. The organisms accumulated metals at different rates. Abnormal molting in crustacea was demonstrated in the absence of metal accumulation but in the presence of metal-binding proteins. The presence of metal-binding proteins confirms toxic metal pollution. This concept was then tested under field conditions in the whelk Bullia digitalis and in metal-enriched grass. It is suggested that metal-binding protein determinations should replace metal analyses in pollution studies. (Peters-PTT)
W86-04763

CADMIUM-BINDING PROTEINS IN THE SCALLOP PECTEN MAXIMUS,

Institute of Marine Biochemistry, Aberdeen (Scotland).
H. C. Stone, S. B. Wilson, and J. Overnell.
Environmental Health Perspectives EVHPAZ, Vol. 65, No. 189-191, March 1986. 1 tab, 3 fig, 14 ref.

Descriptors: *Cadmium, *Scallops, *Chromatography, Amino acids, Carbohydrates, Metallothionein, Proteins, Tissue analysis, Detoxification.

Progress in characterizing the cadmium-binding components in the scallop digestive gland is discussed. Scallops accumulate cadmium naturally in the digestive gland to a level of approximately 100 ppm net weight. Of this cadmium, 60% was soluble and was composed of three weight classes as judged by Sephadex G-100 chromatography. Of the soluble cadmium, 60% was in the 55,000 weight range and 20% each in an excluded fraction and a 10,000 molecular weight fraction. The 55,000 molecular weight fraction showed a maximum cadmium concentration of 1.4%. The cadmium was thiolate bound but not as strongly as in the case of metallothionein. The 10,000 molecular weight fraction was a metallothionein-like protein. (Peters-PTT)
W86-04764

ENVIRONMENTAL FATE AND AQUATIC TOXICOLOGY STUDIES ON PHTHALATE ESTERS,

Exxon Chemical Co., Baton Rouge, LA.
E. F. Group, Jr.
Environmental Health Perspectives EVHPAZ, Vol. 65, p 337-340, March 1986. 2 tab, 5 ref.

Descriptors: *Aquatic environment, *Toxicity, *Phthalates, Daphnia, Esters, Trout, Minnows, Algae, Shrimp, Activated sludge, Organic compounds, Biodegradation, Bioassay, Fish, Benthos, Algae, Invertebrates, Solubility.

A condensation of the results and conclusions from Phase 1 of a study sponsored by the Chemical Manufacturers Association (CMA) to broaden the environmental data base on phthalate esters is presented. The concentration at which effects on aquatic life might occur, the potential for bioconcentration in aquatic life, and the relative persistence in the environment of 14 phthalate esters were studied. A total of 195 individual studies were carried out. No single test species was unusually sensitive to the test materials. The higher molecular weight (longer side-chain) phthalates ex-

hibited no toxic effects up to their limits of water solubility in the test systems. No lower molecular weight, more water-soluble phthalates, exhibited unusually severe effects even though they produced toxic effects below their limits of water solubility. Data from water flea chronic studies, coupled with recent data published outside of the CMA program, show that effect levels for di(2-ethylhexyl) phthalate (DEHP) and other phthalates are one to two orders of magnitude (10 x 100 x) above the 3 ppb reproductive effect level for DEHP reported in 1973. Phthalates were shown to be practically nonvolatile and only sparingly soluble in water. The high molecular weight phthalates can be expected to partition preferentially from water to organic matter. All phthalates tested were readily biodegraded under the aerobic/highly microbial population test conditions. The CMA Phthalate Esters Panel believes the scientific data support a conclusion that phthalates do not pose a significant threat to the environment. (Peters-PTT)
W86-04765

FRESHWATER BIOLOGICAL MONITORING.

International Association on Water Pollution Research and Control, London (England).
For primary bibliographic entry see Field 5A.
W86-04767

FRESHWATER BIOLOGICAL MONITORING: KEYNOTE ADDRESS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5A.
W86-04768

EARLY WARNING OF EUTROPHICATION IN RIVERS BY ANALYSIS OF PERIPHYTON CHLOROPHYLL A,

National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5A.
W86-04772

INVESTIGATIONS INTO THE CAUSES OF FISH KILLS OCCURRING IN THE RIVER MEUSE (1979-1983),

Antwerpse Waterwerken (Belgium).
F. Van Hoof, W. Van Craenenbroeck, and D. Marivoet.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 53-63, 5 fig, 6 tab, 10 ref.

Descriptors: *Water pollution, *Cyanide, *Water pollution effects, *Fishkill, Meuse River, River Meuse, Ourthe River, Tissue analysis, Fish kill, Lethal limit, Toxicity, Belgium, Heavy metals, Cadmium, Zinc, Copper.

A series of fish kills occuring in the rivers Meuse and Ourthe at Liege (Belgium) has been investigated by analysis of water samples collected near the sites of the incidents and by analysis of fish tissues obtained from representatives of dominant species killed in the incidents. Most kills were shown to be caused by cyanide containing discharges. In three of these, no other toxicants than cyanide were involved. In the remaining cases discharges containing cyanides and metals were found. The analysis of fish tissues for metals proved to be a valuable tool for confirming or excluding the implication of metals in these incidents. Complementary to the conclusions concerning acute exposure, information is obtained on the levels and distribution of cadmium, zinc and copper due to chronic exposure. For cadmium a substantial decreases in tissue concentrations has occurred over the last five years, which reflected a decrease in cadmium levels in the river Meuse over the same period. No clear trends were observed for tissue levels of copper and zinc although levels of these metals in river water showed a downward trend. (See also W86-04767) (Author's abstract)
W86-04773

ASPECTS OF UTILIZING CONTINUOUS AUTOMATIC FISH BIOMONITORING SYSTEMS FOR INDUSTRIAL EFFLUENT CONTROL,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W86-04774

TOXICITY TESTING WITH FRESHWATER MACROINVERTEBRATES: METHODS AND APPLICATION IN ENVIRONMENTAL MANAGEMENT,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5A.
W86-04776

PREDICTION OF THE TOXICITY OF COPPER TO AUSTRALIAN FRESHWATER ANIMALS,

New South Wales Inst. of Tech., Broadway (Australia).
J. F. Skidmore, and I. C. Firth.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. New York, 1984. p 93-101, 3 fig, 7 ref.

Descriptors: *Water pollution effects, *Toxicity, *Prediction, *Bioassay, Prediction, Copper, Zinc, Fish, Invertebrates, Molluscs, Crustaceans, Lethal limit, Australia.

The damaging effects of pollution are usually only evaluated by surveys before and after the pollution has occurred. By then it is often too late to reverse the deterioration to the quality of life. With forethought, toxicity bioassays may be used to predict the adverse effects of potential pollutants before release. By relating pollutants to water quality, and using test animals indigenous to the affected locality, toxicity bioassays can predict quite closely the impact of pollutants on an ecosystem at risk. Work at the New South Wales Institute of Technology has compared the sensitivity of Australian freshwater fish and invertebrates to copper and zinc at three temperatures. Acute tests over 9 days have indicated that freshwater mussels are very resistant to copper, whilst fish and crustaceans are relatively sensitive. Work in progress is attempting to identify the most sensitive life stages of a representative fish, crustacean and snail, in order to assess the maximum acceptable toxic concentration (MATC) of copper to three potential Australian biological indicators of water quality. (See also W86-04767) (Author's abstract)
W86-04777

COMPARISON OF BIOMONITORING TECHNIQUES FOR EVALUATING EFFECTS OF JET FUEL ON BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
T. R. Doane, J. Cairns, and A. L. Buikema.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. p 103-112, 2 tab, 25 ref. Grant No. AFOSR-82-0059.

Descriptors: *Hydrocarbons, *Bluegills, *Biological monitoring, *Monitoring, *Water pollution effects, Water pollution, Lepomis macrochirus, Oil pollution, Oil, JP-4, Fish physiology, Sunfish.

The purpose of this study was to compare the effects of the water soluble fraction (WSF) of JP-4, a common military and civilian jet fuel, on survival, behavior, and physiology of bluegill sunfish (Lepomis macrochirus). The dynamic 96-hr LC50 for WSF JP-4 was 26.2% (percent of the maximum soluble amount of JP-4). A 5.1% WSF JP-4 caused a shift in ventilatory rate and amplitude; this concentration was equivalent to the 96-hr LC01. Fish displayed an avoidance reaction when exposed to 3.5 and 4.9% WSF JP-4. At higher concentrations approaching the 96-hr LC50, fish appeared to lose their ability to detect WSF JP-4indicating a potential for fish not to avoid lethal concentrations. Few significant changes in whole and serum blood parameters were detected in fish exposed to 13% WSF JP-4; near the 96-hr LC50 changes were primarily attributed to osmoregulatory failure. (See also W86-04767) (Author's abstract)
W86-04778

LEMNA AS AN INDICATOR OF WATER POLLUTION AND THE ABSORPTION OF HEAVY METALS BY LEMNA,

Shinshu Univ., Matsumoto (Japan). Dept. of Public Health.
For primary bibliographic entry see Field 5A.
W86-04779

APPLICATION OF AN ALGAL ASSAY TO ASSESS TOXICITY AND EUTROPHICATION IN POLLUTED STREAMS,

Norsk Inst. for Vannforskning, Oslo.
T. Kallqvist.
IN: Freshwater Biological Monitoring, Proceedings of a Specialised Conference held in Cardiff, England, September 12-14, 1984. 1984. p 121-129, 2 fig, 3 tab, 7 ref.

Descriptors: *Bioassays, *Toxicity, *Eutrophication, *Water pollution effects, *Algal growth, Water pollution, Monitoring, Biological monitoring, Running waters, Lotic environment, Selenastrum capricornutum, Oslo, Norway. Domestic wastes.

Algal assays can give information on the content of nutrients as well as toxic compounds in water samples. These characteristics of the algal assays were utilized in a study of four streams running through the city of Oslo. The streams receive pollutants from municipal sewage, industrial wastewater and surface runoff. The pollution situation is therefore often very complicated. Water samples from different parts of the streams were divided into two fractions. To one of these a nutrient solution was added. Algal assays with the green alga Selenastrum capricornutum were performed on both fractions. From the cell yield, growth rate and shape of the growth curves it was possible to classify the water samples into five categories as regards nutrient content and toxic properties. The algal assays revealed that the water quality of the streams changed drastically on the way through the city. Pollution caused by seepage of domestic sewage from the sewerage system resulted in very high algal growth potential in streams running through built up areas. Toxic effects of industrial wastewaters were also detected. The study has shown that algal assays may be a useful supplement to chemical analysis to assess the state of pollution. The bioassays provide a simple and effective instrument for the identification of sources of toxic pollutants and nutrients causing eutrophication. (See also W86-04767) (Author's abstract)
W86-04780

COMPLIANCE BIOMONITORING - STANDARD DEVELOPMENT AND REGULATION ENFORCEMENT USING BIOMONITORING DATA,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W86-04783

BIOACCUMULATION AND EFFECTS ON REPRODUCTION IN AQUATIC ORGANISMS: AN ASSESSMENT OF THE CURRENT LITERATURE,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W86-04825

HYDROTHERMAL-BIOLOGICAL COUPLING OF LAKE EUTROPHICATION MODELS,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
M. -P. Wang, and D. R. F. Harleman.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB83-174391,

Price codes: A17 in paper, A01 in microfiche. Report No. 270, April 1982. 384 p, 192 ref, 2 append. Contract No. CEE7906125.

Descriptors: *Eutrophication, *Limnology, *Model studies, *Lakes, *Hydrothermal-Biological model, Phytoplankton, Nutrients, Phosphorus, Dynamics, Hydrologic data collection.

A deterministic model is developed to simulate lake response to changes in hydrologic conditions or nutrient input. The state of the art of hydrothermal modeling in a phosphorus-limited condition is presented. It is demonstrated that a mixed layer hydrothermal model, which calculates the daily vertical temperature profile and thickness of the upper fully mixed layer based on meteorological and hydrological information, is capable of simulating the transport and diffusive process in a stratified lake with a minimum number of calibrated parameters. Phytoplankton modeling of L227 is used as a case study to illustrate the methodology for arriving at a biological model whose complexity is consistent with available data. A procedure is indicated for extracting biological rate constants from primary productivity measurement, and the extent to which the linked hydrothermal-biological model simulates the phytoplankton dynamics is discussed. The importance of capturing the short-term dynamics of the fully mixed layer in the modeling of phytoplankton variation is illustrated. (Author's abstract)
W86-04938

HEALTH HAZARDS ASSOCIATED WITH WINDSURFING ON POLLUTED WATER,

Laval Univ., Quebec. Dept. of Medicine.
E. Dewailly, C. Poirier, and F. M. Meyer.
American Journal of Public Health, Vol. 76, No. 6, p 690-691, June 1986. 2 tab, 13 ref.

Descriptors: *Water pollution effects, *Swimming, *Rivers, Canada, Quebec, St. Lawrence River, Gastroenteritis, Otitis, Conjunctivitis, Skin infection, Human diseases, Recreation, Windsurfing.

In August 1984, the Windsurfer Western Hemisphere Championship was held in Quebec city, on the St. Lawrence River in the baie de Beauport, where water is contaminated by sewage. This event prompted an assessment of the health hazards associated with windsurfing on polluted water. There were 79 windsurfers and 41 controls who were studied over a nine-day period for occurrence of symptoms of gastroenteritis, otitis, conjunctivitis, and skin infection. Relative risks were 2.9 for occurrence of one or more of these symptoms and 5.5 for symptoms of gastroenteritis. Relative risk increased with the reported number of falls into the water. (Peters-PTT)
W86-04943

INFECTIOUS DISEASES AND FIELD WATER SUPPLY AND SANITATION AMONG MIGRANT FARM WORKERS,

Utah Univ., Salt Lake City. Coll. of Health, Physical Education, and Recreation.
D. M. Arbab, and B. L. Weidner.
American Journal of Public Health, Vol. 76, No. 6, p 694-695, June 1986. 1 tab, 2 ref.

Descriptors: *Sanitation, *Fecal-related disease, *Water supply, Migrant workers, Water supply, Legal aspects, Feces, Public health, Human diseases, Standards, Regulations.

The Occupational Safety and Health Administration (OSHA) requested testimony regarding fecal-related diseases among migrant farm workers in Utah, where there is no law for provision of excreta disposal, hand washing, and drinking water facilities for farm workers. An audit was performed on clinic charts for 936 migrant workers and 8,968 urban poor. Migrants displayed a clinic utilization rate for diarrhea 20 times higher than that of the urban poor. Similar findings for other enteric disease symptoms were documented. The data suggest that a water and sanitation standard mandating facilities in the work field for farm workers would reduce the incidence of fecal-related disease. (Peters-PTT)
W86-04944

CHRONIC TOXICITY OF 4-NITROPHENOL TO DAPHNIA MAGNA STRAUS UNDER STATIC-RENEWAL AND FLOW-THROUGH CONDITIONS,

Lilly (Eli) and Co., Indianapolis, IN. Lilly Research Lab.
P. C. Francis, D. W. Grothe, and J. C. Scheuning.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 730-737, May 1986. 3 tab, 1 fig, 11 ref.

Descriptors: *Daphnia, *Toxicity, *Pesticides, *Bioindicators, Nitrophenol, Survival, Neonates, Population dynamics, Growth rates, Testing procedures.

The objectives of the study were to develop a flow-through system for chronic testing with Daphnia magna; compare the reproduction and growth of D. magna under flow-through and static-renewal conditions; and evaluate the chronic toxicity of 4-nitrophenol (4-NP) in the two test systems. Survival frequencies in the static-renewal test ranged from 70% at 20 mg/liter to 100% in the control. At 4-NP concentrations < or = 50 mg/liter, average neonate production per female ranged from 111.7 to 124.6. Significant decreases in reproduction per female dropped to 88.4 and 11. The only significant reduction in growth occurred at 20 mg/liter where body lengths averaged 3.87 mm compared to mean lengths of 4.19 to 4.27 mm at concentrations < or = 10 mg/liter. Under flow-through conditions, survival frequencies at 4-NP concentrations of < or = 10 mg/liter ranged from 65% to 90% compared to control survival of 90%. Total mortality occurred at the 20 mg/liter treatment by day 7. As in the static-renewal test, 10 mg/liter was the lowest concentration that caused a significant decrease in reproduction. It is concluded that 4-NP concentrations > or = 10 mg/liter were chronically toxic to D. magna under both static-renewal and flow-through conditions. (Peters-PTT)
W86-04962

IMPACT OF PULP AND PAPER MILL EFFLUENT ON EGG HATCHABILITY OF PIKE (ESOX LUCIUS L.),

Finnish Pulp and Paper Research Inst., Helsinki.
J. Tana, and E. Nikunen.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 738-743, May 1986.

Descriptors: *Pulp and paper industry, *Pike, *Effluent, *Fish eggs, *Hatching, Finland, Wastewater disposal, Mortality, Survival, Bioassay, Teratogenicity, Kraft mill wastes.

The egg survival and malformation frequencies of a pike population living in a pulp and paper discharge area were studied and compared with corresponding values of a reference group from a clean area. The effects of different pulp and paper mill effluent concentrations on survival and malformation frequencies were examined and the impact of waste water concentration at the fertilization moment was studied. The eggs of pikes caught from the discharge site of the mill were more resistant to the effluent than the eggs of fish from a clean area; a higher percentage of eggs stayed alive in all the effluent concentrations used. All the waste water concentrations used (0.5, 2.5, and 10% bleached kraft pulp mill effluent) caused significant increases in egg mortality. The highest concentrations used raised the mortality quickly whereas the eggs died later in a more dilute solution. A significant positive linear correlation was obtained between the effluent concentration and mortality. No significant alterations in malformation frequencies could be detected. The pike population that lived in the recipient site showed indices of acclimatization to the strongly altered water quality. Hauling increased the mortality of the eggs of the exposed pike population. The intolerance to hauling may indicate that the acclimatization to pulp and paper wastewater diminished the capacity to survive in simultaneous stress. (Peters-PTT)
W86-04963

EFFECTS OF TEMPERATURE ON THE ACUTE TOXICITY OF PCP IN THE MIDGE CHIRONOMUS RIPARIUS MEIGEN,

Ohio State Univ., Columbus. Dept. of Entomology.
S. W. Fisher.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 744-748, May 1986. 2 tab, 1 fig, 14 ref.

Descriptors: *Toxicity, *Midges, *Organic pesticides, *Temperature effects, Phenols, Aquatic animals, Pentachlorophenol, Bioassay, Herbicide.

The results of studies conducted on the acute toxicity of the pesticide pentachlorophenol (PCP) under different temperature regimes in the aquatic invertebrate, Chironomus riparius are presented. The toxicity of PCP varies significantly with temperature. The compound is most toxic at 35 C and least toxic at 25 C. PCP is of intermediate toxicity at 15 C. The initial rate of uptake of 14C-PCP is rapid for all three temperatures. An apparent maximum is reached at 21 hours following which depuration of the chemical appears to exceed absorption. The 24 hr uptake readings are slightly depressed relative to the respective 21 hr measurements. The internal concentrations of 14C-PCP at 24 hr decrease in the order 35 > 15 > 25 which is consistent with the toxicity data. Significantly higher levels of PCP are present in the midges held at 35 C than in those maintained at 25 C. Temperature is clearly a factor which must be taken into account when assessing the hazard of aquatic pollutants. (Peters-PTT)
W86-04964

ACCUMULATION AND METABOLIC EFFECTS OF DI-N-BUTYLTIN DICHLORIDE IN THE FRESHWATER CLAM, ANODONTA ANATINA,

Utrecht Rijksuniversiteit (Netherlands). Lab. of Chemical Animal Physiology.
D. A. Holwerda, and H. J. Herwig.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, P 756-762, May 1986. 4 tab, 2 fig, 18 ref.

Descriptors: *Clams, *Toxicity, *Metals, Metabolism, Body burden, Cadmium, Tin, Kidneys, Pollutants, Animal physiology.

The metabolism of clams exposed to dialkytin compounds was examined. The accumulation and location of tin in several organs were determined. Anodonta anatina L. were collected from a pond near Leiden and were exposed to 0.125 millimoles dibutyltin dichloride (DBTC) (equivalent to 15 ppb Sn) for 7 mo. DBTC was not lethal to the clams at this concentration. DBTC significantly influenced parameters that are indicative of delivery and status of energy. The dry weight decreased from 6.8% to 3.8%. Carbohydrate stores were reduced to <25%. The data indicate that the intoxicated clams relied on an anaerobic type of energy metabolism; in all tissues containing significant amounts of glycogen in control animals, glycogen was markedly reduced after exposure of the clams to DBTC. The highest concentrations of tin were found in the kidney. Simultaneous exposure of Anodonta to cadmium chloride did not result in cadmium storing in the kidney. The kidneys did not contain >6% of the total Cd body burden. (Peters-PTT)
W86-04965

TRACE METALS IN MUSSELS (MYTILUS EDULIS) FROM THE WADDENZEE, COASTAL NORTH SEA AND THE ESTUARIES OF EMS, WESTERN AND EASTERN SCHELDT,

Fish Technology Inst. TNO, Ijmuiden (Netherlands).
J. B. Luten, W. Bouquet, M. M. Burggraaf, A. B. Rauchbaar, and J. Rus.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 770-777, May 1986. 6 tab, 1 fig, 5 ref.

Descriptors: *Trace metals, *Mussels, *Estuaries, The Netherlands, Mercury, Cadmium, Lead, Zinc, Copper.

The trace metal content of mussels in the Netherlands has been monitored as part of the Joint Monitoring program for the assessment of the level of marine pollution and the effectiveness of measures taken for its reduction. About 25% of all examined mussel samples have a mercury content >0.5 mg/kg dry matter. The highest mercury content was observed in the Ems-Dollard estuary. The lowest mercury content was found in a sample from the Western Scheldt. The lead contents in mussels from Ems-Dollard, Eastern Scheldt and Waddenzee did not significantly differ from each other. The median lead content in mussels from the coastal North Sea (Noordwijk) was somewhat higher (4.3 mg/kg dry matter). The median lead content of mussels from the Western Scheldt varied from 5.6 to 6.7 mg/kg dry matter. The highest lead content (12.9 mg/kg dry matter) was found in a mussel sample from the Western Scheldt. The lowest lead content (1.4 mg/kg) was in a sample from the Eastern Scheldt. The accumulation of cadmium in mussels from the Western Scheldt sampling locations was much higher than in mussels from the other sampling locations. In the Western Scheldt estuary the cadmium results show a downward gradient from Zuidergat towards the open sea. The highest copper content (29.0 mg/kg) was found in mussels from the Western Scheldt. The median zinc content of mussels from the Waddenzee (87 mg/kg dry matter) was two to three times lower than the median zinc content in mussels from the Western Scheldt and Zuidergat. It is concluded that the trace metal content in mussels from the Western Scheldt is higher than the content of trace metals in mussels from the other sampling locations. (Peters-PTT)
W86-04967

CAUSTIC WASTE MENACES JAMAICA,

J. Bell.
New Scientist, Vol. 110, No. 1502, p 33-37, April 3, 1986.

Descriptors: *Caustic wastes, *Iron oxides, *Jamaica, *Groundwater pollution, Bauxite, Alumina, Industrial wastes, Sodium hydroxide, Wells, Slurries, Aquifers, Alkalinity, Phytotoxicity, Springs.

Each year, bauxite processing in Jamaica produces enough caustic mud to bury 700 football fields and their goalposts. The search is on for ways to limit the waste and its hazards. Bauxite treated with sodium hydroxide (caustic soda) produces aluminium oxide (alumina) and solid waste in about equal quantities. Jamaica's exports of alumina help to feed the world's demand for aluminium. The waste that remains, called red mud, presents a problem. Its particles, mainly of iron oxide, are tiny. More than half are <0.5 micrometers. The result is a slurry that the industry dumps in ponds in dammed valleys, old bauxite pits and clay-lined ponds. The highly caustic red mud waste, which is dangerous to people, plants, and animals has leaked or seeped from two of the biggest ponds and contaminated some shallow wells and ground water. One spring, which rises from an aquifer, is almost as alkaline as the red mud itself, although the aquifers show no sign of alkaline pollution so far. If it is allowed to dry, the slurry becomes hardest at the surface and much softer underneath. Although the Alpart Company has ceased alumina production, its red mud pond remains. The concentration of sodium (which kills plants) in wells near Alpart rose from the year that production began. Seeping ponds have polluted ground water. The worry is that streams and aquifers might become affected. The only way to reclaim a pond is to cover it with topsoil. (Peters-PTT)
W86-04970

EFFECT OF FLUORIDES ON SURVIVAL AND REPRODUCTION OF DAPHNIA MAGNA,

Pittsburgh Univ., PA. Dept. of Industrial Environmental Health Sciences.
A. H. Fieser, J. L. Sykora, M. S. Kostalos, Y. C. Wu, and D. W. Weyel.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 82-86, January 1986. 3 fig, 5 tab, 12 ref.

Descriptors: *Water pollution effects, *Daphnia magna, *Fluorides, *Survival, *Reproduction, *Bioassay, *Toxicity, Mathematical models, Temperature, Hard water, Egg production, Hatchability, Baseline studies.

Baseline data were obtained for the effects of dissolved fluoride on Daphnia magna survival and reproduction. The model developed in this study shows that there exists a simple exponential relationship between the toxicity of fluorides and temperature in hard water. Chronic testing of D magna in hard water at 20 C indicated that the presence of F- anions has a multiple effect on the reproductive system. Increases in F- content up to 65 mg/L F- stimulate egg production by increasing amounts, up to 150% of the control. Conversely, increasing F- concentrations reduce the hatchability rate continuously with a sharp decrease around 34 mg/L. Neonate production equivalent to that of controls was established at 29 mg/L F-, which is, in effect, a 'break-even' point between increased egg production and reduced hatchability. The chronic-to-acute ratio calculated from this safe concentration and the corresponding acute value for hard water was 20 C at 0.12. The application factor calculated on the basis of maximum acceptable toxicant concentration was established to be between 0.11 and 0.14. (Rochester-PTT)
W86-05024

DECLINING LAKE SEDIMENT PHOSPHORUS RELEASE AND OXYGEN DEFICIT FOLLOWING WASTEWATER DIVERSION,

Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch, D. E. Spyridakis, J. I. Shuster, and R. R. Horner.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 92-96, January 1986. 3 fig, 2 tab, 16 ref.

Descriptors: *Water pollution effects, *Lake Sammamish, *Phosphorus, *Lake sediments, *Oxygen deficit, *Wastewater diversion, *Hypolimnion, Mass balance model, Washington, Chlorophyll A, Cores, Oxygen demand, Flocculation, Particulate matter, Sediments.

Sediment phosphorus release rates were determined in vitro from cores obtained in Lake Sammamish, Washington, and these data and sediment P content results were compared with results from the early 1970s. In addition, a P mass balance model was used to independently evaluate sediment release. Lake Sammamish failed to show a predictable response after P loading was reduced by one-third through wastewater diversion in 1968. Over the past 5 yr, however, P concentrations, summer chlorophyll a, and transparency have improved markedly. This dramatic improvement has been largely the result of a decrease in the anaerobic sediment P release rate during summer and fall. The decrease in sediment P release, as determined recently by the rate of hypolimnetic buildup of P, was substantiated by sediment content of interstitial P and by rate of P release in anaerobic columns, but not by total P content in the sediment. Decreased P release rate was also verified by mass balance model. The observed trend of a decreasing rate of hypolimnetic P buildup following diversion may have been caused by a gradual removal of flocculent particulate material, and hence the decreased oxygen demand, at rates much less than the flushing rate. (Rochester-PTT)
W86-05025

OZONIZATION OF HUMIC ACIDS. MEDIUM TERM TOXICITY TOWARDS DAPHNIA MAGNA,

Lille-2 Univ. (France). Unit of Pharmacy.
M. Imbenotte, J. Pommery, N. Pommery, and F. Erb.
Ozone, Vol. 8, No. 1, p 37-48, 1986. 4 tab, 3 fig, 8 ref.

Descriptors: *Ozonation, *Daphnia, *Humic acids, Toxicity, Trace metals, Lyophilization, Surface waters.

The determination of the possible toxicity of ozonized humic acids is investigated. The ozonation products of humic acids are toxicologically interesting because of both their actual toxicity and also, because of their complexing vis-a-vis trace metals present in water. These trace metals are not completely eliminated by potabilization techniques. Determination of the ultimate toxicity of ozonized humic acids is achieved with the aid of the medium term Daphnia magna test. Statistical treatment of the two lethal parameters and of the four sublethal parameters have shown a toxicity for ozonized humic acids in solution, at a concentration of 100 mg/liter. Ultrafiltration allowed isolation of those fractions discovered to be responsible for complexing of metals (M>3 times 100,000 and M <5 times 1000). In following the change of chemical structure of the compounds under the effect of ozonation, it is clear that the medium term toxicity can be related to the increase in aromatic character, which is practically triple in the intermediate mass fraction. The first fraction is toxic only after ozonation, and uniquely on a level of a number of ranges. The fraction M<5 times 1000 before ozonation manifests an appreciable sublethal toxicity on N sub p from a concentration of 2.04 mg/liter. This toxicity disappears after ozonation. Ozonation causes a lethal toxicity of this fraction shown by the CEI 50 (8.9 mg/liter). This concentration is very near to those usually encountered in surface waters. (Peters-PTT)
W86-05041

EFFECTS OF SYNTHETIC POLYELECTROLYTES ON SELECTED AQUATIC ORGANISMS,

Environmental Research Lab.-Duluth, MN.
K. E. Biesinger, and G. N. Stokes.
Journal of the Water Pollution Control Federation JWPFA, Vol. 58, No. 3, p 207-213, March 1986. 7 fig, 5 tab, 12 ref.

Descriptors: *Polyelectrolytes, *Toxicity, *Aquatic organisms, Acute toxicity, Daphnids, Fathead minnows, Gammarids, Midges, Detoxification, Aquatic animals, Algae, Flocculation, Clays.

A series of experiments was conducted on the toxicity of synthetic polyelectrolytes, used extensively in potable and wastewater treatment to promote flocculation. Acute toxicities were tested on daphnids, fathead minnows, gammarids, and midges. Nonionic and anionic polymers were not acutely toxic; cationic polymers were very toxic, their toxicity varying widely with their chemical structure. A subsequent microcosm test using five aquatic animals and 10 algal species showed varying effects on species densities and compositions. Additional studies demonstrated the detoxification of cationic polyelectrolytes by anionic polyelectrolytes and by red, montmorillonite, and kaolinite clays. Finally, gill damage as a result of cationic polyelectrolyte exposure was described based on microscopic examination of fathead minnow gill tissue. (Doria-PTT)
W86-05050

EFFECTS OF ACID EXPOSURE ON THE ION REGULATION AND SEAWATER ADAPTATION OF COHO SALMON (ONCORHYNCHUS KISUTCH) PARRS AND SMOLTS,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
J. F. F. Powell, and B. A. McKeown.
Comparative Biochemistry and Physiology, Vol. 83C, No. 1, p 45-52, 1986. 6 fig, 38 ref.

Descriptors: *Water pollution effects, *Physiological ecology, *Coho salmon, *Acid streams, Fish, Fish physiology, Aquatic environment, Sodium, Enzymes, Potassium.

Juvenile coho salmon parrs and smolts were subjected to acid stress in soft water prior to entry into seawater in order to determine possible lifestage-dependent deleterious effects of acid exposure. Parrs and smolts of one year-class were exposed to acid for varying times; parameters to assess ion regulatory ability were measured in these fish while in freshwater as well as fish exposed to seawater. Smolts exhibited decreases in

plasma sodium levels after 7 days and lower Na(+), K(+)-ATPase activities 14 days after acid exposure. Parrs exhibited increased plasma Na(+) as well as Na(+), K(+)-ATPase activity immediately after transfer to seawater. It is concluded that acid exposure prior to entry into seawater is detrimental to coho salmon with regard to the length of acid exposure and state of development. It is suggested that a possible method by which fish die from acid stress is inhibition of gill Na(+), K(+)-ATPase concomitant with decreases in plasma Na(+) levels. (Doria-PTT)
W86-05061

SEROTYPES OF VIBRIO PARAHAEMOLYTICUS ISOLATES FROM HYDROBIOLOGICALLY DISSIMILAR AQUATIC ENVIRONMENTS,

National Inst. of Cholera and Enteric Diseases, Calcutta (India).
For primary bibliographic entry see Field 5A.
W86-05062

STUDIES OF DIURNAL ACID FLUCTUATIONS IN BRITISH ISOETID-TYPE SUBMERGED AQUATIC MACROPHYTES,

Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
A. M. Farmer, and D. H. N. Spence.
Annals of Botany ANBOA4, Vol. 56, No. 3, p 347-350, September 1985. 3 tab, 16 ref.

Descriptors: *Plant physiology, *Isoetids, *Crassulacean acid metabolism, *Macrophytes, Submerged plants, Aquatic plants, Oligotrophic lakes, Lakes, Photosynthesis, Diurnal distribution.

British isoetid species were surveyed for Crassulacean acid metabolism (CAM) in plants collected directly from a small lake and in plants grown under constant conditions in the laboratory. Wide diurnal fluctuations in titratable acidity (to pH 6.4) were found in Isoetes lacustris and in both terrestrial and submerged populations of Littorella uniflora. They were absent in Lobelia dortmanna, Subularia aquatica, Eriocaulon septangulare, Ranunculus flammula, and Pilularia globulifera. It is hypothesized that CAM is selected in Isoetes spp. as a means of enhancing carbon gain in carbon-limiting environments. Isoetids also possess two additional mechanisms to increase carbon fixation. Root uptake of carbon dioxide is an adaptation to oligotrophic lakes where the sedimentary interstitial water is much richer in dissolved inorganic carbon than the lake water. Also, large lacunae and thick cuticles are efficient at trapping CO2 generated by photorespiration. These mechanisms conserve carbon or trap richer carbon sources, and would enable the plant to avoid competition with other macrophytes which absorb CO2 from lake water. Only one species, Littorella uniflora, is known to possess all three mechanisms; it is also the most widely distributed isoetid, existing over a broad range of alkalinities and trophic levels. (Doria-PTT)
W86-05064

EFFECTS OF CHLORINE AND AMMONIA FROM WASTEWATER TREATMENT FACILITIES ON BIOTIC INTEGRITY,

Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
J. R. Karr, R. C. Heidinger, and E. H. Helmer.
Journal of the Water Pollution Control Federation JWPFA, Vol. 57, No. 9, p 912-915, September 1985. 2 fig, 1 tab, 12 ref. Illinois Department of Energy and Natural Resources Project No. 20.132; EPA Grants R-806391 and CR-810745.

Descriptors: *Wastewater treatment, *Water pollution effects, *Biotic integrity, *Chlorine, *Ammonia, Halogens, Cost-benefit analysis.

Construction projects for wastewater treatment have the goal of improving both chemical and biological integrity. Wasteload allocation models used to site and design treatment facilities usually emphasize reduction in chemical loading to the receiving system and assume that biological integrity will improve. Chorination kills pathogens discharged in wastewater effluents but the residual chlorine can produce toxic effects in fish and other biota. Ammonia at high concentrations is also detrimental to aquatic life. The purpose of this study was to determine if IBI (Index of Biotic Integrity) is sensitive enough to track changes in the biota of streams that are subjected to various concentrations of chlorine and ammonia. IBI varied in space and in time in concert with known variation in physical, chemical, and biological parameters in the stream. IBI clearly showed that inclusion of chlorine in secondary wastewater treatment has major negative impacts on biotic integrity. IBI also showed that massive expenditures required for removal of ammonia in tertiary treatment plants are not always warranted. In many cases, nitrogen levels do not limit biotic integrity. (Khumbatta - PTT)
W86-05067

WATER AND NEPAL,

C. Collins.
Journal of the Royal Society of Health, Vol. 105, No. 5, p 181-183, October 1985. 4 ref.

Descriptors: *Nepal, *Water-borne disease, Contamination of water supply, Water quality management.

The lack of available safe drinking water and sanitation is a serious problem throughout the country of Nepal. The demand for water is ever increasing especially in the hills and mountains. More concentrated water supply programmes will have far reaching impact on the well being of the people in the rural areas. The lack of safe drinking water has a deleterious impact on the life in Nepal and water-borne diseases are common throughout the country. Both streams and groundwater supplies are unreliable and not safe to drink. In Katmandu, water leaves the treatment plant free of pathogens but becomes contaminated in the distribution system. Most of this problem is caused by the intermittent water supply which leaves the pipes empty for part of the day. If Nepal can develop water as it intends to, development will occur in all other fields as well, and this will help to control the water-borne diseases which are so prevalent and improve the general health status of the country. (Khumbatta-PTT)
W86-05075

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES: 3. AMMONIA,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. A. Williams, D. W. J. Green, and D. Pascoe.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 1, p 61-70, 1986. 2 fig, 4 tab, 14 ref. EEC Contract ENV.484.81 UK(H).

Descriptors: *Water pollution effects, *Macroinvertebrates, *Ammonia, *Toxicity, Lethal limit, Median tolerance limit, Mollusks, Insects, Crustaceans, Oligochaetes, Ecological effects.

Acute toxicity tests (approximately 14 days) using a continuous-flow testing apparatus were conducted on eleven species of macroinvertebrate. In assessing the acute toxicity of this pollutant the relative importance of the ammonium ion (NH4(+)) and the unionized molecule (NH3) was determined. The median lethal time (LT50) for each species decreased with increasing ammonia concentration (total and unionized). Results showed that the ionized form of ammonia (NH4(+)) was not acutely toxic, the concentration of the unionized molecule (NH3) determining the acute toxicity of ammonia. Interspecific differences in 96 h LC50 values were observed with a fourfold difference between the most sensitive (P. tenuis) and the most tolerant species (H. angustipennis). The mollusk L. stagnalis was approximately twice as sensitive as another mollusk P. fontinalis. The insects L. ineris, C. riparius, B. rhodani and E. ignita were all intermediate in sensitivity while the oligochaete L. hoffmeisteri and the crustaceans G. pulex and A. aquaticus proved most resistant of the species tested. The species studied were of similar sensitivity when assessed after 150 hours exposure. However, sensitivities were very different with respect to toxic threshold concentrations over very short exposure periods. Thus some macroinvertebrates in the present study would survive for short periods in high concentrations, which would be lethal to other species. (Lantz-PTT)
W86-05086

BENTHIC MACROINVERTEBRATE COMMUNITY STRUCTURAL AND FUNCTIONAL GROUP RESPONSE TO THERMAL ENHANCEMENT IN THE SAVANNAH RIVER AND A COASTAL PLAIN TRIBUTARY,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
N. L. Poff, and R. A. Matthews.
Archiv fuer Hydrobiologie AHYBAY, Vol. 106, No. 1, p 119-137, 1986. 3 fig, 3 tab, 51 ref. DOE Contract DE-AC0976SR00001.

Descriptors: *Macroinvertebrates, *Thermal pollution, *Savannah River, *Coastal plains, Benthic fauna, Water pollution effects, Thermal stratification, Thermal water, Thermal stress, Effluents, South Carolina, Powerplants.

Benthic macroinvertebrate community structure and functional groups on leaf detritus in a thermal, post-thermal and an undisturbed stream, and in the Savannah River immediately downstream from each stream mouth, were compared over a 7 week (48 d) period from December 1982 to February 1983. Temperatures in the post-thermal and undisturbed streams ranged from 4-8 and 4-11 C, respectively, and from 7-12 C in the Savannah River. Temperatures in the thermal stream fluctuated irregularly between 7-31 C and in the river below this stream mouth between 7-22 C. A total of 13,993 macroinvertebrates representing at least 51 families and 84 genera are collected. Numbers of organisms and taxa were depressed at the thermal stream site, whereas numbers of both organisms and taxa were depressed at the thermal stream site, whereas numbers of both organisms and taxa increased at the river site receiving thermal effluent. Chironomids of the subfamily Orthocladiinae comprised 46-60% of the fauna at all sites except in the thermal stream, where they comprised 5%. Gastropoda, Tanypodinae, and Chironominae, each contributed over 20% to the fauna at the thermal stream. Trichoptera represented 12-13% of the riverine fauna at the ambient sites, but 25% at the thermally-perturbed site. Collectors (mostly gatherers) contributed 51-75% at all sites except the thermal stream, where scrapers dominated with 39%. Filterer relative abundance increased from 16-19% at the ambient river sites to 29% at the thermally-perturbed river site, suggesting that suspended carbon transport from the thermal stream occurred and subsidized the macroinvertebrate community in the Savannah River. (Lantz-PTT)
W86-05089

EFFECT OF RIVER WATER ON PHYTOTOXICITY OF BA, CD AND CR,

Illinois State Water Survey, Peoria. Water Quality Section.
W. Wang.
Environmental Pollution (Series B), Vol. 11, No. 3, p 193-2004, 1986. 10 fig, 10 ref.

Descriptors: *Phytotoxicity, *Water pollution effects, *Duckweed, *Barium, *Cadmium, *Chromium, Illinois River, Deionized water, Toxicity, Heavy metals, Chemical reactions, Biological properties.

The phytotoxicity of heavy metals in the environments of deionized water and Illinois River water was compared. An attempt was made to differentiate which fraction of the river water (dissolved vs. particulate) was affecting the phytotoxicity. A 75 liter sample of Illinois River water was taken on December 6, 1982 for comparison with deionized water to test metal toxicity to duckweed. Barium, cadmium and chromium (VI) were tested. There were three different types of results. Ba is moderately toxic in deionized water and non-toxic in river water. Cd is extremely toxic in deionized water and also substantially toxic, though somewhat less so, in river water. Cr(VI) toxicity in river water is more or less identical to that in

deionized water. The results suggest that biological effects and chemical characteristics are interrelated. There are substantial differences between the results of using deionized water and ambient water samples, and more importantly, the differences are dependent upon species of metal ions. (Peters-PTT)
W86-05101

IMPACT OF PHYSIO-CHEMICAL STRESS ON THE TOXIGENICITY OF VIBRIO CHOLERAE,

London School of Hygiene and Tropical Medicine (England). Dept. of Tropical Hygiene.
For primary bibliographic entry see Field 5B.
W86-05105

HEALTH EFFECTS AND RISKS FROM RN222 IN DRINKING WATER,

Battelle Pacific Northwest Labs., Richland, WA. Biology Dept.
F. T. Cross, N. H. Harley, and W. Hofmann.
Health Physics, Vol. 48, No. 5, p 649-670, May 1985. 6 tab, 122 ref. Dept. of Energy contract DE-ACO6-76RLO 1830.

Descriptors: *Water pollution effects, *Public health, *Drinking water, *Radon radioisotopes, *Air pollution, Uranium radioisotopes, Mine wastes, Radioactive wastes, Carcinogens, Epidemiology.

This paper presents an evaluation of the inhalation and digestion doses from exposure to Rn and Rn progeny and gives an overview of the human and animal health-effects data. Estimates of the lung cancer risks and stomach and whole-body cancer risks from exposure to Rn and Rn-progeny in drinking water are also examined. A rounded Rn-in-water concentration limit of 10,000 pCi/L can be supported by health-effects considerations alone, based on the conservative 'tolerance dose' concept and other conservative assumptions regarding lung dose. A practical concentration limit (or action level) of 20,000 pCi/L has been derived by estimations of exposure distributions in the United States and in relation to current U. S. Environmental Protection Agency standards for U-tailings-contaminated buildings. It is suggested that before a maximum contaminant level for Rn in water can be firmly established, the broader issue of setting the maximum contaminant level for Rn in indoor air must be addressed. (Geiger-PTT)
W86-05143

EUTROPHICATION IN NORTHERN TUNISIA,

Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H., Eschborn (Germany, F.R.).
P. Krause, and H. Krist.
Aqua AQUAAA, No. 2, p 98-102, 1986. 4 fig, 4 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Tunisia, *Lakes, Reservoirs, Sidi Salem, Legal aspects, Effluents, Wastewater treatment, Water quality control, Rain, Water quality control, Recreation, Long-term planning, Water quality management.

This paper examines two cases of overloading of waters with nutrients as a result of human activities, which have occurred in North Africa, showing the specific problems encountered and the measures taken to overcome them. Under the German-Tunisian cooperation program, two different bodies of water showing evidence of eutrophication, the Sidi Salem reservoir and the Lagoon of Tunis. The Sidi Salem reservoir, 2 years after its first filling, is already in a mesotrophic to mildly eutrophic state. Effluent treatment must be taken into the Beja area to prevent total eutrophication of the lake. The Lagoon of Tunis is undergoing complete rehabilitation by protecting the lagoon from treated effluents and mixed rainwater/effluent, by means of open ring drains. The cost of this procedure, and its prospects for future use as a recreational area, are discussed. (Lantz-PTT)
W86-05150

MARINE BENTHOS IN RELATION TO PORE WATER CHEMISTRY AND SEDIMENT GEOCHEMISTRY OF SIMULATED DREDGED MATERIAL,

Delaware Univ., Lewes. Coll. of Marine Studies.
D. Maurer, T. M. Church, C. Lord, and C. Wethe.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 3, p 369-377, 1985. 2 tab, 29 ref.

Descriptors: *Benthos, *Sediments, *Dredging, *Spoil banks, Interstitial water, Geochemistry, Oxygen, Ammonia, Silt, Clay, Sulfide, Hydrogen ion concentration.

Studies on changes in pore water chemistry and sediment geochemistry in simulated dredged material revealed the presence of patterns. There was a marked decrease in mean oxygen concentration between overlying water and pore water and a marked increase in mean ammonia concentration. Ammonia concentration in sediments with silt-clay was several times higher than values for 100 percent sand. No sulfide was recorded by Day 1 for all sediment types. Sulfide increased regularly with depth in 100% sand by Day 8 and Day 15 but no regular trends with depth were observed in sediments with silt-clay. Hydrogen ion concentration values were relatively stable with depth, sediment type, and time. Comparison of these data with biological responses indicated that effects of dredge disposal on benthos are not limited to mechanical ones. (Peters-PTT)
W86-05152

EFFECTS OF HYDRAULIC DREDGING TO CONTROL OYSTER DRILLS ON BENTHIC MACROFAUNA OF OYSTER GROUNDS IN DELAWARE BAY, NEW JERSEY,

Rutgers Shellfish Research Lab., Port North Norris, NJ.
N. S. Ismail.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 3, p 379-395, 1985. 5 tab, 4 fig, 37 ref.

Descriptors: *Benthos, *Dredging, *Oysters, *Delaware Bay, New Jersey, Seasonal variation, Species diversity.

The extent and nature of the effects of hydraulic dredging to control oyster drills (Urosalpinx cinerea and Eupleura caudata, Family Muricidae, Order Neogastropoda) on benthic macrofauna and sediments of oyster grounds were studied in Delaware Bay, New Jersey. The immediate effects of hydraulic dredging were reductions in numbers of species as well as in total numbers of animals on the three oyster grounds selected. However, oyster drills were most affected. The hydraulic dredge did not totally remove any of the species present on the dredged grounds, but only decreased their densities. Repopulation of the species to control levels or to predredging levels was evident three months after dredging on Ground 515 which was dredged late April and early May. Repopulation on Laboratory Ground which was dredged during October, was evident 10 months after dredging. Apparently dredging the oyster grounds in early spring has greater advantages than dredging any other time of the year. Oyster drills are removed before they start ovipositing egg cases and benthic populations can recover completely during the remainder of the spring and during the summer. (Peters-PTT)
W86-05153

CLEARANCE RATES OF CRUSTACEAN MACROFILTRATORS: THE NATURE OF IN SITU RATE DEPRESSIONS IN A FERTILIZED OLIGOTROPHIC LAKE IN THE KUOKKEL AREA, NORTHERN SWEDEN,

Uppsala Univ. (Sweden). Limnologiska Institutionen.
G. Persson.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 4, p 335-358, 1985. 7 tab, 4 fig, 76 ref.

Descriptors: *Crustaceans, *Oligotrophic lakes, *Limnology, *Phytoplankton, *Eutrophic lakes, Fertilization, Algae, Seston, Lake Stugsjon, Lake Hymenjaure, Sweden, Radioactive tracers, Zooplankton, Subarctic zone, Particle size.

Lake seston labelled by (14)CO2, (14)C-actate and (32)PO4 in parallel was used in zooplankton feeding experiments and checked for size distribution of the labelled particulates. Lake Stugsjon (reference) and Lake Hymenjaure were included in a lake fertilization program in the Kuokkel area in northern Sweden during the years 1971 to 1976. The lakes are situated close together at the timberline and have very similar temperatures and an icefree period of 100 to 130 days. A chrysophycean phytoplankton community normally exists in these lakes. The in situ experiments were designed to determine if depressed Eudiaptomus and Holopedium clearance rates, in an artificially fertilized lake where seston was dominated by micro-algae, were due to low retention of such algae. Addition of a labelled reference alga (Chlamydomonas sp.) was used to discover if high food concentrations (above the Incipient Limiting Concentration) or toxins caused the depressions. Clearance rates mostly ranked highest for CO2-labelled seston followed by (32)P and (14)C-acetate labelled seston, reflecting approximately the size distribution of the labelled food. Clearance rates for the added reference alga were high and similar in the fertilized lake and in an oligotrophic reference lake. It is concluded that the detection rate depression is explained purely by poor retention of small particles (passive size selection) by the crustaceans studied, but that active food selection offers optional explanations of the experimental results. (Peters-PTT)
W86-05154

ENVIRONMENTAL EFFECTS ON SPECIFIC RATE OF PHOTOSYNTHESIS IN SMALL FERTILIZED LAKES (NORTH-WEST OF THE USSR),

Gosudarstvennyi Nauchno-Issledovatel'skii Inst. Ozernogo i Rechnogo Rybnogo Khozyaistva, Leningrad (USSR). Dept. of Hydrobiology.
T. V. Tereshenkova.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 4, p 453-470, 1985. 4 tab, 9 fig, 28 ref.

Descriptors: *Phytoplankton, *Photosynthesis, *Lakes, *Limnology, *Biomass, Temperature effects, Russia, Leningrad, Seasonal variation, Diurnal variation, Algae, Fertilizers, Nutrients.

Results of long-term integrated studies performed on 8 shallow water fertilized small lakes from 1975 to 1981 revealed a distinct direct dependence of the specific rate of photosynthesis on temperature. The studies were performed in the Leningrad district (Luga region) on 8 lakes of the Syaber group: Pelyuga, Bakhmanskoe, Malyi Okunyenok, Bolshoi Okunyenok, Muzha, Lyubevoe, Dryvyaty, and Naroch. During the period from summer to autumn, the mean temperature coefficient was 1.7, the recorded temperature range was 4 to 22 C, and the biomass range was 0.1 to 8.2 grams/cu m. In spring, no distinct dependence was found between the values of the diurnal P/B coefficients and the temperature. The influence of temperature on the photosynthetic activity of the algae was very distinct when the former changed. Higher photosynthetic activity of the phytoplankton is characteristic of the lakes during the early vegetation period and is induced by many favorable factors. From spring to autumn this activity usually declines. However, isolated high P/B coefficients can also be recorded in summer and autumn. For small lakes, there was a direct connection between the specific rate of photosynthesis and the coefficient of the open water area. High rates of turnover of the phytoplankton biomass in the experimental lakes are due to the shallow water factor, steady replenishment with nutrients (mineral fertilizers), relatively low values of the phytoplankton biomass and the predominance of small forms in most lakes. (Peters-PTT)
W86-05155

AVAILABILITY OF PHOSPHORUS AND THE SPECIES COMPOSITION OF THE SPRING PHYTOPLANKTON IN LAKE ERKEN,

Uppsala Univ. (Sweden). Limnologiska Institutionen.
K. Pettersson.

Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 4, p 527-546, 1985. 6 tab, 10 fig, 39 ref.

Descriptors: *Phytoplankton, *Eutrophic lakes, *Limnology, *Phosphorus, *Lake Erken, Sweden, Ice, Dinoflagellates, Algae, Diatoms, Species diversity, Seasonal variation, Biochemical tests, Enzymes, Fluorometry, Photometry.

The spring development of phytoplankton and the phosphorus content were monitored intensively in Lake Erken, a moderately eutrophic lake in central Sweden which is regularly covered with ice for about 18 weeks from January to late April, during the springs of 1979 and 1980. The dominant species were dinoflagellates, mainly Woloszynskia ordinata and Peridinium aciculiferum, during the entire spring of 1979. The long period of ice cover favored the motile species, which were able to utilize the available light immediately below the ice. A considerable migration was noticed in March 1979. These large and slow growing algae were able to store phosphorus,and surplus phosphorus concentrations up to 12 micrograms P/liter were measured, which corresponds to an algal content of 10 micrograms P/mg C. These values were more than twice as high as those recorded earlier in Lake Erken. Although a spring outburst of diatoms did not occur in 1979 and 1980, the algae were phosphorus limited in May, as indicated by high alkaline phosphatase activity, low algal surplus phosphorus content and high inorganic N:P ratios. It is concluded that phosphorus is important for the development of the spring phytoplankton. (Author's abstract)
W86-05156

PRIMARY PRODUCTION AND EFFECTS OF ENRICHMENT WITH NITRATE AND PHOSPHATE ON PHYTOPLANKTON IN THE BARRA BONITA RESERVOIR (STATE OF SAO PAULO, BRAZIL),

Universidade Federal de Sao Carlos (Brazil). Dept. of Zoology.
R. Henry, K. Hino, J. G. Gentil, and J. G. Tundisi.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 4, p 561-573, 1985. 1 tab, 11 fig, 24 ref.

Descriptors: *Barra Bonita reservoir, *Limnology, *Nitrates, *Phosphates, *Phytoplankton, *Reservoirs, *Primary productivity, Chlorophyll, Sao Paulo, Brazil, Photosynthesis, Surface, Biomass, Nutrients, Aphatic zone.

The construction of reservoirs for the generation of electricity has increased during the past 20 years in Brazil. The creation of artificial ecosystems, distributed over various catchment areas and at various latitudes and longitudes, provides an opportunity to develop comparative limnological studies. Primary productivity of phytoplankton was evaluated by the (14)C and dissolved oxygen methods in December 1981 at the Barra Bonita Reservoir (Sao Paulo State, Brazil). The primary production varied between 0.17 to 14.51 mg C/cu meter/hr at 4 and 0 meters depth, respectively. About 57 to 94% of the photosynthetic activity was due to phytoplankton >50 micrometers. The highest value of assimilation rate was found in the surface water. Dissolved nutrient concentrations were very high and consisted mainly of nitrate. Light penetration was low, the aphotic zone accounted for 90% of the water column. Enrichment with nitrate and phosphate showed that both N and P stimulated the production of biomass (chlorophyll alpha), mainly due to the addition of phosphate. The enrichment experiment also indicated that phosphate addition has a significant stimulatory effect on the growth of Melosira sp. The limiting effect of light penetration on photosynthetic activity is more severe than that of nutrients. (Peters-PTT)
W86-05157

ANALYSIS OF THE BIOTIC COMMUNITY IN A KUMAUN HIMALAYAN LAKE, NAINITAL (U.P.), INDIA,

Kumaun Univ., Naini Tal (India). Dept. of Zoology.
M. C. Pant, A. P. Sharma, P. C. Sharma, and P. K. Gupta.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 4, p 591-602, 1985. 5 tab, 6 fig, 30 ref.

Descriptors: *Phytoplankton, *Eutrophic lakes, *Zooplankton, *Limnology, *Eutrophication, *Lake Nainital, Macrozoobenthos, Mud-water interface, Dissolved oxygen, Respiration, India, Biomass, Seasonal variation, Fish, Mortality, Benthos, Species diversity.

In the last 2 or 3 decades, due to intensive man made modifications in its catchment basin, Lake Nainital has undergone a considerable limnological evolution. The impact of eutrophication on the structure and function of the plankton and benthos communities of the lake was investigated. A comprehensive study of phyto- and zooplankton and macrozoobenthic components in Lake Nainital showed that species richness was high for plankton and low for macrozoobenthos. Fish mortality is high every winter due to severe depletion of dissolved oxygen during the cold season. The algal biomass is dominated by greens (54%) and bluegreen (31%), the zooplankton population by copepods (84%), and the macrozoobenthic community by a Tubilex-Chironomus association constituting > or = 95% of the annual number of the macrobenthic invertebrates. Respiration surpassed gross production. The mean annual ratio between phyto- and zooplankton biomass is 3.3 and between phytoplankton and herbivores is 4.6. If biomass is treated as a measure of crude production, the relationship among the three trophic levels suggests that herbivory is inefficient while carnivory is efficient. The low diversity of different biotic components and the P/R ratio of <1 suggest that the lake is passing through the stage of heterotrophic succession. (Peters-PTT)
W86-05159

MEASURE OF PLANKTON COMMUNITY SIMILARITY UTILIZING VARIABLE WEIGHTING OF TOTAL DENSITY AND TAXONOMIC PROPORTIONALITY,

Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 2H.
W86-05160

CHEMICAL AND MICROBIOLOGICAL PROCESSES AS REGULATORS OF THE EXCHANGE OF SUBSTANCES BETWEEN SEDIMENTS AND WATER IN SHALLOW EUTROPHIC LAKES,

Swedish Environmental Research Inst., Stockholm.
S.-O. Ryding.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 5, p 657-702, 1985. 8 tab, 21 fig, 115 ref.

Descriptors: *Eutrophic lakes, *Sediments, *Phosphorus, Temperature effects, Sweden, Anaerobic conditions, Seasonal variations, Chelation, Shallow water, Morphology, Hydrology.

It is generally believed that excessive phosphorus release from lake sediments, i.e., internal P load, is only a problem in deep lakes with stagnant anaerobic bottom waters. However, substantial amounts of P can also be released from sediments in shallow, well-mixed lakes. The dynamics and magnitude of P release from sediments in these types of lakes are affected primarily by physical factors, such as seasonal variations in water temperature and year to year differences in water renewal. These factors, in turn, induce chemical and microbiological processes which regulate the exchange of substances between sediments and water. The fractional distribution of sedimentary P and the chelating capacity of the water are also important factors that can provide insights to the processes involved and their quantitative impact on the P status in shallow, eutrophic lakes. Morphological and hydrological features of the following lakes were examined: Boren, Djolosjon, Finjasjon, Glaningen, Garan, Hacklasjon, Kalven, Malmsjon, N. Bergundasjon, Nasbysjon, Ramsjon, Ryssbysjon, Satoftasjon, S. Bergundasjon, V. Ringsjon, and O. Ringsjon. (Peters-PTT)
W86-05161

INFLUENCE OF COPPER IN VARIOUS FORMS ON NATURAL PHYTOPLANKTONIC POPULATIONS FROM THE SAGUENAY RIVER, QUEBEC, CANADA. (INFLUENCE DE LA SPECIATION DU CUIVRE SUR LES POPULATIONS PHYTOPLANCTONIQUES NATURELLES DE LA RIVIERE DU SAGUENAY, QUEBEC, CANADA.),

Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.
P.-A. Thompson, and R. Cote.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 5, p 711-731, 1985. 3 tab, 6 fig, 44 ref.

Descriptors: *Copper, *Phytoplankton, *Algae, *Toxicity, *Saguenay River, Quebec, Canada, Chlorophycea, Chlorophyll, Photosynthesis, Diatoms, Humic acid, Dissolved organic matter, Cellulose fibers, Species diversity, Estuaries, Primary production.

Experiments to study the toxicity of copper in its ionic, complexed (to humic acid) and adsorbed (on cellulose fibers from a local paper mill) forms on species composition, standing crop, and photosynthesis of phytoplankton were conducted in chemostats with natural aggregations composed mainly of either green algae or of diatoms from the Saguenay River. The Saguenay River is situated in an industrialized area (aluminum smelters, paper mills), and it receives both industrial and urban wastewaters. Experiments conducted in July and September 1981 with populations composed mainly of Chlorophyceae showed Chlorella sp. to be quite tolerant to copper; however, when copper concentrations were high (50 and 100 mg/l ionic copper), Nitzschia palea became the dominant species. Primary production is more strongly inhibited by copper than is chlorophyll alpha concentration. In November 1981, experiments with diatoms from the Saguenay River showed that of the species present, Asterionella formosa, is the species most sensitive to copper, whereas Melosira islandica is the least sensitive. Copper has a strong negative effect on the cell densities, standing crop and photosynthesis of the diatom populations. The addition of humic acid, and to a lesser degree, cellulose fibers significantly reduced the toxicity of copper. The relatively high concentrations of dissolved organic matter and suspended cellulose fibers in the waters of the Saguenay River are probably important factors controlling the toxicity of copper to the phytoplankton of this estuary. (Peters-PTT)
W86-05162

COMPARATIVE LIMNOLOGY OF SEVERAL RESERVOIRS IN CENTRAL INDIA,

Government Post Graduate Coll., Chhindwara (India). Dept. of Botany.
K. S. Unni.
Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 6, p 845-856, 1985. 4 tab, 1 fig, 23 ref.

Descriptors: *Reservoirs, *Chemical composition, *Limnology, Vegetation, Electrical conductivity, Calcium, Carbonate, Chloride, Phytoplankton, Zooplankton, Eutrophication, Oligotrophy, Mesotrophy, Morphology, Transparency, Rotifers.

Twenty four reservoirs in Central India were investigated for their physical, chemical and biological features. The reservoirs were located in the state of Madhya Pradesh. These reservoirs differed significantly in their size, physical features, chemical composition and vegetation. Three medium and three major reservoirs recorded comparatively low electrical conductivity. All the 18 minor reservoirs showed high conductivity and low transparency since they were all situated in densely populated urban areas polluted by human feces and domestic sewage. The most abundant ions in water are calcium, carbonate and chloride. The phytoplankton was found to be dominated by Cyanophyceae. Rotifers dominated among zooplankton. All the minor reservoirs are highly eutrophicated. Among the major reservoirs Tawa Reservoir is oligotrophic while others are mesotrophic to eutrophic in nature. (Peters-PTT)

W86-05164

EVOLUTION OF BACTERIAL POPULATIONS IN SALT MARSH SEDIMENTS OF ILE GRANDE POLLUTED BY AMOCO CADIZ. (EVOLUTION DES POPULATIONS BACTERIENNES DANS LES SEDIMENTS DES MARAIS MARITIMES DE l'ILE GRANDE POLLUES PAR L'AMOCO CADIZ.).

Endoume Marine Station and Oceanography Centre, Marseille (France).

Internationale Revue der Gesamten Hydrobiologie, Vol. 70, No. 6, p 815-827, 1986. 10 fig, 23 ref.

Descriptors: *Oil spills, *Salt marshes, *Sediments, Ile Grande, Oil pollution, Microbial activity, Alkanes, Heterotrophic bacteria.

Microbial investigations on heterotrophic bacteria (MPN counts, adenylates charge, growth rate and enzymatic activities) and hydrocarbon utilizing microorganisms (MPN counts) were carried out during 3 yr in the salt marshes of Ile Grande. The aim was to follow their recovery after oil pollution. Three years after oiling, the amount of Amoco Cadiz oil in the surface level of some Juncus maritimus meadows of Ile Grande remains very high. In other biotopes a variable decline in concentrations has been observed. These differences are linked to differences in microbial activities. Microbial activity is low in the asphalt-like pavement characteristic of higher meadows where alkanes have been removed. Activity has been nearly destroyed in heavily polluted meadows where alkanes are still present. In the surface layer of creeks and mud flats, microbial activity is high and hydrocarbons are well degraded. The results for the 3 yr show a significant enhancement of the microflora during the first year (corresponding to removal of n. alkanes) followed by a decrease in bacterial activity which persisted for >2 yr. The activity of the heterotrophic bacterial population is deeply disturbed compared with unoiled sites, and these shifts remain detectable 3 yr after oiling. This study does not modify previous estimations regarding the recovery of the salt marshes. (Peters-PTT)

W86-05167

VERTICAL MIGRATION AND MORTALITY OF MARINE BENTHOS IN DREDGED MATERIAL: A SYNTHESIS,

Delaware Univ., Lewes. Coll. of Marine Studies.

D. Maurer, R. T. Keck, J. C. Tinsman, W. A. Leathem, and C. Wethe.

International Revue der Gesamten Hydrobiologie, Vol. 71, No. 1, p 49-63, 1986. 2 tab, 36 ref.

Descriptors: *Benthos, *Spoil banks, *Sediment, Sand, Silt, Vertical distribution, Invertebrates, Temperature effects, Mollusks, Amphipods, Crustaceans, Geochemistry, Polychaetes, Dredging, Mortality.

The responses of the species of benthic invertebrates to burial in terms of migration ability or mortality were compared, and a synthesis and recommendations for assessing future impacts were provided. The four species compared were the bivalve Mercenaria mercenaria, the amphipod crustacean Parahaustorius longimerus, and the polychaetes Scoloplos fragilis and the Nereis succinea. There was evidence of synergistic effects on burrowing activity and mortality with changes in time of burial, sediment depth, sediment type, and temperature. N. succinea was the most resistant species followed by M. mercenaria, S. fragilis, and P. longimerus in sediment with silt-clay. In sediment without silt-clay the order of percent mortality was reversed. Dissolved oxygen decreased and ammonia and sulfide increased between the surface and below 2.0 cm within a 15-day period. M. mercenaria and N. succinea should be relatively resistant to chemical effects of spoil disposal and S. fragilis and P. longimerus would be less resistant. Vertical migration of benthic invertebrates through dredged disposal can be a viable mechanism of recolonization under certain conditions. Some effects of burial of benthos can be predicted based on morphology, behavior, and physiology. These biological features are discussed with examples dealing with molluscs, crustaceans, and polychaetes. (Peters-PTT)

W86-05169

FATTY ACIDS IN LIPIDS FROM PARTICULATE ORGANIC MATTER IN A EUTROPHIC LAKE, LAKE NAKANUMA, JAPAN,

Tsukuba Univ. (Japan). Inst. of Biological Sciences.

T. Miyazaki, J. Irie, Y. Ogawa, and S.-E. Ichimura.

International Revue der Gesamten Hydrobiologie, Vol. 71, No. 1, p 101-113, 1986. 2 tab, 5 fig, 43 ref.

Descriptors: *Eutrophication, *Fatty acids, *Eutrophic lakes, *Limnology, *Particulate matter, *Phytoplankton, Lake Nakanuma, Japan, Myristic acid, Linoleic acid, Palmitic acid, Palmitoleic acid, Linoleic acid, Oleic acid, Stearic acid, Lakes, Seasonal variation, Photosynthesis, Water depth, Mixing.

Seasonal changes in the amounts of fatty acids in lipids of suspended particulate organic matter were investigated in a eutrophic lake, Lake Nakanuma, Japan. Fatty acids were distributed uniformly throughout the whole water column during the mixing period, and their concentrations were between 28 and 46 micrograms/liter. During the summer stagnation period, concentration maxima of 60 to 80 and 60 to 100 micrograms/liter appeared in the near-surface and metalimnetic layers, respectively. The depth of the shallower maximum seemed to correspond to that of the photosynthetic maximum. Major fatty acids were myristic, palmitic, palmitoleic, and oleic acids. Stearic acid was a minor component. Linoleic acid, linolenic and eicosa pentaenoic acids were less abundant, but their percentage remained relatively constant. (Peters-PTT)

W86-05171

ANALYSIS OF THE INSHORE MACROZOOBENTHIC COMMUNITY IN LAKE NAINI TAL, UP, INDIA,

Kumaun Univ., Naini Tal (India). Dept. of Zoology.

For primary bibliographic entry see Field 2H.

W86-05172

FIELD AND LABORATORY STUDIES ON NILE PHYTOPLANKTON IN EGYPT. I. SOME PHYSICAL AND CHEMICAL CHARACTERISTICS,

Assiut Univ. (Egypt). Dept. of Botany.

For primary bibliographic entry see Field 2H.

W86-05173

PHYTOPLANKTON PRODUCTIVITY IN TURBID WATERS,

Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.

J. U. Grobbelaar.

Journal of Plankton Research JPLRD9, Vol. 7, No. 5, p 653-663, September 1985. 6 fig, 3 tab, 22 ref.

Descriptors: *Turbidity, *Primary productivity, *Suspended sediments, *Euphotic zone, *Phytoplankton, Inorganic particles, Wuras Dam, Mixing layers, Photosynthesis, Aphotic zone, Respiration.

Many of the freshwater areas in the world are turbid, due to suspended inorganic particles. The effects of turbidity on measurements of primary productivity was investigated using test tubes of various lengths. The euphotic depth of the shallow turbid impoundment, Wuras Dam, varies between 0.3 and 1.3 meters. A plexiglass tube the depth of the euphotic zone confined the phytoplankton in the light and the rates measured represent the maximal possible under the prevailing conditions. Longer tubes include an aphotic portion and give an idea of the magnitude of respiration losses. The depth of the mixing layer appears to be especially important in turbid systems as the time spent in the dark, relative to the light is of great importance and may be the most important regulating factor in such waters. (Peters-PTT)

W86-05177

REGULATION OF BACTERIAL SECONDARY PRODUCTION IN TWO EUTROPHIC LAKES AND IN EXPERIMENTAL ENCLOSURES,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.

B. Riemann, and M. Sondergaard.

Journal of Plankton Research JPLRD9, Vol. 8, No. 3, p 519-536, May 1986. 10 fig, 1 tab, 42 ref. Danish Natural Science Research Council J. No 11-1816, 11-4758.

Descriptors: *Eutrophic lakes, *Limnology, *Phytoplankton, *Experimental basins, *Bacteria, Biomass, Lake Hylke, Lake Skanderborg, Denmark, Phosphates, Fish, Algae, Organic carbon, Radioactive tracers, Tritium, Phytotoxicity.

Changes in bacterial production and biomass in two eutrophic lakes were examined in relation to changes in phytoplankton biomass, and primary production and release of extracellular organic carbon (EOC). Bacterial cell number and secondary production of bacterioplankton were measured during two periods of 14 and 19 days, respectively, in experimental enclosures of lake water, and in two Danish eutrophic lakes. One lake was Lake Hylke (part of Lake Skanderborg) situated in the central part of Jutland and the second was Frederiksborg Slotsso in the northern part of Zealand, Denmark. Additions of phosphate and planktovorous fish in some of the enclosures induced rapid changes in the phytoplankton biomass, primary production and release of EOC. In some of the enclosures containing fish, release of EOC from phytoplankton constituted from 36 to 55% of the bacterial secondary production, determined by means of (3-H) thymidine incorporation into DNA. In others, this relationship was not found, suggesting that phytoplankton species-specific release rates of composition of EOC might play a role in the microbial response. In enclosures without fish, released dissolved organic carbon from zooplankton grazing activities could sustain > or = 32% of the bacterial production. Algal senescence, induced by phosphate depletion, also created large increases in bacterial secondary production. Changes in the growth of pelagic freshwater bacteria are controlled by a variety of events occurring on several trophic levels as well as in the nutrient regime. (Peters-PTT)

W86-05186

IMPACT OF THE IXTOC-1 OIL SPILL ON ZOOPLANKTON,

Instituto Politecnico Nacional, Mexico City. Escuela Nacional de Ciencias Biologicas.

S. A. Guzman del Proo, E. A. Chavez, F. M. Alatriste, S. de la Campa, and G. de la Cruz.

Journal of Plankton Research JPLRD9, Vol. 8, No. 3, p 557-581, May 1986. 22 fig, 3 tab, 17 ref.

Descriptors: *Zooplankton, *Oil spills, *Environmental impact, Ixtoc-1, Gulf of Mexico, Campeche City, Terminos Lagoon, Estuaries, Hydrocarbons, Plankton, Grijalva River, Usumacinta River, Mexico, Biomass, Seasonal variation.

The impact of the Ixtoc-1 oil spill on the zooplankton community in the southern part of Gulf of Mexico was assessed. Zooplankton data taken from seven cruises between 1979 and 1982 show a decrease in biomass levels of almost four orders of magnitude, lower than previously observed when mean biomass reached 389 mg/m. Seasonal biomass changes observed before and after the spill shown the same pattern, with a maximum in the summer, and a minimum in the spring. Together with specific diversity, the highest heterogeneity of the community was a present in the spring and the lowest diversity in the fall. Areas of high plankton productivity are the coastal zones in Campeche City, Terminos Lagoon and off the estuaries of Grijalva and Usumacinta rivers. Changes in the organization and structure of the zooplankton community occurred after the spill, reaching a lower level of stability. Most samples appear to be contaminated by hydrocarbons, but the role of the Ixtoc-1 oil spill as a factor in this is hard to determine. Decay of oil in zooplankton occurs exponentially, with persistent levels of aliphatic hydrocarbons suggesting a persistent pollution source, with damaging effects on plankton

lower than those produced by the Ixtoc-1. The accident at the Ixtoc-1 oil well, according to official figures, spilled 3.1 million barrels through a 10-month period, starting in June 1979. (Peters-PTT)
W86-05187

THERMAL AND OXYGEN CONDITIONS AND THE CHEMICAL COMPOSITION OF THE WATER IN THE GREAT MASURIAN LAKES,

Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
B. Zdanowski, A. Korycka, and J. Zachwieja.
Ekologia Polska, Vol. 32, No. 4, p 651-677, 1984. 6 fig, 4 tab, 37 ref.

Descriptors: *Trophic level, *Limnology, *Physicochemical properties, *Chemical composition, *Chlorophyll, Great Masurian lakes, Phytoplankton, Biomass, Phosphorus, Temperature, Nitrogen, Eutrophication, Wegorapap River, Pisa River, Poland, Agricultural watersheds, Forest watersheds, Epilimnion, Hypolimnion.

The trophic state of the lakes of the Great Masurian Lakes complex Poland, was analyzed based on investigations carried out only once during the summer stagnation period (July 1976). The physicochemical condition of the water, visibility of Secchi's disc and chlorophyll content in 21 lakes was examined and compared with literature data for the last several years. In the meta- and hypolimnion of polluted lakes deteriorated oxygen conditions were found. Near the upper range of the thermocline an acute oxygen deficit was found. The chemical composition of the water in the lakes was correlated with the degree of development of the drainage area. The lakes in an agricultural drainage area were characterized by an advanced state of eutrophication. The lowest concentrations of mineral salts and hence the lowest state of eutrophication, were seen in the forest drainage area. Phytoplankton biomass, chlorophyll content, and water transparency were correlated with the content of phosphorus in the epilimnion. (Peters-PTT)
W86-05194

RESIDUES OF ORGANOCHLORINE INSECTICIDES IN FISH FROM POLLUTED WATER,

Biological Research Center, Baghdad (Iraq).
For primary bibliographic entry see Field 5B.
W86-05264

GROWTH AND PHOTOSYNTHETIC RESPONSE OF A FRESHWATER ALGA, SELENASTRUM CAPRICORNUTUM, TO AN OIL SHALE BY-PRODUCT WATER,

University of Wyoming Research Corp., Laramie. Western Research Inst.
D. Delistraty.
Bulletin of Environmental Contamination and Toxicology, Vol. 36, No. 1, p 114-121, January 1986. 3 tab, 21 ref.

Descriptors: *Selenastrum capricornutum, *Oil shale, *Industrial wastes, Photosynthesis, Algal toxins, Bioindicators, Chemical analysis, Biological assays, Toxicity.

Toxicological research and development of effective control technologies are needed to identify and minimize the environmental impact of complex by-product waters generated during in situ recovery of shale oil. Using a standard algal species, such as Selenastrum capricornutur, provides a systematic approach to toxicant evaluation. Chemical fractionation and short-term bioassays is the approach used in this study to compare the growth and photosynthetic response of S. capricornutum to an oil shale by-product water and its organophilic and hydrophilic subfractions. Based on median effective concentration values, toxicity ranked at follows: organophilic > hydrophilic > oil shale by-product water (growth experiment) hydrophilic > oil shale by-product water > organophilic (photosynthesis experiment). The data obtained in this study indicate that concentrations above 2% whole oil shale water are inhibitory to algae. Chemical fractionation provided more detailed toxicity information than whole water analysis alone. Furthermore, the longer-term growth experiment provided greater sensitivity than the rapid photosynthesis test. As a screening tool the five-day algal growth assay was more diagnostic than the four-hour photosynthesis test when combined with chemical fractionation. (Main-PTT)
W86-05265

EFFECTS OF ENDOSULPHAN ON THE HYPOTHALAMO HYPOPHYSIAL COMPLEX AND FISH REPRODUCTIVE PHYSIOLOGY,

Government Coll., Sendhwa (India). Dept. of Zoology.
L. Shukla and, and A. K. Pandey.
Bulletin of Environmental Contamination and Toxicology, Vol. 36, No. 1, p 122-131, January 1986. 16 Fig, 1 tab, 24 ref.

Descriptors: *Endosulphan, *Hypothalamo-hypophysial complex, *Fish physiology, Tissue analysis, Insecticides, Fish populations.

It is essential to work out the damages caused by the insecticides at lower concentration in the fish endocrine physiology in relation to fish reproduction and culture. This study aims to assess the histophysiological lesions produced by endosulphan in the hypothalamo-hypophysical complex ovarian axis in Sarotherodon mossambicus. The insecticide endosulphan was dissolved in acetone and added to 20 l aquarium water for preparing 0.001 ppm concentration of insecticide. Water was changed on every third day with an aim to keep the fish in a constant concentration of this insecticide. Histological and histochemical studies were performed on the pituitary gland and ovaries. The 3 beta and 17 beta HSDH (steroid dehydrogenase activity) was studied. The activity of the pituitary gland was assessed by calculating the area of cyanophils and acidophils by occulometer and tinctorial details. The diameter of nucleus preopticus and nucleus lateralist ubaries was also recorded. In the ovary, the percentage and diameter of oogonia were calculated. Endosulphan treated fish showed many histological and histochemical changes. This study suggests that the aquatic medium in which the fish lives, when it is contaminated with endosulphan results in changes in oxygen content and pH and also in other physico-chemical factors of water, probably these interfere with the reproductive mechanisms in this fish. (Main-PTT)
W86-05266

IMPAIRMENT OF THYROID ACTIVITY IN SAROTHERODON MOSSAMBICUS DUE TO DDT TREATMENT,

Government Coll., Sendhwa (India). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W86-05267

IN VIVO METABOLISM OF FENITROTHION (0,0-DIMETHYL-0-(4-NITRO-M-TOLYL) PHOSPHOROTHIOATE) IN FRESH WATER TELEOST (TILAPIA MOSSAMBICA),

Regional Research Lab., Hyderabad (India). Entomology and Toxicology Div.
For primary bibliographic entry see Field 5B.
W86-05268

DIFFUSION THROUGH A DOUBLE-SIDED PLATE: DEVELOPMENT OF A METHOD TO STUDY ALGA-BACTERIUM INTERACTIONS,

Northern Arizona Univ., Flagstaff. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W86-05277

PUBLIC HEALTH SIGNIFICANCE OF INDUSTRIAL POLLUTION IN ZARIA, NIGERIA,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Veterinary Public Health and Preventive Medicine.
A. O. Oganga, and D. Abijoroh.
Royal Society of Health Journal, Vol. 105, No. 6, p 211-215, December 1985. 3 tab, 8 ref, 2 append.

Descriptors: *Public health, *Industrial pollution, *Zaria, *Nigeria, Air pollution, Water pollution, Land disposal, Industrial wastes, Malaria, Gastroenteritis, Solid wastes, Sludges, Chemical wastes, Water pollution effects.

Pollution factors and pollution loads associated with rapid industrial growth is related to the health of local inhabitants reporting to a university teaching hospital. Industries involved included tarpaulin making, corrugated cardboard making, cigarette making, leather tanning, foam making, and slaughter houses. The problems of water pollution have been accentuated by the speed of population growth and industries as well as by changing technologies and new agricultural practices. The uncontrolled disposal of sewage and other liquid wastes resulting from domestic uses of water, sediment from land erosion, minerals and chemicals from industrial wastes, insecticides, pesticides, detergents, radioactive substances and heat from power and industrial plants are considered as sources of water pollution. When these solid wastes and sludges from chemical works and industries containing toxic metals such as lead, tin, zinc, iron, and mercury are allowed to flow from factories without prior treatment, the toxic or poisonous materials will be leached out and ultimately reach water sources. Liquid and solid wastes for each industry are quantified. The incidence of diseases associated with environmental pollution are reported, with malaria and gastroenteritis highest. (Lantz-PTT)
W86-05301

COOLING TOWER EVAPORATION OF TREATED COAL GASIFICATION WASTEWATERS,

Pittsburgh Univ., PA. School of Engineering.
For primary bibliographic entry see Field 5D.
W86-05313

BEHAVIORAL ASSAY FOR ASSESSING EFFECTS OF POLLUTANTS ON FISH CHEMORECEPTION,

Saskatchewan Univ., Saskatoon. Dept. of Biology.
A. D. Lemly, and R. J. F. Smith.
Ecotoxicology and Environmental Safety, Vol. 11, No. 2, p 210-218, April 1986. 4 fig, 15 ref.

Descriptors: *Water pollution effects, *Computers, *Monitoring, *Fish behavior, *Hydrogen ion concentration, Bioassay, Fathead minnows, Ecological effects, Automation, Fish toxins, Assay, Fish physiology.

A system that assesses the response of fish to sublethal levels of pollutants was used to examine the effects of reduced pH on the response of fathead minnows to chemical feeding stimuli. The observation system consists of a special aquarium coupled to a recirculating water system, and an Opto-Varimex-Aqua activity tracking meter interfaced to a microcomputer. The tracking meter forms an intersecting, planar grid of light beams which, when interrupted by fish movements, is translated into a digitized signal and fed to the computer. The assay is based on the response of fish to natural chemical stimuli such as food odors or pheromones. When these stimulus solutions are injected into the water circulation the response of the fish is monitored by the computer system, which is capable of discriminating and quantifying changes in eight parameters. Normal responses to stimuli are compared with the response of fish that have been exposed to pollutants. The system should be easily adapted to any laboratory engaged in testing for effects of toxic substances, and will identify effects of pollution that have thus far been difficult or impossible to assess. (Geiger-PTT)
W86-05325

EFFECT OF AL AND HUMIC ACIDS ON THE 241 AM ADSORPTION ON THE EXOSKELETON OF THE CRAYFISH ASTACUS LEPTODACTYLUS ESCHSCHOLTZ,

Antwerp Univ., Wilrijk (Belgium).
For primary bibliographic entry see Field 5B.
W86-05328

INFLUENCE OF WATER ON REPRODUCTIVE SUCCESS AND CHEMICAL COMPOSITION

OF LABORATORY REARED POPULATIONS OF DAPHNIA MAGNA,

Dow Chemical U.S.A., Midland, MI. Dept. of Environmental Quality.
U. M. Cowgill, H. W. Emmel, D. L. Hopkins, S. L. Applegath, and I. T. Takahashi.
Water Research, Vol. 20, No. 3, p 317-323, March 1986. 8 tab, 16 ref.

Descriptors: *Water pollution effects, *Daphnia, *Foods, Reproducibility, Rivers, Chemical properties, Lakes, Statistical analysis, Industrial wastewater, Trace elements, Conductivity, Ecological effects, Toxicity.

The purpose of this study was to examine the effect of two types of natural water and one processed water on the reproductive success of Daphnia magna. It was also of interest to discover whether the chemical composition of the water or that of the food was more important in determining the chemical composition of the organisms. To achieve this purpose 50 neonates per water type were reared to maturity. Their progeny were enumerated every other day. The study lasted 4.5 weeks. In addition, neonates were batch cultured in each water for 4 weeks. These random aged populations, with no individual older than 28 days, were analyzed for their elemental content. Sodium, K, Cu, Mg, Ca, Zn, P, S, Se, Mo, Cl, Fe, Mn, Co and Ni were measured in random populations of D. magna grown in each of the three waters, neonates and adults reared in processed and one natural water and finally, in the three waters themselves. Linear correlation coefficients were calculated among all the variables. Partial correlation coefficients showed that the chemical composition of the organisms is determined by the chemical composition of the rearing water. The largest number of broods, the greatest total number of neonates, the largest mean brood size, the greatest number of neonates per female, occurred among populations reared in lake water. The poorest demographic results were obtained from daphnids reared to processed water. Suggestions are offered for ways in which processed water could be improved as a rearing medium for daphnids. (Author's abstract)
W86-05337

ENVIRONMENTAL PH INFLUENCES GROWTH AND TISSUE CHEMISTRY OF THE SUBMERSED MACROPHYTE VALLISNERIA AMERICANA,

State Univ. of New York at Binghamton. Dept. of Biological Sciences.
D. Grise, J. E. Titus, and D. j. Wagner.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 2, p 306-310, February 1986. 3 fig, 43 ref. EPA Grant R809436010.

Descriptors: *Hydrogen ion concentration, *Tissue analysis, *Macrophytes, *Vallisneria americana, *Water pollution effects, Wild celery, Acid waters, Nitrogen, Phosphorus, Calcium, Manganese, Aluminum, Iron, Plant growth, Plant tissues.

Wild celery (Vallisneria americana, Hydrocharitaceae) is a common submersed freshwater macrophyte rarely seen in lakes with pH below 6. Plants grown in a greenhouse on a uniform sediment within pH-controlled tanks all survived 60 days at pH 5 but showed reduced dry matter accumulation (by 76%), leaf area (by 79%), and rosette and winter bud production (by 44 and 63%, respectively) compared with plants grown at pH 7.5. The sensitivity of this plant to only moderate acidity did not differ for plants in water acidified to pH 5 by a combination of H2SO4 and HNO3 or by HCl, indicating that the former acids exerted no fertilizing effects to counter the detrimental influence of acidification. Tissue nitrogen and phosphorus levels were well above the critical concentrations previously reported for this species. Tissue calcium and manganese concentrations showed no clear relationship to treatment pH. Both aluminum and iron levels in tissues were twofold to threefold higher for the smaller plants grown at pH 5, suggesting that metal toxicity may have caused a growth reduction at low pH. (Lantz-PTT)
W86-05347

DEVELOPMENT, TESTING AND INTERCALIBRATION OF REFERENCE METHODS FOR POLLUTION STUDIES IN COASTAL AND ESTUARINE WATERS,

International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
S. R. Aston.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 27-34, 1986. 1 tab, 7 ref.

Descriptors: *Water pollution, *Estuaries, *Coastal waters, Environmental effects, Monitoring, Water analysis, Water pollution control.

Following the 1972 United Nations Conference on the Human Environment, the United Nations Environment Program (UNEP) initiated a Regional Seas Program in 1974. At present the Program involves ten regions and has over 120 coastal states participating. It is conceived as an action-oriented program having concern not only for the consequences but also for the causes of environmental degradation and encompassing a comprehensive approach to combating environmental problems through the management of marine and coastal areas. Each regional action plan is formulated according to the needs of the region as perceived by the governments concerned. One of the basic components of the regional action plans is the assessment of the state of marine pollution. For this purpose a set of Reference Methods for marine pollution studies is being developed. This paper describes the development of Reference Methods for use by participants in Regional Seas Programs, where they are intended to ensure that the data can be compared on a world-wide basis and thus contribute to the Global Environment Monitoring System (GEMS) of UNEP. The study draws on particular aspects of the development and testing of some individual Reference Methods to illustrate the problems and philosophy adopted for a project which represents a world-wide attempt to promote the detection, understanding and control of coastal and estuarine pollution. The scientific criteria for method selection and application emphasize the pragmatic approaches which are being adopted to fulfill this ambitious project. (Lantz-PTT)
W86-05354

CADMIUM AND LEAD CYCLING BETWEEN WATER, SEDIMENT, AND BIOTA IN AN ARTIFICIALLY CONTAMINATED MUD FLAT ON BORKUM (F.R.G.),

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 5B.
W86-05365

DISTRIBUTION OF MERCURY IN THE SEDIMENTS AND FISHES OF THE LAGOONS OF AVEIRO, PORTUGAL,

Aveiro Univ. (Portugal). Dept. de Quimica.
For primary bibliographic entry see Field 5B.
W86-05366

BIOLOGICAL EFFECTS AND POLLUTION ASSESSMENT,

Marine Lab., Aberdeen (Scotland).
A. D. McIntyre.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 155-160, 1986. 21 ref.

Descriptors: *Water pollution effects, *Ecological effects, *Environmental assessment, Water pollution control, Monitoring, Research priorities.

Techniques for studying biological effects of pollution in the sea are briefly reviewed and the circumstances under which they are most useful in coastal waters considered. Some approaches are particularly suitable for studying pollution hot spots, others for detecting low levels of contamination. The role of the scientist in pollution assessment is discussed and the problems caused by lack of ecological understanding highlighted. The discussion can be summarized by the following points: (1) biological effects information is central to pollution assessment; (2) existing techniques at the level of individual organisms and lower, are useful in detecting impacts in situations of low contaminant concentrations where chemical measurements alone could be ambiguous; (3) these techniques may be amenable to utilization in broad-scale monitoring programs, and the time is ripe to test them in this context; (4) approaches at the community level are valuable in areas of high contaminant input particularly around hot spots where the input is variable and biological change can be used to delineate the extent of the effect in space; and, (5) the final assessment of an impact in terms of harm to the marine environment, although to some extent a value judgement, is one to which the scientist must contribute on the basis of his experience. (Lantz-PTT)
W86-05368

MERCURY CONTAMINATION IN COMPONENTS OF AN ESTUARINE ECOSYSTEM,

Forth River Purification Board, Queensferry (Scotland).
M. Elliott, and A. H. Griffiths.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 161-170, 1986. 3 fig, 3 tab, 31 ref.

Descriptors: *Mercury, *Water pollution effects, *Ecological effects, *Estuaries, Forth Estuary, Scotland, Sediments, Food chains, Fate of pollutants, Fish, Birds, Suspended solids, Mussels, Plankton, Fauna.

The Forth Estuary, Scotland, has received discharges containing mercury for several decades. This study describes the ecological effects of these discharges as contaminants in many components of the ecosystem, and attempts to quantify the standing mass of Hg within these components. The contaminated area is contrasted with a less-contaminated area, 19 km downstream, and shown to have significantly greater Hg levels in most components (sediments, plankton, infauna, epifauna, macroalgae and fish). The standing mass of Hg in the biota is 1% of that in the nonbiotic components (sediments, suspended material and soluble phase). Sediments alone contain 97% of the standing mass. The critical pathways in this system are: (1) the sediment-infauna-estuarine demersal fish and wading birds; and (2) suspended material-mussels-oystercatchers. Therefore, the top consumers in each of these are most at risk from increased contamination. However, in assessing the biological effects of increased contamination, there was no change at the contaminated area in fecundity in the viviparous estuarine demersal fish, Zoarces viviparus. (Author's abstract)
W86-05369

MERSEY ESTUARY (U.K.) BIRD MORTALITIES - CAUSES, CONSEQUENCES AND CORRECTIVES,

North West Water Authority, Warrington (England).
K. W. Wilson, P. C. Head, and P. D. Jones.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 171-180, 1986. 6 fig, 2 tab, 17 ref.

Descriptors: *Mersey Estuary, *Birds, *Mortality, *Water pollution effects, England, Trialkyl lead compounds, Lead, Heavy metals, Bioaccumulation, Estuaries, Ecological effects, Water pollution control, Industrial wastes, Water quality standards.

In late 1979, there was an extensive mortality among newly arrived, over-wintering populations of waders, wildfowl and gulls in the Mersey Estuary. Mortalities on this scale were unprecedented in the area and there was no obvious cause, although circumstantial evidence collected during the months following the incident indicated the probability of acute poisoning by trialkyl lead compounds. The principal source of trialkyl lead compounds was a discharge into the Manchester Ship Canal, from a factory producing tetraalkyl lead petroleum additives. Under certain conditions of freshwater flow and tidal movements, appreciable concentrations of trialkyl lead in the estuarine waters provided a suitable source for its up-take by benthic fauna and subsequently birds in amounts similar to those shown to be acutely toxic in laboratory experiments. Simple empirical models were used to calculate an appropriate effluent quality standard to protect waders and wildfowl. Full

cooperation was received from the factory concerned and the levels of trialkyl lead discharged have been reduced to the standard. Levels of alkyl lead in the water and in estuarine fauna have fallen in line with the reduced discharge. No bird mortalities attributable to alkyl lead have been observed since the lower discharge levels have been consistently achieved. (Lantz-PTT)
W86-05370

IMPACT OF TRIBUTYL TIN (TBT) ANTI-FOULING PAINTS ON MOLLUSCAN FISHERIES,

Brest Univ. (France). Lab. d'Oceanographie Biologique.
J. E. Thain, and M. J. Waldock.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 193-202, 1986. 4 fig, 3 tab, 17 ref.

Descriptors: *Tributyl tin, *Environmental effects, *Estuaries, *Water pollution effects, *Oysters, Aquaculture, Toxicity, Tin, Organic compounds, England, Mollusks, Mortality, Crouch River, Roach River.

Historically the European flat oyster, Ostrea edulis, has been the basis of an important fishery on the east coast of England, but the population has recently declined to an all-time low. Laboratory experiments have been carried out to compare larval survival, growth of spat, and the development of gametes in adult O. edulis and the growth of spat of four other bivalve species in the presence and absence of organotin toxins. The results from these experiments are discussed in relation to the concentrations or organotin compounds in samples of water and oyster tissues, from several sites in the United Kingdom, and the reproductive behavior of adult oysters from natural stocks in the Crouch/Roach estuary system. The United Kingdom government has proposed legislation to control and reduce organotin emissions into the marine environment and this is briefly outlined. (Lantz-PTT)
W86-05372

ECOLOGICAL IMPACT OF AN OIL SPILL: UTILIZATION OF BIOLOGICAL INDICATORS,

Environmental Protection Agency, Kowloon (Hong Kong).
M. Glemarec.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 203-211, 1986. 9 fig, 14 ref, append.

Descriptors: *Oil spills, *Ecological effects, *Bioindicators, Sand, Toxicity, Hydrocarbons, Water pollution effects, Organic matter, Fauna, Biomass, Equilibrium, Degradation, Oil pollution.

The effects of the 'Amoco Cadiz' oil spill on the fine sand ecosystem are evaluated by means of macrofauna which represent medium hydrodynamic conditions. Different species were classified in ecological groups according to their sensitivity to hydrocarbons and to organic matter overload. The two parameters, specific richness and abundance per square meter, indicate the structure of the macrofauna population, while a third parameter, the biomass, can also be used. The study of these factors and their evolution in time, as well as the ecological groups, enables definition of the degradation, recolonization and restructuring conditions. Finally, predators such as fish juveniles, regulate these communities. Six years after the 'Amoco Cadiz' oil spill, even if this fine sand ecosystem reaches a new equilibrium, it is still too early for the regulation processes by predators to take place. (Lantz-PTT)
W86-05373

CHEMICAL FORMS OF ARSENIC IN MARINE ORGANISMS, WITH EMPHASIS ON HEMIFUSUS SPECIES,

Environmental Protection Agency, Kowloon (Hong Kong).
For primary bibliographic entry see Field 5B.
W86-05374

MOLECULAR AND CELLULAR INDICES OF POLLUTANT EFFECTS AND THEIR USE IN ENVIRONMENTAL IMPACT ASSESSMENT,

Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5A.
W86-05375

TRANSPORT AND WATER QUALITY MODELLING IN THE SOUTHERN NORTH SEA IN RELATION TO COASTAL POLLUTION RESEARCH AND CONTROL,

Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5B.
W86-05377

EFFECTS OF FERTILIZER, PIG MANURE, AND SEWAGE SLUDGE ON TIMOTHY AND SOILS,

Nova Scotia Agricultural Coll., Truro.
For primary bibliographic entry see Field 5E.
W86-05382

NATURE OF DICHLORVOS INTOXICATION IN A FRESHWATER PRAWN, MACROBRACHIUM LAMARREI (H. MILNE EDWARDS),

Gorakhpur Univ. (India). Dept. of Zoology.
O. Shukla, and G. S. Shukla.
Environmental Research Vol. 37, No. 2, p 349-354, August 1985. 2 tab, 28 ref.

Descriptors: *Toxins, *Organophosphorous pesticides, Enzymes, Carbohydrates, Animal behavior, Prawns, Bioindicators.

Exposure of the freshwater prawn to a lethal dose (96-hr LCsub50: 0.78 mg/l) of dichlorvos for 24, 48, 72, and 96 hr. induced inhibition of avcetylcholinesterase (AChE) and alkaline phosphate activities and enhanced acidophosphatase activity. Hephatic glycogen values were depleted, whereas blood glucose level increased up to 72 hr of exposure. After 96 hr of dichlorvos exposure, hypoglycemia was observed. In general, the statistical significance of all physiologic effects increased with exposure time. It is inferred that dichlorvos exposure inhibits AChE activity and the accumulation of acetylcholine at the synaptic junctions, possibly leading to behavioral changes and creating a widespread disturbance of physiology, ultimately leading to the death of the animal. These dichlorvos-induced distrubances of physiology may be used as an index of environmental pollution by dichlorvos. (Rochester-PTT)
W86-05412

EFFECT OF AIRBORNE SULPHUR AND NITROGEN DEPOSITION ON AQUATIC AND TERRESTRIAL HEATHLAND VEGETATION,

Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5B.
W86-05416

5D. Waste Treatment Processes

SUMMER DISCOUNT METHODS IN SANITARY SEWER RATE STRUCTURES,

Lexington Dept. of Public Works, KY.
For primary bibliographic entry see Field 6C.
W86-04684

USED CHASSIS MAKES SEWER AND CATCH BASIN CLEANER AFFORDABLE,

T. P. Gilles, J. W. Konrad, and R. Westbrook.
Public Works, Vol. 117, No. 5, p 65-66, May 1986.

Descriptors: *Sewer systems, Ohio, Sewer cleaner, Catchment basin cleaner, Economic aspects, Drainage systems, Maintenance, Flooding, Maintenance costs.

Lake County, the smallest of Ohio's 88 counties, faces a multitude of problems resulting from the maintenance of drainage facilities. However, because of the county's size, budget dollars were not available for a combination sewer and catch basin cleaner, a machine that would be the ultimate solution to many of the sewer maintenance problems. The major problems included flooded catch basins, blocked sewer lines, and blocked driveway and roadway culverts. The Hydropower Sewer and Catch Basin Cleaner made by P. B. Loader Manufacturing Company, Fresno, CA fit on the used but still good chassis of a 1978 International Model 2010 truck. The chassis frame and driveshaft had to be extended, the suspension rebuilt, and some body work performed. P. B. Loader engineers supervised the preparation and mounting of the Hydropower unit onto the chassis. Total installation cost, including rebuilding the truck chassis and body work, came to $2,500. A combination sewer and catch basin cleaner was purchased for a total of $60,720, which was substantially less than the $100,000 originally projected for this type of equipment. In addition to using the high pressure system to clean sewers, the county has used it to clean other equipment, bridge bearings and seats, and, on occasion, to cool hot asphalt to allow traffic to return to normal after pavement repairs. (Peters-PTT)
W86-04685

SOLUTION TO RESIDENTIAL SEWER BACKUPS,

T. R. Adams, and G. Crane.
Public Works, Vol. 117, No. 5, p 70-71, May 1986. 2 fig.

Descriptors: *Sewer systems, *Precipitation, *Storm sewers, Separated sewers, Ohio, Sewer backups, Flow regulators, Flow rates, Storm runoff, Flooding, Drainage systems.

Since it was built in 1959, portions of the Colony Park residential development in Brunswick, Ohio suffered back-ups from the sanitary sewer system into basements during heavy rains. Because Colony Park was served by separate storm and sanitary sewers, it was believed to be immune from pressurized sanitary sewers and the possibility of sewage discharges into basements. The sewer systems were tested to find cross connections or places where leakage could exfiltrate from the storm system and flow quickly into the sanitary sewer. The city finally concluded that the problem was one of porosity at the house connections. In routine rain events, there was no appreciable leakage out of the house connections to the storm drains, but when flows were heavy enough to surcharge and pressurize the storm drains, then the house connections would pressurize as well. Then water would leak out of the storm drains and into the sanitary sewers, all via the house connections. The solution ultimately adopted was to install custom fitted, clog resistant flow regulators in each catch basin to regulate the flow rates from the catch basins into the storm drains. By careful sizing of the flow regulators, the catch basin discharges could be set to equal the capacity of the storm sewer pipes, thereby running the pipes at full capacity while protecting them against pressurization. The city built a short relief pipe designed to follow the lowest profile through the area to a suitable discharge point at a nearby stream. It would collect the runoff that could not enter the controlled catch basins, runoff that would continue flowing downhill in the curb and gutter until it reached the relief pipe. In the two and a half years since the stormwater management project was built, the city has received no complaints from Colony Park residents about either sewer back-ups or street flooding. (Peters-PTT)
W86-04686

USING THE FECAL COLIFORM TEST FOR SEWER AND STORM DRAIN MAINTENANCE,

Rogue Valley Council of Governments, Central Point, OR.
E. R. Dittmer.
Public Works, Vol. 117, No. 5, p 75, 98, 100, May 1986.

Descriptors: *Sewer systems, *Oregon, *Coliforms, *Storm drains, Storm Runoff, Bioassay, Medford, Bear Creek, Urban drainage, Bacterial analysis, Monitoring.

The Rogue Valley Council of Governments is working with Medford, Oregon to address the maintenance of sewer lines and storm drain pipes with the help of fecal coliform bacteria testing. Medford (population 40,000) like most urbanized areas, directs storm runoff via the storm drain system to local natural drainages rather than the wastewater treatment plant. Medford has an efficient and effective program for sewer and storm drain maintenance and recognized the potential value in expanding the use of the fecal coliform test for this purpose. The effort led to monitoring of other storm drain systems contributing to Bear Creek, which flows through downtown Medford. Detailed monitoring from the Bear Creek outfall progressively upstream along two major storm drain systems located a variety of coliform sources. These included a house with its sanitary lines plumbed to the storm drain lines, several leaking sewer lines saturating the ground with effluent entering the nearby storm drains, and an agricultural equipment wash rack plumbed to the storm rather than sanitary system. The cooperative effort worked efficiently in Medford. Significant sources of raw sewage entering the storm drain system have been located and fixed. The adverse impact of the storm drains has decreased and Bear Creek water quality has improved significantly. (Peters-PTT)
W86-04687

EVALUATING THE IN-VESSEL COMPOSTING OPTION, PART I,

Environmental Protection Agency, Washington, DC.
J. Walker, N. Goldstein, and B. Chen.
Biocycle BCYCDK, Vol. 27, No. 4, p 22-27, April 1986. 1 fig, 3 tab, 13 ref.

Descriptors: *Wastewater treatment, *In-vessel composting, *Evaluation, *Sludge disposal, Odor control, Pathogens, Bulking agents, Air management, Temperature, Curing, Municipal wastewater, Cost analysis, Public participation.

Guidelines are presented for determining how well an in-vessel composting system meets the needs and goals of a community seeking a sludge management solution. An evaluation approach was developed. Community goals for in-vessel sewage sludge composting operations that guided the development of this approach were as follows: odor-free operation, compost that is adequately dry, stable, pathogen free, and marketable, economical and reliable system, and public acceptability. Key areas for consideration in evaluating in-vessel composting that are discussed in this first of two articles are: citizen participation, sludge and bulking agent properties, mixing and porosity, air handling, air collection, air scrubbing and odor control, temperature and pathogen control, retention time, and curing. (Rochester-PTT)
W86-04716

DENVER'S DUAL UTILIZATION SLUDGE PROGRAM,

Black and Veatch, Aurora, CO.
For primary bibliographic entry see Field 5E.
W86-04717

SLUDGE MANAGEMENT ALTERNATIVES FOR SAN DIEGO,

Nolte (George S.) and Associates, Sacramento, CA.
For primary bibliographic entry see Field 5E.
W86-04718

DETERMINATION OF LINEAR ALKYLBENZENESULFONATES IN SEWAGE SLUDGE BY HIGH-RESOLUTION GAS CHROMATOGRAPHY/MASS SPECTROMETRY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5A.
W86-04721

SLUDGE ODOR CONTROL: IF AT FIRST YOU DON'T SUCCEED...,

D. Arey.
Public Works, Vol 117, No. 3, p 88, March 1986.

Descriptors: *Hydrogen sulfide, *Odor control, *Activated sludge, *Chlorination, *Cost analysis, Deodorant, Potassium permanganate, Calcium hypochlorite, Ozone, Carbon absorption, Microorganisms.

Attempts at odor control of hydrogen sulfide emanating from a secondary activated sludge plant with primary clarifiers are described. The first efforts were deodorizing and potassium permanganate spray; liquid live microorganisms and pH adjustment to keep sulfide in solution also were tried without success. After consideration of ozone and carbon absorption, chemical oxidation was chosen as the treatment method. Two types of oxidizing solution have been used: powdered calcium hypochlorite (65% solution) and liquid caustic (50% solution) or granular caustic, and a chlorine solution made with gaseous chlorine. The first oxidizing solution achieved 100% H2S removal, but cost 10.34 dollars/day to use. The second did not produce as high removal of H2S, but costs 20 cents per day for chemicals with operation and maintenance costs of 400 dollars annually. (Rochester-PTT)
W86-04736

BIG BUCKS SAVED ON SEWER REHABILITATION PROJECT,

For primary bibliographic entry see Field 8A.
W86-04740

METHOD FOR EVALUATION AND PROCUREMENT OF IN-VESSEL COMPOSTING SYSTEMS,

Schenectady City Dept. of Water Pollution Control, NY.
D. A. Conner, and J. A. Stearns.
Public Works, Vol. 117, No. 4, p 64-66, April 1986. 1 fig, 1 tab.

Descriptors: *Composting, *Evaluation, *Procurement, *Pilot plants, *Bidding process, *Waste treatment facilities, *Schenectady, New York, Modular design, Management planning.

In-vessel composting was evaluated as a replacement for a sludge incinerator in Schenectady, New York is discussed. The first step in the evaluation phase was on-site operation of a pilot test reactor. After successful completion of the tests, procurement was planned; four bidding alternatives were considered: sole source, bidding by functional specifications, multiple designs, and two-bid procurement. The two-bid procurement method was chosen; following the award of the first contract, which is for an evaluated piece of equipment, the remainder of the system was designed around the piece of equipment to be utilized. This system maintains control in the hands of the owner and provides an acceptable level of competition. Ultimately, an American Bio Tech system was chosen that featured a modular design with multiple independent composting units, an open architecture without enclosed areas, and a low-pressure aeration system. The presently designed system at Schenectady uses four full-size composting cells and a half cell for preconditioning the infeed material. The total composting volume will be 75,000 cu ft, which will provide over 29 days of detention time at average infeed conditions. (Rochester-PTT)
W86-04741

EFFECT OF NICKEL ON METHANE PRODUCTION AND BUTYRIC ACID UTILIZATION IN A DOWNFLOW FIXED-FILM REACTOR,

University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
M. Canovas-Diaz, and J. A. Howell.
Biotechnology Letters BILED3, Vol. 8, No. 4, p 287-292, April, 1986. 6 fig, 14 ref.

Descriptors: *Wastewater treatment, *Nickel, *Butyric acid, *Whey, *Cheese factory waste, *Methane bacteria, *Downflow fixed-film reactor, Methanogenesis, Pilot plant, Wastewater facilities, Bacterial physiology.

Butyric acid conversion by a mixed methanogenic population in a pilot-scale anaerobic downflow fixed-film reactor (DFFR), treating a cheese factory effluent, was increased by the addition of nickel (30 mg/l NiCl2.6H2O). The butyric acid concentration dropped abruptly from 2,300 to 150 mg/l when the reactor was fed with Ni(II). When running two laboratory-scale DFFR's, butyric acid utilization and methane production were slightly higher within the reactor supplemented with nickel than in the reactor without nickel (control). Nickel appears to increase butyric acid utilization in a DFFR for whey and deproteinized cheese whey anaerobic digestion and slightly increases the reactor performance as reflected in higher methane production. (Rochester-PTT)
W86-04743

INFLUENCE OF DIFFERENT SUBSTRATE PH VALUES ON THE PERFORMANCE OF A DOWNFLOW ANAEROBIC FIXED BED REACTOR TREATING A PETROCHEMICAL EFFLUENT,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
L. H. Nel, and T. J. Britz.
Biotechnology Letters BILED3, Vol. 8, No. 4, p 293-298, April 1986.

Descriptors: *Wastewater treatment, *Hydrogen ion concentration, *Petrochemical effluent, *Methane bacteria, *Downflow anaerobic fixed bed reactor, *Sodium hydroxide, *Toxicity, Sodium ion, *Process control, Bases, Chemical oxygen demand, Cost analysis.

Neutralizing requirements for the anaerobic treatment of an acidic petrochemical effluent in a downflow anaerobic fixed-bed reactor were examined. Neutralization (pH 6.0 with NaOH) of the effluent prior to digestion resulted in a Na+ concentration of over 3 g/l, which produced a toxic effect, inhibiting the digestion process. Decreasing the Na+ concentration and subsequent replacement of NaOH by a mixture of Ca(OH)2, NaOH, and KOH resulted in an increase in reactor performance. The addition of different alkaline materials resulted in the best loading rates thus far applied in the anaerobic treatment of this effluent. During the final stages of this study, the effluent (pH 3.95) was with at a loading rate of 10.37 kg chemical oxygen demand/cu m per day (hydraulic retention time = 1.35 days), with more than 94% fatty acid removal. The methane yield at pH 3.95 was somewhat lower than at higher pH values, but this was insignificant compared to the rate increase in the processing. The economic implication of reducing the amount of alkali used for neutralizing is considerable. (Rochester-PTT)
W86-04744

KINETICS OF ANAEROBIC PURIFICATION OF INDUSTRIAL WASTEWATER,

Dow Chemical (Nederland) B.V., Terneuzen.
W. L. Bolle, J. van Breugel, G. C. van Eybergen, N. W. F. Kossen, and W. van Gils.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 4, p 542-548, April 1986. 8 fig, 1 tab, 11 ref.

Descriptors: *Up-flow anaerobic sludge blanket reactor, *Growth rates, *Monod Model, *Andrews model, *Volatile fatty acids, *Bacterial physiology, *Kinetics, *Wastewater treatment, Mathematical models, Hydrogen ion concentration, Substrate inhibition, Statistics, Reactor failure.

As part of the development of an integral mathematical model describing the up-flow anaerobic sludge blanket reactor, the kinetics of the conversion of organic wastes has to be known. The Monod model was compared with one proposed by Andrews and others. Together with the assumption that this substrate for the anaerobic bacteria is formed by nonionized, volatile fatty acids, the Andrews model is able to describe substrate inhibition and reactor failure due to pH changes. From four batch experiments with different con-

centrations of microorganisms, it could be concluded with a reliability of over 95% that the Monod model was inadequate and the Andrews model was adequate to describe the measurements. Standard statistical techniques like Chi-square and F-tests were used. From a parameter sensitivity analysis for the Andrews model, it followed that the maximum specific growth rate (mu(A) sub max) of the bacteria and the inhibition constant K sub I are the parameters that influence the system most. These parameters were defined experimentally and most accurately, as follows: mu(A) sub max = 16 x 10(-4) per hr, + or - 2%, and K sub I = 0.0158 g unionized acetic acid/l + or - 2.5%. From a calculation of the Thiele modulus for the particles it follows that transport limitation of the substrate in the flocs is not significant. The efficiency is 0.85 in the worst case. (Author's abstract)
W86-04745

RECENT DEVELOPMENTS IN HYDROGEN MANAGEMENT DURING ANAEROBIC BIOLOGICAL WASTEWATER TREATMENT,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. R. Harper, and F. G. Pohland.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 4, p 585-602, April 1986. 5 fig, 9 tab, 158 ref.

Descriptors: *Hydrogen, *Anaerobic digestion, *Energetics, *Methane bacteria, *Substrate specificities, *Single phase anaerobic filter, *Phase separated anaerobic filters, *Wastewater treatment, Phase-separated filters with gas cycling, Thermodynamics, Hydrogen acceptors, Kinetics, Bacterial physiology.

A comprehensive review of the microbial kinetics, energetics, and substrate specificities of anaerobic wastewater treatment systems includes descriptions of three state-of-the-art reactor configurations (single phase anaerobic filter, phase-separated anaerobic filters, and phase-separated filters with gas cycling). Topics reviewed are: the role of hydrogen in regulating acidogenesis, experimental and thermodynamic quantification of hydrogen effects, regulatory roles of hydrogen acceptors, the roles of hydrogen and acetate in regulating methanogenesis, and phase separation. Each of the three reactor systems is intended to enrich different populations of anaerobic acidogens and methanogens as a result of design and operational strategies for control of hydrogen and volatile acids. Imposition of these strategies result in different substrate utilization patterns, conversion kinetics, and operational stabilities as are currently being demonstrated in laboratory-scale investigations. (Rochester-PTT)
W86-04746

TIGHT MONEY HAMPERS CLEVELAND SEWER JOBS,

For primary bibliographic entry see Field 6C.
W86-04754

COPPER (2+), ZINC (2+), AND NICKEL (2+) UPTAKE BY ACTIVATED SLUDGE,

Universidad Complutense de Madrid (Spain). Dept. de Quimica Industrial.
A. Vian, F. J. Mirada, and J. J. Rodriguez.
Separation Science and Technology, Vol. 20, No. 7-8, p 587-597, September/October 1985. 1 fig, 5 tab, 28 ref.

Descriptors: *Activated sludge, *Adsorption, *Heavy metals, *Separation techniques, *Chemical precipitation, Copper, Zinc, Nickel, Fate of pollutants, Wastewater treatment, Biological wastewater treatment, Activated sludge process.

Removal of Cu, Zn, and Ni by activated sludge in a completely mixed unit occurs by uptake and by precipitation, the latter being particularly important in the cases of Cu and Zn. The amount of heavy metal taken up by the microorganisms at equilibrium varies with influent concentration for the three metals studied. The values obtained ranged from 2.3 mg/g VSS for Cu at 1 mg/liter in the influent to 57.4 mg/g VSS for Ni at influent 25 mg/liter. Soluble metal removal from wastewater increases in percentage with influent concentration, being higher for Cu and lower for Ni. Results of experiments carried out with mixtures of these metals show that the uptake values for Zn and Ni together are very similar to the individual figures of these metals at the same influent concentrations. A small reduction is observed for Zn and a small increase for Ni. When mixtures include Cu, the decrease in Zn uptake becomes more significant and there is a substantial increase in the amount of Ni taken up by the activated sludge. No important differences are observed for Cu between individual and mixture experiments at the same concentrations but when the Cu concentration in the mixture increases, there is a decrease of Zn and Ni uptakes. Higher metal removals occur when working with mixtures due to greater precipitation. Experiments with three-metal mixtures show an increase of relative precipitation and a decrease of uptake, which is more significant as the Cu concentration rises. (Geiger-PTT)
W86-04755

BACILLUS SUBTILIS/MICROSOME REC-ASSAY FOR THE DETECTION OF MUTAGENS IN WATERS OF A MUNICIPAL WASTEWATER TREATMENT PLANT,

Kanazawa Univ. (Japan). Dept. of Construction and Environmental Engineering.
For primary bibliographic entry see Field 5A.
W86-04782

FLOW MEASUREMENT AT SEWAGE TREATMENT PLANTS,

Vizgazdalkodasi Tudomanyos Kutato Intezet. Budapest (Hungary).
For primary bibliographic entry see Field 7B.
W86-04806

SULFUR OXIDES CONTROL TECHNOLOGY SERIES: FLUE GAS DESULFURIZATION; LIME/LIMESTONE PROCESSES,

Radian Corp., Austin, TX.
P. B. Hulman, and J. M. Burke.
Summary Report EPA 625/8-81-006, April 1981. 30 p, 6 fig, 9 tab, 33 ref.

Descriptors: *Sulfur, *Waste management, *Waste disposal, *Lime, *Limestone, Solid waste disposal, Land disposal, Waste dumps, Landfills, Wastes, Industrial wastes, Fly ash, Environmental effects.

The basics of the lime/limestone flue gas desulfurization processes are provided. The process is outlined in schematic form, including flue gas inflow, lime/limestone inflow, holding tanks, absorber system, recycle system, solids waste concentration, and cleaned flue gas removal. Design considerations, with emphasis on feed material processing, adsorption systems, scale control, mist elimination, solids dewatering and disposal, and fly ash chlorides are discussed. Environmental considerations and status of development are described. The major requirements for these systems, mainly raw materials (lime and limestone), electric power (pump, blowers and miscellaneous equipment), installation space, and land for solids disposal, are discussed. (Halterman - PTT)
W86-04819

REMEDIAL ACTION AT WASTE DISPOSAL SITES (REVISED): HANDBOOK.

Science Applications, Inc., McLean, VA.
EPA/625/6-85/006, October 1985. 645 p, 171 fig, 95 tab, 2 append. Contract No. 68-03-3113.

Descriptors: *Water pollution control, *Waste disposal sites, *Wastewater treatment, *Wastewater treatment facilities, *Wastewater disposal, *Waste disposal, *Remedies, Wastewater management, Waste management, Hazardous materials, Toxins, Air pollution, Landfills.

A handbook intended for use as a basic reference tool on remedial action at waste disposal sites is presented. An overview of the remedial investigation/feasibility study process, as outlined in the National Contingency Plan, is followed by a description of remedial technologies. The established technologies are described in terms of applications, limitations, design considerations, construction/implementation considerations, operation, maintenance, monitoring, technology selection/evaluation, and costs. Remedial action categories discussed include: surface water controls, air pollution controls, gas control, on-site and off-site disposal of wastes and soil, removal and containment of contaminated sediments, in-situ treatment, direct waste treatment, and contaminated water supplies and water and sewer lines. (Halterman - PTT)
W86-04820

ODOR AND CORROSION CONTROL IN SANITARY SEWERAGE SYSTEMS AND TREATMENT PLANTS,

Smith (J.M.) and Associates, Cincinnati, OH.
R. P. G. Bowker, and J. M. Smith.
EPA/625/1-85/018, October 1985. 132 p, 77 fig, 57 tab, 166 ref.

Descriptors: Descriptors; *Wastewater treatment, *Odor control, *Hydrogen sulfide, *Corrosion, *Corrosion control, Wastes, Sulfur, Sulfur Compounds, Wastewater, Wastewater facilities, Municipal wastewater, Industrial wastewater.

A major cause of odors in wastewater treatment systems is the toxicant hydrogen sulfide. This compound is also noted for its ability to corrode various materials used in sewer and treatment plant construction. A comprehensive design manual that brings together available information in a form for those designing new systems or applying odor and corrosion control procedures in existing systems is presented. Specific topics covered include: theory, prediction and measurement of odor and corrosion, odor and corrosion control in existing wastewater treatment plants, designing to avoid odor and corrosion in new wastewater collection systems, and designing to avoid odor and corrosion in new wastewater treatment facilities. (Halterman - PTT)
W86-04821

ELECTROPLATING INDUSTRY.

Centec Corp., Reston, VA.
Environmental Regulations and Technology Report EPA/625/10-85/001, September 1985. 44 p, 16 fig, 11 tab, 29 ref.

Descriptors: *Electroplating, *Wastes, *Industrial wastes, *Heavy metals, Wastewater, Industrial wastewater, Wastewater composition, Wastewater disposal, Wastewater management, Wastewater treatment.

A summary of the laws, regulatory activities, and technologies that affect decisions regarding wastewater treatment and solid waste handling and disposal, within the elctroplating industry, is provided. Specific areas covered include: water pollution control regulations, water pollution control technologies, water pollution control case histories, hazardous waste regulations and management, and pollution control financing alternatives. A list of Environmental Protection Agency sources of additional information is also provided. (Halterman - PTT)
W86-04823

USE AND DISPOSAL OF MUNICIPAL WASTEWATER SLUDGE,

Eastern Research Group, Inc., Arlington, MA.
J. Connery, E. Burke, and F. Lowenstein.
Environmental Regulations and Technology Report EPA 625/10-84-003, September 1984. 76 p, 31 fig, 17 tab, 45 ref.

Descriptors: *Sludge disposal, *Waste disposal, *Sludge combustion, Incineration, Waste treatment, Wastewater management, Waste management, Wastewater treatment, Land application, Land disposal, Ocean dumping.

When properly used, sludge can be a valuable resource as a soil conditioner partial fertilizer and as a source of methane for producing energy. This guidance document describes the five major sludge use/disposal options currently available -- land application, distribution and marketing of sludge

products, landfilling, incineration and ocean disposal. Factors influencing their selection and implementation are discussed. The initial framework for evaluating sludge use/disposal alternatives is provided. Accepted and proven technologies and Federal regulations pertinent to sludge management are described. The need to consult additional sources for more detailed information and design criteria, and for the most current information on emerging technologies is emphasized. (Halterman - PTT)
W86-04826

INFORMATIONAL/EDUCATIONAL APPROACHES TO PUBLIC ATTITUDES ON POTABLE REUSE OF WASTEWATER,

Denver Research Inst., CO.
L. C. Lohman, and J. G. Milliken.
Research Study Report and Program Guide for Municipal Water, System Administrators, August 1985. 128 p, 23 tab, 23 ref, 6 append.

Descriptors: *Water reuse, *Public opinion, *Public relations, Wastewater facilities, Water treatment facilities, Wastewter management, Wastewater renovation, Wastewater treatment.

A study is described in which the degree of public awareness about potable wastewater reuse was measured, and the effects of information/education measures on public understanding acceptance of potable wastewater reuse is analyzed. Results indicate that there is no identifiable subgroup in the population that can be targeted for an information/education program designed to achieve broad acceptance of potable water reuse. A prerequisite to positive change in attitude is citizen faith in the water supply agency. Reading material, supplemented by a plant tour, is necessary to achieve public interest and understanding of the reuse concept. Degree of public acceptance is closely related to understanding of potable reuse treatments. (Halterman - PTT)
W86-04827

SEPTAGE TREATMENT AND DISPOSAL: HANDBOOK,

Weston (Roy F.), Inc., West Chester, PA.
K. C. Wiswall, G. M. Johnson, L. Y. H. Lin, A. Dasgupta, and A. S. Eikum.
EPA-625/6-84-009, October 1984. 300 p, 79 fig, 59 tab, 221 ref, 1 append.

Descriptors: *Septic tanks, *Septic wastewater, *Wastewater, Domestic wastes, Wastewater disposal, Wastewater facilities, Wastewater management, Wastewater treatment, Land disposal.

An up-to-date review of available design, performance, operation and maintenance, cost and energy information pertaining to the receiving, treatment, and disposal of septage is presented. Information needed to facilitate the design of septage receiving stations, pretreatment processes, new sewage treatment plants with provisions for receiving septage, and independent septage treatment and disposal alternatives is provided. Methods for septage treatment and disposal discussed include land treatment and disposal, co-treatment at existing wastewater treatment facilities, and independent facilities for treatment and disposal. Individual treatment processes are discussed in detail and specific design guidance is provided. (Halterman - PTT)
W86-04828

ESTIMATING SLUDGE MANAGEMENT COSTS.

Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
Handbook EPA/625/6-85/010, October 1985. 540 p, 138 fig, 18 tab, 7 ref, 3 append. Contract No. 68-03-3017 & 68-01-6621.

Descriptors: *Sludge disposal, *Economic aspects, *Sludge drying, Sludge digestion, Land disposal, Waste disposal, Waste treatment, Waste management, Wastewater management, Wastewater treatment.

Preliminary cost estimating curves, covering both capital costs and annual operating and maintenance costs, for commonly used processes in municipal wastewater sludge treatment, storage, transport, use or disposal, are provided. In addition, annual operating and maintenance curves, which provide additional user flexibility, are also included. The processes can be arranged into various sludge management chains and preliminary costs estimated for each sludge management chain to be evaluated. The cost curves provided generally cover a range up to 100 million gallons of sludge per year, equivalent to a wastewater treatment plant capacity of at least 50 mgd. An annotated bibliography of selected literature containing sludge management cost estimating information is included. (Halterman - PTT)
W86-04829

IMPROVING POTW PERFORMANCE USING THE COMPOSITE CORRECTION PROGRAM APPROACH: HANDBOOD,

Process Applications, Inc., Fort Collins, CO.
B. A. Hegg, J. R. Schultz, and K. L. Rakness.
EPA-625/6-84-008, October 1984. 258 p, 13 fig, 27 tab, 62 ref, 15 append.

Descriptors: *Publicly owned treatment works, *Wastewater treatment, *Wastewater, *Municipal wastewater, Performance evaluation, Sludge, Wastewater disposal, Wastewater facilities, Water treatment facilities.

Information on methods to economically improve the performance of existing publicly owned treatment works (POTWs) is presented. A variety of aspects of a recommended approach to conducting comprehensive performance evaluations are outlined. Data collection, evaluation of major unit processes, performance evaluation, evaluation of performance-limiting factors, and reports, are discussed. Details of conducting composite correlation programs are also presented. The initial site visit, improving design performance-limiting factors, improving maintenance limiting factors, improving administrative performance-limiting factors, and improving operational performance-limiting factors are detailed. (Halterman - PTT)
W86-04830

SULFUR OXIDES CONTROL TECHNOLOGY SERIES: FLUE GAS DESULFURIZATION; SPRAY DRYER PROCESSES,

Radian Corp., Austin, TX.
E. D. Gibson, M. A. Palazzolo, and M. E. Kelly.
Summary Report EPA 625/8-82-009, September 1982. 26 p, 4 fig, 6 tab, 20 ref.

Descriptors: *Flue gas desulfurization processes, *Waste management, *Sulfur, *Waste disposal, Spray dryers, Lime, Sodium carbonate, Solid waste disposal, Land disposal, Waste dumps, Landfills, Wastes, Industrial wastes, Fly ash, Environmental effects, Air pollution.

A basic description of the spray dryer flue gas desulfurization process is provided. Both sodium carbonate and lime spray drying are discussed, although lime is emphasized because of the higher reagent costs and waste disposal problems associated with sodium carbonate, and the greater commercial acceptance of lime for dry flue gas desulfurization. The process description, including absorbent preparation, absorption and drying, solids collection and solids disposal, is outlined. Design considerations such as selection and preparation of the absorbent, spray dryer design, spray dryer operation, and solids recycling are discussed. Environmental considerations are presented, and the major requirements of the system, such as raw materials, energy and installation space, are outlined. (Halterman - PTT)
W86-04831

FLUE GAS DESULFURIZATION INSPECTION AND PERFORMANCE EVALUATION: MANUAL.

PEI Associates, Inc., Cincinnati, OH.
EPA/625/1-85/019, October 1985. 295 p, 425 fig, 36 tab, 13 ref, 3 append.

Descriptors: *Waste management, *Sulfur, *Waste disposal, Soild waste disposal, Wastes, Air pollution, Industrial wastes, Fly ash, Environmental effects.

Information regarding various problems pertaining to lime/limestone slurry flue gas desulfurization systems is provided. The information is designed to aid inspectors, from federal and state environmental agencies, in their inspections and performance evaluations of these systems with respect to compliance with the emission standards that have evolved since the passage the 1970 Clean Air Act. Lime and limestone flue gas desulfurization technology is reviewed; performance monitoring techniques for all key operating parameters are outlines; inspection methods and procedures are detailed; and performance evaluation and problem diagnosis/correction techniques are discussed. A model operations and maintenance plan is presented as an example of an ideal system. (Halterman - PTT)
W86-04832

OPERATION AND MAINTENANCE MANUAL FOR ELECTROSTATIC PRECIPITATORS,

Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
G. L. Saunders, R. L. Hawks, and M. F. Szabo.
Manual EPA/625/1-85/017, September 1985. 480 p, 93 fig, 17 tab, 32 ref, 5 append. Contract No. 68-02-3919.

Descriptors: *Waste management, *Sulfur, *Waste disposal, *Electrostatic precipitators, Solid waste disposal, Wastes, Air pollution, Industrial wastes, Fly ash, Environmental effects, Operation manual.

All aspects of the operation and maintenance of electrostatic precipitators are presented. The basic theories and principles of electrostatic precipitation are outlined. Performance monitoring as a major element in an operation and maintenance program are discussed. Performance monitoring and other data in the evaluation of control system performance, in the discovery of real or impending problems, and in the diagnosis and correction of causes of poor performance are described. Guidelines for general operation and maintenance, and procedures that can be used to improve and sustain control equipment performance and reliability are presented. Methods and procedures for the detailed inspection of electrostatic precipitator systems and their components are detailed. Finally, the more important elements of an adequate operation and maintenance program are summarized. (Halterman - PTT)
W86-04833

MUNICIPAL WASTEWATER SLUDGE COMBUSTION TECHNOLOGY.

Environmental Protection Agency, Cincinnati, OH. Center for Environmental Research Information.
Seminar Publication EPA/625/4-85/015, September 1985. 177 p.

Descriptors: *Sludge disposal, *Sludge combustion, *Waste disposal, *Municipal wastewater, Incineration, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Wastewater, Septic sludge.

Various municipal sludge combustion systems are described and evaluated. The necessity for considering and evaluating the costs involved in the total sludge management train, including dewatering, combustion, air pollution control, and ash disposal processes are emphasized. Questions that have been raised about incineration as a means of processing sludge solids for ultimate disposal are answered. The primary objectives of the material presented are to assess the current status of municipal sludge combustion technology as to performance of in-place systems, environmental concerns, and regulatory agency viewpoints; to increase economy of sludge combustion; and to discuss current technology. (See W86-04836 thru W86-04839) (Halterman - PTT)
W86-04835

SLUDGE INCINERATION FACILITIES,

D. C. Bergstedt, R. I. Dick, K. S. Feindler, S.
Kyosai, and C. H. Nels.
IN: Municipal Wastewater Sludge Combustion Technology, Seminar Publication EPA/625/4-85/015, September 1985. p 1-28, 6 fig, 10 tab.

Descriptors: *Sludge disposal, *Sludge combustion, *Waste disposal, Incineration, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Japan, Europe, Federal Republic of Germany, Fluidized beds furnace, Multiple-Hearth furnace, Electric furnace.

Recent developments in more efficient solids dewatering processes and advances in combustion technology have renewed interest in the use of high temperature processes for specific applications. These processes are recommended where available land is scarce, stringent requirements for land disposal exist, destruction of toxic materials is required, or potential exists for recovery of energy, either with wastewater solids alone or combined with municipal refuse. The structure and function of major furnace types, including multiple-hearth, fluidized-bed, and electric are described. Statistics on wastewater sludge incineration in the United States, Europe, the Federal Republic of Germany and Japan are presented. (See also W86-04835) (Halterman - PTT)
W86-04836

IMPROVING SLUDGE INCINERATION METHODS,

Zimpro, Inc., Rothschild, WI.
R. G. Forbes, P. F. Gilbert, R. T. Haug, S. Kyosai, and F. M. Lewis.
IN: Municipal Wastewater Sludge Combustion Technology, Seminar Publication EPA/625/4-85/015, September 1985. p 29-64, 9 fig, 4 tab.

Descriptors: *Sludge disposal, *Sludge combustion, *Waste disposal, *Incineration, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Dewatering, Furnaces.

Case studies are used to discuss how several operational problems were overcome at existing wastewater sludge incineration facilities. Specific topics discussed include the rate and properties of feed, combustion processes, furnace operation, multiple-hearth furnaces, moisture evaporation rate, combustion control logic, dewatering sludge, fuel needs, upgrading existing furnaces to reduce fuel needs, autogenous combustion, superautogenous combustion, and waste heat recovery equipment. (See also W86-04835) (Halterman - PTT)
W86-04837

COCOMBUSTION OF SLUDGE AND SOLID WASTES,

Carlson Associaters Technical Services, Redwood City, CA.
E. G. Carlson, A. Baturay, D. C. Bergstedt, W. F. Cosulich, and K. S. Feindler.
IN: Municipal Wastewater Sludge Combustion Technology, Seminar Publication EPA/625/4-85/015, September 1985. p 65-100, 3 fig, 10 tab.

Descriptors: *Sludge disposal, *Sludge combustion, *Waste disposal, *Incineration, *Cocombustion, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Solid wastes, Solid waste disposal.

Various aspects of cocombustion of sludge and solid wastes are discussed. The rationale for considering the joint combustion of sludge and solid wastes is that sludge, even after dewatering by conventional methods, lacks sufficient heat value to balance the evaporative burden of its remaining moisture when it is burned in a typical combustor. Types of burners suitable for codisposal and predrying of sludge solids are evaluated. Case histories of coincineration practices are presented for systems in Stamford, CT; Glen Cove, NY; Duluth, MN; and Flint River, GA. Types of codisposal systems in the United States and Europe are reviewed, and statistics on specific sites are listed. (See also W86-04835) (Halterman - PTT)
W86-04838

EMERGING TECHNOLOGY,

Environmental Protection Agency, Washington, DC. Office of the Assistant Administrator for Water.
R. K. Bastian, C. Spooner, D. C. Chase, and H. T. Chase.
IN: Municipal Wastewater Sludge Combustion Technology, Seminar Publication EPA/625/4-85/015, September 1985. p 134-177, 17 fig, 7 tab.

Descriptors: *Sludge disposal, *Sludge combustion, *Waste disposal, *Incineration, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Solid waste disposal, Liquification, Gasification.

Processes for thermal conversion of municipal sludge are discussed. Gasification, liquification, wet oxidation and combustion are emphasized. Specific topics covered include operating parameters, development status, fuel ash content, air pollution emissions, conversion of sludge solids to fuel oil, conversion of sludge to oil by hydroliquefaction, energy considerations, starved-air combustion, and pyrolysis. Case studies in the United States, Germany, and Japan are presented. (See also W86-04835) (Halterman - PTT)
W86-04839

PROCESS DESIGN MANUAL FOR LAND TREATMENT OF MUNICIPAL WASTEWATER: SUPPLEMENT ON RAPID INFILTRATION AND OVERLAND FLOW.

Environmental Protection Agency, Cincinnati, OH. Office of Water Program Operations.
Report EPA 625/1-81-013a, October 1984. 121 p.

Descriptors: *Land disposal, *Overland flow, *Infiltration, *Soil disposal fields, *Waste disposal, *Municipal wastewater, Wastewater disposal, Wastewater treatment, Wastewater management, Wastewater.

A supplement to the 1981 Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater is presented. The design of rapid infiltration systems is described, and guidance and detail on planning, design, construction, and operation is provided. The information is provided to avoid problems which have been observed in recently constructed systems. Detailed information pertaining to overland flow is also provided. Design criteria, preapplication treatment, storage, distribution systems, terrace design and construction, as well as vegetation selection and establishment, are discussed. (See W86-04841 thru W86-04842) (Halterman - PTT)
W86-04840

RAPID INFILTRATION,

Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed, A. T. Wallace, H. Bouwer, C. Enfield, and C. Stein.
IN: Process Design Manual for Land Treatment of Municipal Wastewater: Supplement on Rapid Infiltration and Overland Flow. Report EPA 625/1-81-013a, October 1984. p 1-66, 6 fig, 7 tab, 71 ref.

Descriptors: *Land disposal *Waste disposal, *Rapid infiltration, *Percolation, Soil disposal fields, Wastewater disposal, Municipal wastewater, Wastewater treatment, Wastewater management, Groundwater, Wastewater.

Rapid infiltration (RI) is a very successful and cost-effective method for wastewater management. RI systems can be designed for wastewater treatment; or as one component in a waste re-use plan involving recovery of the treated water and/or storage in an aquifer. The concept depends on a relatively high rate of wastewater infiltration into the soil followed by rapid percolation, either vertically or laterally, away from the application point. The best soils are relatively coarse textured, with moderate to rapid permeabilities. In practice, wastewater application rates have ranged from about 15 m/yr to 120 m/yr (50-400 ft/yr) for successful RI systems. This supplement provides additional guidance, than in the Manual, and where necessary, a stronger emphasis and more specific detail on critical aspects so that problems can be avoided in future design. In addition, this supplement presents information developed since 1981 on performance of RI systems with respect to nitrogen removal, organics removal, and the need for disinfection. (See also W86-04840) (Lantz - PTT)
W86-04841

OVERLAND FLOW,

ERM-Southeast, Inc., Brentwood, TN.
D. D. Deemer, R. E. Thomas, S. C. Reed, J. L. Witherow, and G. Morgan.
IN: Process Design Manual for Land Treatment of Municipal Wastewater: Supplement on Rapid Infiltration and Overland Flow. Report EPA 625/1-81-013a, October 1984. p 67-121, 6 fig, 4 tab, 63 ref.

Descriptors: *Overland flow, *Land disposal, *Soil disposal fields, *Waste disposal, *Municipal wastewater, Wastewater disposal, Wastewater, Wastewater treatment, Wastewater management.

When the 2nd edition of the Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater was published, the overland flow (OF) process was just beginning to gain recognition as an effective wastewater treatment alternative. The experience gained and successes reported from these early OF projects have led to a substantial increase in the use of the OF process for smaller communities. As of March 1984, there were approximately 48 municipal OF systems in operation or in some stage of design or construction. Although not intended to replace the Manual, this section aims to update and refine the information contained in the Manual with the more recent experiences gained during design, construction, and operation of an increasing number of municipal OF systems. The information provided here, is based principally on two sources of information: (1) field investigations of six OF systems which were placed into operation in 1983 and 1984, ranging in size from 265 to 11,356 cu m/d (0.07 to 3.0 MGD) and three systems which were under construction in early 1984; and (2) recently available data from research/demonstration projects. Although it is premature to assess adequately the effectiveness of the municipal OF facilities, it appears that most of them will be capable of meeting their discharge criteria. The field investigations also uncovered a number of design, construction, and operational factors which could be modified to improve their performance and reliability. These factors are organized by subject matter in this text. (See also W86-04840) (Lantz - PTT)
W86-04842

TREATMENT OF A PETROCHEMICAL WASTEWATER IN SEQUENCING BATCH REACTOR,

Shell Development Co., Houston, TX.
E. H. Hsu.
Environmental Progress, Vol. 5, No. 2, p 71-81, May 1986. 4 tab, 20 fig, 19 ref.

Descriptors: *Wastewater treatment, *Oil industry, *Biological oxygen demand, Sequencing batch reactors, Nitrification, Organic shock, Effluents, Phenols, Monod kinetics, Activated sludge process, Solids, Model studies, Mathematical models.

The performance of sequenching batch reactors (SBR) in an industrial application was investigated by using wastewater from a petrochemical complex. Four bench-scale SBR's and a bench-scale conventional activated sludge unit were operated. In terms of the degradation of BOD material and nitrification, the performance of the SBR's was comparable or slightly superior to that of the conventional activated sludge unit. However, for high strength wastes with BOD's > 300 mg/l under organic loading conditions, effluent from an SBR may have a high solids content as a result of abundant dispersed-cells growth. The SBR reacted well to a series of phenolic shock loadings; phenols were degraded from initial concentrations ranging from 200 to 950 mg/l to <0.1 mg/l. The present SBR model was adequate in predicting reactor performance in terms of MLVSS and the effluent BOD's concentration. The model should be useful as a design tool for SBR's. (Peters-PTT)

W86-04945

ECONOMICS OF MEMBRANE TREATMENT OF WASTEWATERS CONTAINING FIRE-FIGHTING FOAM,

Civil Engineering Lab. (Navy), Port Hueneme, CA.
D. B. Chan, and E. S. K. Chian.
Environmental Progress, Vol. 5, No. 2, p 104-109, May 1986. 6 tab, 1 fig.

Descriptors: *Wastewater treatment, *Ultrafiltration, *Reverse osmosis, Membrane processes, Aqueous film forming foam, Oil, Gasoline, Cost analysis, Economic evaluation.

Aqueous Film Forming Foam (AFFF) is the most effective fuel/oil firefighting agent. Wastewater generated from firefighting training facilities contains mixtures of AFFF, residual free fuel oil, emulsified fuel oil, gasoline, purple K (PKP), and miscellaneous combustion products. Membrane treatment of these wastewaters by a two stage ultrafiltration (UF) and reverse osmosis (RO) process appears economically attractive. A design of a 10,000 gallon/day (g pd) UF and RO recovery system was prepared for testing at a Navy application site. The total cost of the system including a membrane cleaning module that costs $15,000 and a 10% total cost used as contingency fee is estimated at $220,000. Cost effectiveness of the membrane process is compared with a rotating biological contactor and a carbon adsorption system. A firefighting facility using the UF and RO system can realize net savings if the following conditions at the facility are met: (1) more than 300 gallons of AFFF a day are used and the facility operates 250 days a year; (2) it uses recovered AFF and water; and (3) it generates 10,000 gpd or more AFFF-laden wastewater, and contains 3 percent or more AFFF in the waste. Application of this treatment technology will not only meet pollutions abatement objective, but also will meet Resource Conservation and Recovery Act (RCRA) requirements. (Peters-PTT)
W86-04947

BIOTREATED COAL LIQUEFACTION WASTEWATER: IDENTIFICATION OF ORGANICS BY COMPOSITE RO MEMBRANE CONCENTRATION, HPLC, AND GC/MS,

Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. M. Jevtitch, and D. Bhattacharyya.
Environmental Progress, Vol. 5, No. 2, p 130-134, May 1986. 5 tab, 7 fig, 10 ref.

Descriptors: *Coal, *Reverse osmosis, *Biological wastewater treatment, Phenols, Cresol, Resorcinol, Wastewater treatment, Total organic carbon, Biological oxygen demand, Ash, Suspended solids, Silicon, Calcium, Magnesium, Iron, Sulfur, Sodium, Copper, Zinc, Cadmium, Lead, Nickel, Permeate.

A combination of aromatic polyamide RO membrane, HPLC and GC/MS was used to characterize feed and permeate samples from a coal liquefaction wastewater. The residual organics after biological treatment and their rejections by thin film membranes were identified and tested. Various derivatives of lactams and nitrobenzene esters were detected as by-products of the biooxidation process. Molecules of mass >155 were not detected in the permeate. At 90% water recovery, the membrane showed 91% chloride removal and 94% total organics removal. Similar results were obtained by HPLC analysis by comparing peak ratio reduction between feed and permeate. The membrane process provides an efficient treatment which makes the permeate suitable for recycling even under high water recovery conditions. (Peters-PTT)
W86-04949

ANAEROBIC BIODEGRADATION OF A RECALCITRANT DETERGENT WASTEWATER,

Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Genetics and Cellular Biology.
C. Punchiraman, and R. S. Hassan.
Effluent and Water Treatment Journal, Vol. 26, No. 3/4, p 85-88, March/April 1986. 11 fig, 32 ref.

Descriptors: *Detergents, *Wastewater treatment, *Anaerobic digestion, Anaerobic biodegradation, Alkylbenzene sulphonates, Biodegradation, Organic compounds, Toxicity, Sludge.

The effect of branched chain alkylbenzene sulphonates (ABS) on the anaerobic digestion process was studied as was its possible degradation under anaerobic conditions. There was a direct response between concentration of ABS applied and the inhibition of growth of the bacteria from 1000 to 5000 mg/L of ABS. At low ABS concentrations of <1000 mg/L no inhibition zones were detected. The addition of detergent wastewater generally impairs the proper functioning of the anaerobic digesters compared to the sludge-fed digesters. The deleterious effect could be directly due to the toxic effect of the chemicals in the detergent formulation. The ratio of the admixtures is important; 50% sludge-detergent mixtures is ideal for the process. The addition of pure detergent wastewater seriously affected the anaerobic digestion process due to toxicities, excessive washout and lack of replenishment of nutrients and bacteria. The anaerobic digestion process does not seem to degrade the recalcitrant detergent molecules. (Peters-PTT)
W86-04952

ANAEROBIC FILTRATION OF A DISTILLERY WASTE,

Roorkee Univ. (India). Dept. of Civil Engineering.
R. P. Mathur, R. Bhargava, and A. Gupta.
Effluent and Water Treatment Journal, Vol. 26, No. 3/4, p 89-91, March/April 1986. 3 tab, 6 fig, 10 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Filtration, *Food-processing wastes, Biogas, Biological oxygen demand, Chemical oxygen demand, Volatile acids, Nitrogen, Solids, Dissolved solids, Organic loading, Methane.

Molasses based distillery wastes were used to study the efficacy of anaerobic filtration. The upflow anaerobic filter is capable of reducing organic matter with an efficiency of 80% removal at an organic loading of 3.7 kg/cm m/day. At the maximum removal the average COD stabilization was 12 to 15 gms/day. At lower loadings buffering is not necessary. The system had the ammonia available to buffer the system even at higher organic loading but the detention time was too short to effect it. The average production of biogas was 2.0, 3.6, and 3.9 L/day at three organic loadings of 3.7, 5.6, and 7.4 kg/cu m/day but the methane content was more at low loadings. (Peters-PTT)
W86-04953

FILTRATE AND CAKE QUALITY IN SLUDGE DEWATERING,

Nigeria Univ., Nsukka. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-04954

RECYCLING -- KEY TO ONE STEEL MILL'S POLLUTION CONTROL,

Sverdrup and Parcel and Associates, Inc., St. Louis, MO.
J. Peltier, D. F. Cairns, and J. C. Buzzell, Jr.
Effluent and Water Treatment Journal, Vol 26, No. 3/4, p 127-131, March/April 1986. 2 tab, 2 fig, 1 ref.

Descriptors: *Recycling, *Industrial wastewater, Horseshoe Lake, Blowdown treatment plant, Chlorination, Filtration, Mississippi River, Sulphonation, Stabilization lagoons, Steel, Wastewater treatment, Recreation, Solids.

At the Granite City steel division of National Steel Corporation, a medium sized, integrated facility producing flat rolled steel products, located in Madison County, Illinois, a step in water pollution control was completed by placing a wastewater recycling system into operation to meet both immediate and long term water pollution control goals. Wastewaters originate from the following major production facilities: by product coke plant; two blast furnaces; sintering plant; basic oxygen furnace shop; blooming mill; 80-inch hot strip mill; 72-inch hot rolled coil processing and slitting lines; continuous coil picking line; 56-inch four-stand, cold strip reducing mill; three continuous galvanizing lines; batch pickling unit; and steam generating facilities. The new facilities include a recycle pump station, new pipelines, the blowdown treatment plant, and an outfall channel. The treatment sequence in the blowdown plant includes breakpoint chlorination, filtration and sulfonation. This recycling approach permits Granite City Steel to continue to supply Horseshoe Lake with water of high quality to support a year round recreational base in a State Park and prevent the threat of the lake's becoming dry due to inadequate water supply. Recycling from the stabilization basins provides the mill with a water source containing lower solids content than that withdrawn from the Mississippi River. (Peters-PTT)
W86-04956

LIFT STATION DESIGN,

GRW Engineers, Lexington, KY.
For primary bibliographic entry see Field 8A.
W86-04959

PHOTODEGRADATION OF THE HERBICIDE GLYPHOSATE IN WATER,

Norwegian Plant Protection Inst., Aas.
K. Lund-Hoie, and H. O. Friestad.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 723-729, May 1986. 1 tab, 4 fig, 10 ref.

Descriptors: *Herbicides, *Aquatic environment, *Ultraviolet radiation, Glyphosate, Photodegradation, Lakes, Clay loam.

The effect of artificial light as well as sunlight on glyphosate (Roundup R) in water of varying qualities is reported. Solutions of 1 ppm of glyphosate in deionized water were exposed indoors to the following light qualities: sodium light with energy maximum peaks between 550 nm and 650 nm; mercury light with energy maximum between 400 and 600 nm; and UV-light with energy maximum at 254 nm. Glyphosate (2000 ppm) was dissolved in deionized water and continuously exposed to darkness or UV-light at 254 nm. In an outdoor experiment, different water qualities with 1 percent glyphosate added were exposed to sunlight. The water samples included were: deionized water, deionized water plus silty clay loam; polluted water from an inland lake; polluted water plus 5 percent silty clay loam. Long-wave light did not have any photodegrading effect on glyphosate. UV-light was about 4 days. The rapid photodegradation in pure water was also seen in the outdoor experiment. The degradation of glyphosate in deionized water was faster than in polluted water; the disappearance was influenced by the presence of clay. The content of glyphosate adsorbed to clay derived from deionized and polluted water was 12 ppm and 10 ppm, respectively. The results show that UV-light possesses a high capacity for degrading glyphosate. The rate of degradation proceeds faster in pure water than in polluted water. (Peters-PTT)
W86-04961

OMAHA MOVES FROM 'DISPOSE ALL' TO MANAGEMENT,

Omaha Public Works Dept., NE. Quality Control Div.
For primary bibliographic entry see Field 5E.
W86-04974

UPGRADING WITH SPRAY IRRIGATION,

Tatman and Lee Associates, Wilmington, DE.
For primary bibliographic entry see Field 5E.
W86-04975

RAPID DETERMINATION OF CHEMICAL OXYGEN DEMAND IN WASTE WATERS AND EFFLUENTS BY FLOW INJECTION ANALYSIS,

Loughborough Univ. of Technology (England). Dept. of Chemistry.
For primary bibliographic entry see Field 5G.
W86-04992

PLATE SEPARATION - BUDDING CONVENTIONAL TECHNOLOGY,

Aqua Trend, Inc., Shawnee Mission, KS.
C. G. Steiner.
Water Engineering and Management, Vol. 133, No. 3, p 32-34, 22. 10 fig.

Descriptors: *Gravity separation, *Plate separation, *Oil, *Grease, *Scum, *Waxes, *Neutral-gravity particles, *Wastewater facilities, Water conservation.

The general theory dealing with differential gravity separation is explained, and characteristics of various devices employing these principles are described. These include: simple rectangular clarifier, clarifer with parallel plates, down flow separator, cross flow separator, up flow separator, inclined plate separator, corrugated plate separator, combination flocculator separator, dissolved air flotation (DAF) separator, and combination separator DAF separator. Variants of gravity separators built around stacks of parallel plates offer a number of distinct performance advantages for separating such contaminants as oil, scum, fats, greases, waxes, and neutral gravity particles from water. Separators may be used to separate two types of particles. Such particle classification can save significant quantities of transport, dilution, or elutriation water if done in a dynamic rather than static mode. The technology of plate separation is now better understood than previously; designs offer several treatment options and unlimited flow capabilities in either shop-built packaged steel or site-constructed concrete materials for construction. (Rochester-PTT)
W86-05011

PRETREATMENT BY THE METAL FINISHING INDUSTRY,

Lancy International, Inc., Zelienope, PA.
F. A. Steward.
Water Engineering and Management, Vol 133, No. 3, p 35-36, March 1986. 2 fig.

Descriptors: *Pretreatment of water, *Metal-finishing wastes, *Cyanides, *Chromium, *Municipal wastewater, Surface runoff, Process control, Caustic soda, Lime, Atmospheric particulates, Metal salts, Precipitates, Hydrogen ion concentration.

Waste pretreatment in the metal finishing industry is as an aid to municipal wastewater treatment plant operators who must treat the waste from these businesses. The satisfactory performance of a treatment program for this industry depends on several factors: proper segregation of waste streams containing cyanides or hexavalent chromium; control of reaction pH, chemical additions and reaction time; chemical additions made by ORP controllers in both the cyanide and hexavalent chromium processes; neutralization using caustic soda and chemical treatments for cyanide and chromium are complete within 5 min (20 minute retention time when lime slurry is used); cleanliness of the probes used on pH and ORP controllers; avoidance of problems due to chelating compounds in the waste stream; and adequate physical separation of the precipitated metal salts. Metallic contaminants may also originate from street runoff, wash out of atmospheric particulates, and other sources besides metal finishing plants. (Rochester-PTT)
W86-05012

FIELD EVALUATION OF ARSENIC AND SELENIUM REMOVAL BY IRON COPRECIPITATION,

Brown and Caldwell, Pleasant Hill, CA.
D. T. Merrill, M. A. Manzione, J. J. Peterson, D. S. Parker, and W. Chow.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 18-26, January 1986. 11 fig, 1 tab, 18 ref.

Descriptors: *Arsenic, *Selenium, *Sludge, *Iron coprecipitation, *Pilot plants, *Ash pond effluents, *Wastewater facilities, *Wastewater treatment, Cost analysis, South Carolina, Feasibility studies.

To demonstrate iron coprecipitation technology, a field study was conducted at the Carolina Power and Light Company's Roxboro Power Station. The objectives of the study were to verify previously derived laboratory results, confirm technical and economic feasibility, and develop design and cost information for full-scale treatment plants that remove arsenic and selenium from ash-pond effluents. Basic chemistry, pilot plant, liquid treatment results, sludge production, sludge thickening, sludge dewatering, hazardous waste analysis, and costs are discussed. Arsenate removal exceeded 90% at clarifier overflow rates up to 49 cu m/sq m per day as long as iron doses were 14 mg/liter and above. Selenium removal (56-89%) was limited by the fraction of selenate in the waste stream. Arsenic and selenium adsorption was rapid and was completed within 2 min of chemical addition. Wastewater solids and chemical precipitates were effectively coagulated and settled over wide ranges of pH, iron dose, and polymer dose. Process sludges can be concentrated first with gravity thickeners and then with filter presses. Sludges from treatment of Roxboro plant ash pond effluent were not hazardous as defined by the extraction-procedure toxicity test. Total process costs are estimated at 9.3 cents per cu m of wastewater treatment. Coprecipitation with iron is technically and economically feasible for arsenic removal and for selenium removal as well if selenium is predominantly selenite. (Rochester-PTT)
W86-05015

COMPARATIVE REMOVAL OF TOXIC POLLUTANTS BY SIX WASTEWATER TREATMENT PROCESSES,

Environmental Protection Agency, Cincinnati, OH
S. A. Hannah, B. M. Austern, A. E. Eralp, and R. H. Wise.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 27-34, January 1986. 14 tab, 9 ref.

Descriptors: *Toxins, *Priority pollutants, *Activated sludge, *Trickling filters, *Filtration, *Aerated lagoons, *Facultative lagoons, *Organic matter, *Wastewater treatment, Pilot plants, Wastewater facilities.

The capabilities of five less-than-secondary treatment processes (high-rate trickling filter system, primary treatment with chemical addition, direct filtration of primary effluent, aerated lagoon, and facultative lagoon) were evaluated for removal of priority pollutants and partition and interaction of organics within the systems were determined. A conventional activated sludge system was operated in parallel to provide a control for comparison of the alternative processes. The control activated sludge process provided the best removals of both conventional pollutants and toxic priority pollutants. The facultative lagoon with its long detention time was the most successful alternative process. The aerated lagoon with a shorter detention time was less effective than the facultative lagoon. The high-rate trickling filter system was less effective than the lagoons. The chemical clarification system and the primary plus filtration system removed only those toxics associated with wastewater solids. These two systems would not be good choices for removal of toxic priority pollutants. Selected alternative processes may be acceptable in site-specific situations, where toxic removal requirements are limited because of consistently low influent concentrations of toxic chemicals and where water quality criteria are not overly restrictive. (Rochester-PTT)
W86-05016

ADSORPTION, DESORPTION, AND BIOREGENERATION IN AN ANAEROBIC, GRANULAR ACTIVATED CARBON REACTOR FOR THE REMOVAL OF PHENOL,

General Motors Research Labs., Warren, MI.
B. R. Kim, E. S. K. Chian, W. H. Cross, and S. S. Cheng.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 35-40, January 1986. 7 fig, 1 tab, 16 ref.

Descriptors: *Adsorption, *Desorption, *Bioregeneration, *Activated carbon, *Phenol, *Biogas, *Wastewater treatment, Biomass production, Pilot plants, Wastewater facilities, Biodegradation.

The relative contributions of adsorption, biodegradation (biogas production), and biomass production were studied along with bioregeneration in the removal of phenol in an anaerobic, fluidized granular activated carbon (GAC) reactor. Two two-stage pilot-scale anaerobic GAC reactor units were used. The results, obtained from running a GAC reactor for approximately 200 days (starting with fresh GAC), indicated that contributions of biogas production, adsorption, and biomass production were all important in the removal of phenol. Biogas production was most important, whereas the contributions of adsorption and biomass accumulation to total carbon retained in the reactor were comparable. Bioregeneration occurred as adsorbed phenol was desorbed because of reduced influent phenol concentration. This also was shown by increased biogas production during the same period. (Rochester-PTT)
W86-05017

DESIGN AND PERFORMANCE OF A GROUNDWATER TREATMENT SYSTEM FOR TOXIC ORGANIC REMOVAL,

CH2M Hill, Inc., Gainesville, FL. Hazardous Waste and Industrial Processes Div.
For primary bibliographic entry see Field 5G.
W86-05018

ENERGY USAGE OF ROTATING BIOLOGICAL CONTACTOR FACILITIES,

Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
W. G. Gilbert, J. F. Wheeler, and A. MacGregor.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 47-51, January 1986. 7 tab, 9 ref.
EPA Contract No. 68-01-6622.

Descriptors: *Rotating biological contactor, *Biological wastewater treatment, *Energy use, *Energy conservation, *Electric power demand, *Wastewater treatment, Design considerations, Biofilm, Process control, Wastewater facilities, Onsite tests.

A field survey was conducted of energy requirements of 29 rotating biological contactor facilities (RBC: 22 mechanical drive, 7 air drive), which were selected to include units manufactured by the four major companies supplying RBCs to municipalities. A calibrated electric power demand analyzer was employed in making power measurements. The facilities included in this survey had predominantly light and very light biofilm growths so the impact of heavy growth could not be determined. Most of the mechanical RBC units operated at relatively low power factors (0.19-0.82), even though many plants had capacitors installed on the main power supply for power correction. Blowers of the air-driven systems were often oversized to meet maximum demand, and throttling and speed reduction of the blowers was sometimes necessary during normal operation to reduce the air flow rate. Flexibility for process operation is extremely important. Design features to be considered should include removable baffles between stages in a train, provisions for flow diversion between adjacent trains, and ability to bypass part of the influent flow to a subsequent stage (stepfeed). Flexibility in flow distribution is particularly important in facilities where high flow variability is expected. Such flexibility permits optimization of the process in the most energy-efficient manner. (Rochester-PTT)
W86-05019

INTERACTIONS OF TEMPERATURE, PH, AND BIOMASS ON THE NITRIFICATION PROCESS,

King Saud Univ., Riyadh (Saudi Arabia). Coll. of Engineering.

N. K. Shammas.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 52-59, January 1986. 9 fig, 3 tab, 32 ref.

Descriptors: *Temperature, *Hydrogen ion concentration, *Nitrification, *Microbial mass, *Wastewater treatment, Ammonia, Oxidation, Mixed liquor solids, Activated sludge, Arrhenius relationship, Process control, Bacterial physiology, Efficiency, Mathematical models.

The effects of microbial mass, temperature, and hydrogen ion concentration on nitrification and how these factors affect the rate of ammonia oxidation in nitrifying activated sludge were studied. Ammonia oxidation rates were determined with varying mixed liquor volatile suspended solids (MLVSS) concentration, pH, and temperature, with all other environmental factors held constant. No interaction was observed between pH and temperature in their effect on the nitrification rate. MLVSS concentration influences the extent of temperature and pH effects so that there is a significant interaction between MLVSS and the other two variables. The values of the nitrification rate constant, k, ranged from 0.0085 per day at 4 C and pH 7 to 0.175 per day at 33 C and pH 8.3. A modified Arrhenius relationship was used successfully to estimate the change in nitrification rate with temperature. The extremely depressed nitrification rate at low ammonia concentrations indicate that high nitrification efficiencies can be obtained only with either an unreasonably long detention time or a combination of high mixed-liquor solids concentration and elevated temperature. An increase in the MVLSS concentration at very low temperatures does not significantly improve nitrification efficiency. (Rochester-PTT)
W86-05020

DESIGN OF TRICKLING FILTER NITRIFICATION TOWERS,

Iowa State Univ., Ames. Dept. of Civil Engineering.
H. A. Gullicks, and J. L. Cleasby.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 60-67, January 1986. 5 fig, 4 tab, 16 ref.

Descriptors: *Design procedures, *Nitrification, *Trickling filters, *Ammonium, *Nitrate, *Wastewater treatment, Nitrification towers, Mathematical models, Fixed-film processes, Oxygen, Kinetics, Temperature, Wastewater facilities, Plastic media, Environmental Protection Agency.

Deficiencies in the United States Environmental Protection Agency (EPA) trickling filter nitrification design procedure are examined and new empirical design curves are proposed based on recent theoretical concepts and models for fixed-film processes. The new empirical nitrification tower design curves incorporate and properly account for four critical design parameters: the hydraulic loading rate, the trickling filter influent NH4+-N concentration; the effects of recycle; and the temperature of the wastewater. Application of the new curves is a fairly simple trial and error procedure. The oxidation of NH4+-N to nitrate in plastic media trickling filters seems to be flux-limited by oxygen at NH4+-N concentrations greater than about 4 mg/L. When NH4+-N removal is flux-limited by oxygen for the entire nitrification tower depth, it is possible to design the nitrification tower using zero-order kinetics (with respect to NH4+-N concentration) and a mass removal rate of approximately 1.17 x 10(-3) kg/day per sq m for wastewater temperatures greater than 14 C and hydraulic loading rates of 0.48 to 1.36 L/sq m per sec. For wastewater temperatures below 14 C, a different set of curves (included here) should be used because little oxygen flux-limited data were available at lower temperatures. The active or effective fraction of the plastic media surface appears to be on the order of 0.3 to 0.6. (Rochester-PTT)
W86-05021

ADSORPTION OF ORGANIC POLLUTANTS ON MONTMORILLONITE TREATED WITH AMINES,

Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-05022

EFFECTS OF NON-IDEAL COMPETITION ON MULTI-COMPONENT ADSORPTION EQUILIBRIA,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W86-05023

ACTIVATED SLUDGE CONTROL FOR SEASONAL NITRIFICATION,

J. E. Hart, R. Defore, and S. C. Chiesa.
Water Pollution Control Federation Journal, Vol. 58, N0. 5, p 358-363, May 1986. 5 fig, 2 tab, 17ref.

Descriptors: *Activated sludge, *Nitrification, *Seasonal nitrification, *Wastewater treatment, Ammonia, Aeration, Sludge, Biological oxygen demand, Secondary wastewater treatment, Organic loading.

To gain experience with controlled, seasonal nitrification, full-scale investigations were conducted during the summers of 1982, 1983, and 1984 by operating half of a secondary system to induce and subsequently inhibit nitrification. Control strategies developed by the Metro Plant (St. Paul, MN) process control staff were examined for their effectiveness in regulating nitrification during both transitional periods and extended operation. The experimentation was also used to determine potential problems with related liquid treatment and solids handling processes caused by operating the secondary treatment system for seasonal nitrification. The following conclusions have been formulated from these investigations: 1) Seasonal nitrification in a single sludge activated system can be controlled using an aeration intensity-based specific supply rate; 2) Required specific aeration supply rates are a function of NH3-N concentration, temperature, and organic loading rate; 3) Although single stage nitrification can be maintained at organic loading rates in excess of 0.20 kg BOD sub 5/kg mixed liquor suspended solids (MLSS) x d, the elevated specific oxygen uptake rates associated with higher organic loadings increase the potential for denitrification in the secondary clarifiers. An organic loading rate of 0.15 kg BOD sub 5/kg MLSS x d effectively eliminates denitrification; 4) Significantly more air must be supplied to ensure a rapid, trouble-free initiation than to sustain nitrification once it is achieved; 5) Selection of a proper aeration strategy can effectively control nitrification in the aeration tank yet, maintain a significant seed population of nitrifiers. Once growth conditions are suitable, very short lag periods are required before nitrification is complete; and, 6) Specific oxygen uptake rate or an equivalent sludge activity parameter would be a desirable fine-tuning element in a specific oxygen supply rate strategy. Any such device or analysis would have to directly account for attentuation of applied organic loading in the aeration basin. (Lantz-PTT)
W86-05030

EVALUATION OF HIGH DENSITY CROSS FLOW MEDIA FOR REHABILITATING AN EXISTING TRICKLING FILTER,

Valley Sanitary District, Indio, CA.
D. D. Drury, J. Carmona III, and A Delgadillo.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 364-367, May 1986. 4 fig, 2 tab, 5 ref.

Descriptors: *Wastewater treatment, *Trickling filters, *Cross flow media, *Rehabilitation, Activated sludge, Mathematical analysis, Velz equation, Biological oxygen demand, Effluents.

Since June of 1984, Valley Sanitation District has successfully operated a 21.3-m (70-ft) diameter shallow bed trickling filter with the use of high-density (138 sq m/cu m) cross-flow media was evaluated in a full-scale study. The data were analyzed by the modified Velz equation. The K sub 20 for the high-density media was .00471 (L/sq m.s) to the 0.5 power. The shallow bed trickling filter was loaded up to g/cu m.d BOD and consistently produced less than 35 mg/L effluent total BOD. The trickling filter has been operating for more than 2 years with no maintenance problems or evidence of media plugging. The results showed that the shallow bed cross flow media had significantly higher reaction rate coefficients than previously reported for cross-flow media in towers. The excellent performance of the shallow bed high-density cross-flow media makes it a prime candidate for replacement of rock media for capacity expansion in existing trickling filter plants. (Lantz-PTT)
W86-05031

EVALUATION OF TREATMENT PLANT PERFORMANCE: CAUSES, FREQUENCY, AND DURATION OF UPSETS,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
P. M. Berthouex, and R. Fan.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 368-375, May 1986. 7 fig, 4 tab, 3 ref.
EPA Grant R809162010.

Descriptors: *Wastewater treatment, *Performance evaluation, Water quality management, Statistical analysis, Flow rates, Suspended solids, Dissolved oxygen.

Performance of fifteen well-operated treatment plants was studied. Preliminary data analysis used graphical and statistical smoothing methods to tentatively identify upsets, defined as episodes of uncharacteristically poor performance. These preliminary identifications were checked by visiting the plants to study the plant log and discuss the data with the plant operators. Upsets were classified into eight major catagories and 23 specific assignable causes. Most upsets were caused by operational factors and influent disturbances. Low dissolved oxygen, low mixed liquor suspended solids, high flow, and solids handling, the four most frequent causes of upsets, accounted for between 50 and 60% of all upsets. About 8 to 9 % of the days of record were affected by some kind of upsets. The average duration of upsets was 3.5 days, and 24% lasted 2 days or less. (Lantz-PTT)
W86-05032

PREDICTION OF NITRIFICATION IN WATER HYACINTH TREATMENT SYSTEMS,

State Univ. of New York at Buffalo. Dept. of Civil Engineering.
A. Scott Weber, and G. Tchobanoglous.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 376-380, May 1986. 4 fig, 3 tab, 7 ref.

Descriptors: *Nitrification, *Water hyacinth, *Wastewater treatment, Model studies, Hydraulic models, Ammonia, Data analysis.

According to the predictive model presented in this paper, nitrification is a function of hydraulic application rate, reactor distance, and a rate constant. The model was developed from fundamental concepts and simplified where warranted by experimental findings. The model was correlated to data with ammonium nitrogen concentrations between 0 and 45 mg/L NH4(+)-N while hydraulic application rates ranged from 9.91 to 19.9 cu m/sq m.d. Obviously these ranges do not encompass the full spectrum that would be expected in full-scale applications; however, within the ranges studied, there was excellent correlation between experimental findings and the model. Correlation to full-scale data is required to establish the validity of the proposed model. (Lantz-PTT)
W86-05033

DESIGN MODEL FOR THE OVERLAND FLOW PROCESS,

Robert S. Kerr Environmental Research Lab., Ada, OK.
J. L. Witherow, and B. E. Blesdoe.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 381-386, May 1986. 4 fig, 5 tab, 7 ref.

Descriptors: *Design standards, *Model studies, *Overland flow, *Wastewater treatment, Biological oxygen demand, Suspended solids, Organic carbon, Ammonia, Nitrogen, Phosphates, Primary wastewater treatment, Slopes.

A design model in the Process Design Manual, Land Treatment of Municipal Wastewater' was verified for biological oxygen demand (BOD) removal and further developed by field investigation to include total suspended solids (TSS), NH4, and total organic carbon (TOC) removal. Based on this study, the following conclusions (drawn in warm weather evaluations) were drawn: 1) Increasing the application rate of primary wastewater from 0.11 to 0.33 cu m/l/h, had a significant effect (p 0.05) on NO3, and NH4 concentrations and conductivity value, but not on TSS, total phosphate, BOD sub 5 and TOC concentrations and pH in the overland flow process; 2) The length of overland flow slopes had a significant effect (p 0.05) on BOD sub 5, TOC, TSS, total phosphate, NH4, and NO3 concentrations and on pH and conductivity values when raw wastewater was applied. Except for conductivity and total phosphate, this was also the case when primary wastewater was applied; 3) Those pollutants that showed the most consistent decrease in concentration throughout the slope length were BOD sub 5, TSS, NH4, and TOC; 4) Removal of BOD sub 5, TSS, NH4, and TOC from raw or primary municipal wastewater by the overland flow process is a first-order reaction. Linear regression analysis showing removal of these pollutants is described by C sub s/C sub 0 =Ae(-ks square root of q). The intercept constant A and rate coefficient k in this equation for these four pollutants are provided in this article. This equation and the collected data show secondary treatment criteria for BOD sub 5 and TSS can be met with overland flow slopes of 15 m when raw wastewater is applied and in less than 15 m when primary wastewater is applied during warm weather conditions. (Lantz-PTT)
W86-05034

PERFORMANCE OF SBR/DENITRIFICATION WITH A PRIMARY SLUDGE CARBON SOURCE,

Alfatch Univ., Tripoli (Libya). Dept. of Civil Engineering.
A. A. Abufayed, and E. D. Schroeder.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p 387-397, May 1986. 11 fig, 6 tab, 31 ref. NSF Grant No. CEE 8200794.

Descriptors: *Sequencing batch reactors, *Denitrification, *Primary sludge, *Carbon, *Wastewater treatment, Organic carbon, Kjeldahl procedure, Nitrogen, Chemical oxygen demand, Hydrogen ion concentration, Effluents, Sludge.

Primary sludge from a domestic wastewater was used as an energy and carbon source in a laboratory-scale sequencing batch reactor (SBR) activated sludge denitrification system. Effluent total organic compound (TOC) and filterable total Kjeldahl nitrogen (TKN) were less than 10 mg/L and 2 mg/L, respectively. Oxidized nitrogen was completely removed. Chemical oxygen demand NO3-N ratios were greater than 7 at solids retention times from 6 to 24 days. pH increased during the SBR reaction cycle but did not exceed 8.7, an acceptable upper limit. Oxygen requirements for the system were very low. The reactors were aerated for 15 minutes before settling to remove accumulated gases. A cationic polyelectrolyte added during the aeration period resulted in less than 10 mg/L effluent suspended solids. (Lantz-PTT)
W86-05035

KINETICS AND STOICHIOMETRY OF SBR/DENITRIFICATION WITH A PRIMARY SLUDGE CARBON SOURCE,

Alfatch Univ., Tripoli (Libya). Dept. of Civil Engineering.
A. A. Abufayed, and E. D. Schroeder.
Water Pollution Control Federation Journal, Vol. 58, No. 5, p398-405, May 1986. 7 fig, 2 tab, 35 ref. NSF Grant No. CEE 8200794.

Descriptors: *Wastewater treatment, *Kinetics, *Stoichiometry, *Sequencing batch reactors, *Denitrification, *Primary sludge, Carbon, Organic carbons, Effluents, Suspended solids, Oxidation, Biodegradations, Ammonia, Nitrogen.

Kinetic parameters were established for denitrification in primary sludge and the effects of the type of organic source on the unit rate of denitrification were evaluated. These parameters define the operational characteristics of sequencing batch reactor (SBR)/primary sludge denitrification systems. Conclusions drawn from the study include: 1) Primary sludge is an excellent organic carbon source for denitrification in SBR activated sludge systems; 2) The denitrification rate in SBR systems is determined by the release rate of organic and nitrogenous matter from the primary sludge particulate solids; 3) The denitrification rate is affected by both the type and amount of organic carbon used to drive the denitrification reactions. When primary sludge is used as a carbon source, the denitrification rate is directly related to the feed sludge total suspended solids (TSS); 4) Under non-nitrogen-limiting conditions, nitrate removal rates are zero-order for both soluble and hydrolyzed particulate carbon sources; 5) The denitrification rate is independent of SRT between 6 and 12 days; 6) Utilization of organic carbon sources other than primary sludge is possible only if the bacterial mass is properly acclimated to these sources; and 7) Small concentrations of ammonia are essential for cell synthesis requirements so that dissimilatory denitrification will not be rate-limiting. (Lantz-PTT)
W86-05036

IMPROVED ALKALIMETRIC MONITORING FOR ANAEROBIC DIGESTION OF HIGH-STRENGTH WASTES,

Wisconsin Univ.-Madison. Coll. of Engineering.
L. E. Ripley, W. C. Boyles, and J. C. Converse.
Water Pollution Control Federation Journal, Vol. 58, No. 3, p 406-411, May 1986. 13 fig, 7 ref.

Descriptors: *Alkalimetric monitoring, *Wastewater treatment, *Anaerobic digestion, *Monitoring manure, Animal wastes, Poultry, Methane, Alkalinity, Chemical analysis, Volatile acids.

Poultry manure is a high-strength waste that presents both a disposal problem and an energy-recovery opportunity. The U.S. currently has approximately 280 million egg-laying hens in production. Each hen produces 110 to 150 g (0.25 to 0.33 lb) of manure per day. A bench-scale poultry manure digestion study was undertaken on methane optimization and stability monitoring, measure methane production rates were normal in identical digesters with different HRTs and different influent solids concentrations. All other variables (mixing, heating, and influent composition) were held constant throughout the study. Methods to measure the biological stability of anaerobic digestion were evaluated so that the onset of a process upset can be quickly, easily, and inexpensively detected, and remedial action taken before failure. Methods include: 1) Titration of the centrifuged sample to an endpoint of pH 5.75 partial alkalinity (PA), and then to pH 4.3 intermediate alaklinity (IA) makes it possible to distinguish the relative buffering contributions of both bicarbonate and volatile acids (VA) in the anaerobic digestion of a high-strength waste such as poultry manure. Additionally, IA provides a rapid, semi-quantitative estimate of TVA concentration; 2) IA:PA is a simple, inexpensive, yet sensitive digestion monitoring tool which increases rapidly with a process upset then decreases with recovery. IA:PA is analogous to the VA-to-Alkalinity ratio, but it does not require VA measurement. The ratio is dimensionless; there is no need for precise titrant standardization and sample volume measurement; and 3) IA:PA is also useful to compare steady-state operating configurations in a bench-scale digestion study. Successful digestion of poultry manure occurred with IA:PA below 0.3. (Lantz-PTT)
W86-05037

STATE-OF-THE-ART UPDATE ON COMBINED SEWER OVERFLOW CONTROL,

Municipal Environmental Research Lab.-Cincinnati, Edison, NJ. Storm and Combined Sewer Section.
R. Field.
Critical Reviews in Environmental Control, Vol. 16, No. 2, p 147-165, 1986. 5 fig, 4 tab, 113 ref.

Descriptors: *Combined sewer overflows, *Storm water, *Wastewater treatment, Instrumentation, Simulation models, Toxicity, Bacteria, Oxygen demand, Suspended solids, Aesthetics, Economics, Catchbasins, Sewer flushing, Polymeric injection, Flow routing, Regulators, Tide gates, Hydrobrakes, Maintenance, Physical treatment, Chemical treatment, Disinfection, Biological treatment, Design guidelines.

Accomplishments, methods, and products employed in dealing with the combined sewer overflow (CSO) problem are reviewed under the following headings: pollution problem assessment (characterization and receiving water impacts), user's assistance tools (instrumentation, simulation models), solution methodology, management alternatives (land management, collection system controls, treatment, and sludge/solids), integrated systems (storage/treatment, dual-use wet-weather flow/dry-weather flow facilities, and control/treatment/reuse), and recommendations for the future (receiving water impacts, toxics characterization and control/treatment, sewer system cross connections, integrated stormwater management, institutional socio/economic conflicts). Land management alternatives discussed include porous pavement and surface sanitation. Collection system controls are catchbasins, sewers, sewer flushing, polymeric injection, flow routing, regulators and tide gates, hydrobrakes, maintenance, and storage. Treatment methods discussed are physical/chemical treatment, biological treatment, disinfection, treatment/control design guidebook, and treatment process performance. On a mass basis, toxics, bacteria, oxygen demanding material, suspended solids, and visual matter in CSO and urban stormwater cannot be ignored. The integrated approach to wet-weather pollution control is the only way that is going to be feasible and economical. (Rochester-PTT)
W86-05038

WASTEWATER DISINFECTION--TIME FOR A CHANGE,

Pennsylvania Dept. of Environmental Resources, Harrisburg.
R. H. Schertzer.
Journal of the Water Pollution Control Federation JWPFA, Vol. 58, No. 3, p 174-180, March 1986. 4 fig, 2 tab, 35 ref.

Descriptors: *Disinfection, *Water quality standards, *Wastewater treatment, *Water quality, Recreation, Drinking water, Bioindicators, Coliforms, Human diseases, Monitoring, Public health.

Most disinfection requirements in the U.S. are designed to protect recreational and drinking water by controlling coliform bacteria. However, the current widely used standard of 200 fecal coliform colonies per 100 ml is not supported directly by epidemiological evidence; recent information relating disease incidence in recreational water users to in-stream densities of various indicator organisms suggests enterococci or E. coli are more accurate and reliable indicators of freshwaters of potential health significance. Serious consideration should be given to changing existing regulatory approaches based on fecal coliforms, and efforts should be made to standardize analytical methods for enumerating these organisms. (Doria-PTT)
W86-05046

STUDY OF OPERATIONAL ULTRAVIOLET DISINFECTION EQUIPMENT AT SECONDARY TREATMENT PLANTS,

CRS Sirrine, Inc., Greenville, SC.
S. C. White, E. B. Jernigan, and A. D. Venosa.
Journal of the Water Pollution Control Federation JWPFA, Vol. 58, No. 3, p 181-192, March 1986. 6 fig, 3 tab, 10 ref. EPA Contract 68-03-1821.

Descriptors: *Disinfection, *Secondary wastewater treatment, *Ultraviolet radiation, Wastewater facilities, Design criteria, Performance evaluation, Chlorination.

Ultraviolet disinfection of potable and industrial water has been practiced for several years; however, its use in secondary wastewater treatment is more recent. Plant operations personnel prefer the UV systems over chlorination because of its relative safety and reduced labor requirements. A survey identified 52 UV systems currently operating in the U.S. and Canada. Six sites were inspected, providing examples of both successes and problems with the process. Most of the problems encountered were unrelated to the UV process itself, and resulted from electrical, mechanical, and hydraulic problems. In some cases, equipment design was inconsistent with good engineering application of the fundamentals of UV disinfection theory. Treatment plant design engineers should become better acquainted with UV process details, and should have access to relevant data or guidance documents. (Doria-PTT)
W86-05047

DISINFECTION OF LOW QUALITY WASTEWATERS BY ULTRAVIOLET LIGHT IRRADIATION,

Canviro Consultants Ltd., Toronto (Ontario).
G. Zukovs, J. Kollar, H. D. Monteith, K. W. A. Ho, and S. A. Ross.
Journal of the Water Pollution Control Federation JWPFA, Vol. 58, No. 3, P 199-206, March 1986. 8 fig, 7 tab, 19 ref.

Descriptors: *Disinfection, *Low quality wastewaters, *Wastewater treatment, *Ultraviolet radiation, Combined sewer overflows, Cost analysis, Chlorination, Pathogenic bacteria, Bioindicators.

Ultraviolet light irradiation is an effective alternative for disinfecting secondary and tertiary wastewaters, and its use may be extended to low quality effluents such as combined sewer overflows (CSOs). Advantages of UV disinfection of low quality wastewaters include a high degree of bacterial inactivation and production of disinfected effluent that is nontoxic to receiving water biota. In experiments using simulated CSO, UV light significantly reduced both indicator organisms and pathogenic bacteria, although dosage costs for UV irradiation of CSO were found to be consistently higher than chlorination/dechlorination for flow rates between 5,000 and 500,000 cu m/d; operation and maintenance costs for both types of facilities were similar. (Doria-PTT)
W86-05049

EFFECTS OF SYNTHETIC POLYELECTROLYTES ON SELECTED AQUATIC ORGANISMS,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W86-05050

FLOCCULATOR-CLARIFIER PERFORMANCE,

Brown and Caldwell, Walnut Creek, CA.
D. Parker, and R. Stenquist.
Journal of the Water Pollution Control Federation JWPFA, Vol. 58, No. 3, p 214-219, March 1986. 5 fig, 5 tab, 6 ref.

Descriptors: *Flocculation, *Clarification, *Wastewater treatment, Sedimentation, Design criteria, Activated sludge, Trickling filter, Performance evaluation, Cost analysis, Capital costs.

Improvements in secondary sedimentation tank design and proper preparation of the biological floc can yield tertiary quality secondary effluents; this has been demonstrated for both the activated sludge and trickling filter/solids contact processes. Performance data show that deep flocculator-clarifiers can produce effluents with average suspended solid concentrations of 10 mg/l or less at average overflow rates up to 2.0 m/h. In comparison, conventional clarifiers with shallow sidewater depths degrade rapidly with increased overflow rates. The cost of increasing clarifier depth is offset by the need to construct fewer clarifiers. The additional cost of the larger flocculation center is minimal, since only a larger baffle is provided and the overflow rate is not derated for the center well area. (Doria-PTT)
W86-05051

INHIBITION KINETICS OF NITRIFICATION IN CONTINUOUS-FLOW REACTORS,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, and D. J. Castens.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 220-226, March 1983. 8 fig, 5 tab, 22 ref. OWRT Grant No. 14-08-0001-G833/07.

Descriptors: *Inhibition, *Kinetics, *Nitrification, *Continuous-flow reactors, *Ammonia, *Wastewater treatment, Mathematical equations, Mathematical analysis, Haldone equation, Monod equation, Sludge digestion, Water pollution control.

The purpose of this research was to determine an appropriate growth rate function (mu versus S relationship) that should be used to describe the growth of nitrifying organisms limited by exogenous ammonia. A two-stage continuous culture system was fed a synthetic ammonia waste devoid of organic carbon to assess the nature, inhibitory or non-inhibitory, of ammonia-limited nitrification. The results of these studies indicated that nitrifier growth kinetics are best represented with a substrate inhibition function such as the Haldane equation. Data from these studies suggested that nitrifier growth followed an inhibitory pattern which means that the use of the Monod equation for representing nitrification is mechanistically inappropriate. The mu versus S(NH4(+)-N) data that were collected in the continuous-flow system were fit to the Haldane equation. The substrate inhibition nature of nitrifier kinetics provides some explanation of the instabilities often encountered with nitrification performance in treatment plant facilities. Consequently, it is desirable to implement operating strategies that will provide the greatest degree of stability to substrate removal kinetics in the aeration basin. Implementation of these strategies should result in more consistent performance with regard to ammonia removal for nitrifying activated sludge systems. (Lantz-PTT)
W86-05052

ANAEROBIC TREATMENT OF PHENOL BY AN EXPANDED-BED REACTOR,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y. T. Wang, M. T. Suidan, and B. E. Rittman.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 227-233, March 1986. 8 fig, 3 tab, 21 ref. EPA Contract No. EPA R-809750-01.

Descriptors: *Anaerobic digestion, *Phenols, *Expanded-bed reactors, *Wastewater treatment, Water pollution control, Activated carbon, Chemical oxygen demand, Organic carbon, Methane, Bacteria, Organic compouds.

The objective of this study was to evaluate the effect of influent phenol concentration on performance of the expanded-bed granular activated carbon (GAC) reactor. The organic removal efficiency of an expanded-bed anaerobic reactor using granular activated carbon as a biological attachment medium was very high when subjected to a wide range of feed phenol concentrations. During 588 days of continuous operation, four steady-state conditions were obtained under feed phenol concentrations of 358, 716, 1432, and 2864 mg/L. Steady-state phenol, chemical oxygen demand (COD), and dissolved organic carbon (DOC) removal efficiencies exceeded 99.9, 92, and 93%, respectively, even for the highest loading conditions. By the end of this study, 87.5% of the feed COD was converted to methane gas. Only 6% of the feed COD escaped in the aqueous effluent from the anaerobic reactor. The high conversion to methane and the low retention of COD within the reactor demonstrate that biological utilization was the major removal mechanism and the net growth of bacteria in the reactor was low. The major conclusion of this study was that the granular activated carbon expanded-bed reactor achieved nearly 100% removal of phenol when the surface loading ranged from 0.028 to 0.23 mg/sq cm/d COD. The expanded-bed reactor responded favorably to the sudden doubling of feed phenol concentration. Gas production from the reactor increased rapidly immediately after the increase in organic load. Gas production doubled within a week after the feed phenol concentration was doubled, but increases in effluent phenol concentrations were small. The use of partially saturated granular activated carbon media aud phenol-acclimated activated carbon in inocula enabled biological utilization of phenol to start in 8 days. (Lantz-PTT)
W86-05053

ADSORPTION OF LEAD AND ZINC ON BLAST FURNACE IRON OXIDE SOLIDS,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
J. R. Mihelcic, and R. G. Luthy.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 242-249, March 1986. 12 fig, 1 tab, 33 ref. EPA Grant No. R 809628.

Descriptors: *Adsorption, *Lead, *Zinc, *Iron oxides, *Solids, *Industrial wastes, *Wastewater treatment, Hydrogen ion concentration, Model studies, Chemical analysis, Chemical precipitation, 1-Hydroxyethylidene-1, -1-diphosphonic acid.

The purpose of this investigation was to develop a model to describe lead and zinc adsorption on iron oxide solids, and to evaluate the effect of solids concentration and the presence of an antiscalant additive on metal ion adsorption. These phenomena are important for evaluating the fate of lead and zinc in blast furance recycle scrubber water and for satisfying effluent limitation requirements in blowdown from the recycle system. This study evaluated the adsorption of lead and zinc on blast comprised of iron oxides, and metal adsorption was measured for several solids concentrations as a function of pH. The metals displayed characteristic pH-adsorption edges which were displaced to more alkaline pH values at lower solids concentration. The desorption-adsorption of relatively high concentrations of lead (29 mg/L) and zinc (250 mg/L) at high solids concentration (50 mg/L) can be described by a surface chemical model in which the metal-solid interaction was interpreted as a surface complex. The removal of relatively high concentrations of zinc in the presence of relatively low solids concentration (1 mg/L) depended more on chemical precipitation than surface adsorption, while the removal of relatively high concentrations of zinc in the presence of moderately high solids concentration (5 and 10 g/L) seemed to depend in part on adsorption and in part on lowered solubility product for Zn(OH)2(s) at the solid solution interface. Metal adsorption tests with the iron oxide solids in the presence of an organophosphonate antiscalant compound demonstrated that the compound exhibited a competing reaction for the removal of either lead or zinc from solution by surface adsorption/chemical precipitation. The general characteristics of zinc adsorption on iron oxide in the presence of 1-hydroxyethylidene-1, 1-diphosphonic acid (HEDP) could be described at best qualitatively if metal adsorption, chemical precipitation, and chemical complexation with HEDP are considered simulataneously. Improvement in modeling the adsorption of metal in the presence of HEDP antiscalant requires specific information on adsorption characteristics of the metal-HEDP complex. (Lantz-PTT)
W86-05055

BLAST FURNACE RECYCLE WATER QUALITY AND REACTIONS OF LEAD AND ZINC,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-05056

OXIDATION OF 2-CHLOROPHENOL USING OZONE AND ULTRAVIOLET RADIATION,

New Jersey Inst. of Tech., Newark.
S. R. Khan, C. R. Huang, and J. W. Bozzelli.
Environmental Progress, Vol. 4, No. 4, p 229-235, November 1985. 11 fig, 1 tab, 17 ref, append.

Descriptors: *Ozone, *Priority pollutants, *Hazardous wastes, *Ultraviolet radiation, * 2-Chlorophenol, *Oxidation, Industrial wastes, Wastewater treatment, Organic compounds, Mathematical models, Kinetics, Degradation.

Ozone has been found to be an effective oxidizing agent for the removal of many organic pollutants from water. The technique is more effective in the presence of ultraviolet light; oxidation rates with ozone/UV are 10 to 1,000 times faster than with ozone alone. Experimental data and proposed kinetic schemes are presented for the oxidation of 2-chlorophenol with ozone, with ultraviolet light, and with ozone/UV combined. The purpose is to develop a mechanistic expression for the ozone/UV process, from which, knowing the given ozone dose rate and UV intensity, the disappearance curve for any substrate may be predicted, or its degradation modeled and optimized for the application. Specific kinetic rates were determined based upon experimental results from a series of reactions on 2-chlorophenol using an optimization program on a computer. The experimental results and rate constants computed from them are presented and discussed, and details of the mass transfer and kinetic models are given. It is also shown that this type of reaction system has a high degree of potential for destruction of refractory organic water pollutants in industrial effluents. (Doria-PTT)
W86-05057

EFFECTS OF CHLORINE AND AMMONIA FROM WASTEWATER TREATMENT FACILITIES ON BIOTIC INTEGRITY,

Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 5C.
W86-05067

RELIABLE OZONE DISINFECTION USING OFF-GAS CONTROL,

Canviro Consultants Ltd., Kitchener (Ontario).
A. D. Venosa, L. A. Rossman, and H. L. Sparks.
Journal of the Water Pollution Control Federation JWPFA, Vol. 57, No. 9, p 929-934, September 1985. 9 fig, 13 ref.

Descriptors: *Ozone, *Disinfection, *Off-gas control, Wastewater treatment, Coliform density, Effluents, Mathematical, Analysis.

The electrical energy used in the manufacture of ozone constitutes a major part of the operating cost of disinfection. Presently, the control of ozone disinfection at existing wastewater treatment facilities is usually practiced in one of two ways: either the applied dose or the rate of production is held constant at all levels of liquid flow. What is needed is a means of automatically adjusting the control of ozone disinfection as both liquid flow and ozone demand fluctuate with time. Off-gas concentration and contact time can be empirically correlated with coliform density and thus be used as the basis for a process control strategy. An experimental ozonation pilot unit was used to disinfect a municipal treatment plant effluent over a period of 7 months. The results showed that it is possible to empirically relate effluent fecal coliform densities to the product of off-gas concentration and liquid contact time. The ozone disinfection process can be controlled to meet an effluent fecal coliform limit reliably by maintaining a fixed set-point consisting of the product of off-gas concentration and contact time. Adjustment of point during real-time operation to compensate for changes in factors effecting the coefficients of the performance model can be made by using a sequential estimation scheme. (Khumbatta - PTT)
W86-05068

PHOSPHORUS REMOVAL AT THE LOWER MOLONGO WATER QUALITY CONTROL CENTRE,

Department of Housing and Construction, Canberra (Australia).
D. Philp.
Journal of the Water Pollution Control Federation, Vol. 57, No. 8, 846, August 1985. 9 fig, 2 ref.

Descriptors: *Wastewater treatment, *Phosphorus removal, *Recreation, Primary wastewater treatment, Suspended solids, Organic matter, Chlorination, Operating costs, Physicochemical treatment, Chemical treatment, Murrumbidgee River, Burrinjuck Reservoir, Activated sludge process, Filtration, Biological wastewater treatment.

The Lower Molongo Water Quality Control Center (LMWQCC) was constructed during the mid-1970s to treat wastewater from Canberra, Australia. It was designed to produce an effluent that would not affect the aquatic habitats and the anticipated recreational use of the Murrumbidgee River and Burrinjuck Reservoir downstream of Canberra. In this wasterwater treatment facility, the physical and chemical treatment processes are combined to achieve maximum removal of suspended and organic material and phosphorus in the primary treatment stage. The use of ferrous chloride in a two-stage phosphorus removal process reduced total phosphorus to <0.2 mg/L and lowered operating costs. Ferrous chloride chlorination to ferric chloride for the second stage of phosphorus removal offers an economic approach to achieving a low concentration of phosphorus in the effluent following filtration. The phosphorus objectives could also be achieved by adding a ferrous salt to the activated sludge process followed by effluent filtration provided no biological processes are required between the activated sludge plant and the final filters. The use of the iron salt improves activated sludge settlability with low organically loaded activated ssludge processes. (Khumbatta-PTT)
W86-05081

RELATIONSHIP BETWEEN SVI AND ACTIVATED SLUDGE SETTLING CHARACTERISTICS,

CH2M/Hill, Denver, CO.
G. T. Daigger, and R. E. Roper, Jr.
Journal of the Water Pollution Control Federation, Vol. 57, No. 8, 866, August 1985. 8 fig, 4 tab, 21 ref, Append.

Descriptors: *Activated sludge, *Settling flux theory, *Sludge volume index, *Wastewater treatment, Clarifiers, Design criteria, Pilot plants.

Research by various investigators has led to the development and general acceptance of settling flux theory describing the solids thickening function of activated sludge clarifiers. Direct application to specific designs, troubleshooting, and daily operational control has been limited because there is no simple technique for obtaining the necessary data to use the settling flux theory. The objective of this aresearch was to correlate batch settling test data with sludge volume index (SVI) to develop a practical means for estimating activated sluged settling characteristics and allow the benefits of solids flux theory to be more fully realized. A total of 236 individual settling velocities were measured, and the results were pooled into various SVI categories and fitted to an empirical model. The relationship was then used to develop an operational chart, with SVI as a parameter, which allows design engineers and plant operators to apply settling flux theory easily and directly and in a manner that eliminates the somewhat cumbersome graphical approach traditionally used for settling flux analysis. (Khumbatta-PTT)
W86-05082

CHEMISTRY, MICROBIOLOGY, AND MODELING OF CHLORINATION FOR ACTIVATED SLUDGE BULKING CONTROL,

California Univ., Berkeley. Dept. of Civil Engineering.
J. B. Neethling, D. Jenkins, and K. M. Johnson.
Journal of the Water Pollution Control Federation JWPFA, Vol. 57, No. 8, p 882-889, August 1985. 15 fig, 2 tab, 23 ref, Append. National Science Foundation Grant No.CME-8006295.

Descriptors: *Activated sludge process, *Chlorination, Bulking sludge, *Wastewater treatment, Mathematical models, Kinetics, Biological wastewater treatment.

Bulking is caused by the uncontrolled outgrowth of large amounts of filamentous microorganisms in activated sludge. Chlorine has been used to control activated sludge bulking. A model describing the kinetics of activated sludge bulking control by chlorination was presented. The model predicts that there is a limiting frequency of exposure of solids inventory to chlorine below which it is not possible to prevent bulking by adding chlorine. The limiting frequency is determined by the differance in the growth rates of the filamentous and floc-forming microorganiams (the bulking potential), the relative amounts of filamentous and forming microorganisms, and the relative survival of filamentous and floc-forming organisms when dosed with chlorine. The comcept of a limiting frequency of exposure, predicted by the kinetic model, was supported by laboratory- and field-scale experiments in activated sludge systems that bulked because of DO deficiency. The laboratory activated sludge systems were operated at a high bulking potential and required a frequency of exposure of 3/d to control bulking by chlorination. In the prototype systems the bulking potential was lower and a lower frequency of exposure seemed satisfactory in controlling bulking. These results suggest that a savings in chlorine could accrue in plants where high exposure frequencies exists; chlorine could be dosed for only part of a day, to approach the limiting frequency. (Khumbatta - PTT)
W86-05083

SIMPLICITY IS MARK OF PUMP STATION IN THE ROUND,

For primary bibliographic entry see Field 8C.
W86-05120

SLUDGE MANAGEMENT GOES THE DISTANCE,

Brown and Caldwell, Denver, CO.
For primary bibliographic entry see Field 5E.
W86-05121

AT THE ROOT OF THE MATTER,

R. A. J. Arthur.
Water & Waste Treatment, Vol. 29, No. 3, p 35. 48, March 1986.

Descriptors: *Wastewater treatment, *Great Britain, *Root zone, *Kickuth Root Zone Biotechnology, Phragmites, Denitrification, *Aerobic treatment *Anaerobic treatment, Biological treatment, Sludge dewatering, Reeds, Heavy metals, Ammonia, Sumps.

The Kickuth Root Zone Biotechnology (RZB) system of wastewater treatment offers marked advantages in removal of contaminants, flexibility, energy saving and cost. The Kickuth RZB plant looks like a stretch of marshland overgrown with reeds, but it replaces the conventional sewage works, extracts nitrates, phosphates, phenols, hydrocarbons and mineral waste, and wipes out harmful bacteria. It can be made small or large (from a single household up to about 60,000 people) and is self adjusting to sudden changes in the amount of effluent. The system exploits the abilities of certain reeds (Phragmites) and other marsh plants to absorb oxygen through their pores above ground in air and transport it to the root zone, where it enters the surrounding soils. Roots can run as deep as 1.2 m. The dense root network oxidizes the soil and provides a hydraulic pathway. Plants are being developed with exceptional resistance to flooded soils, high concentrations of ammonia, and heavy metals. The entire reed bed is isolated from ground water by clay, bentonite, or other material, usually at a depth of 0.6 m. The effluent is induced by a slight slope to run horizontally through the root zone from inlet to outlet, and into a collection sump. The RZB system is a natural zeolyte. Activity in the root zone is both aerobic and anaerobic. Denitrification occurs in two phases, the oxidation of nitrogen compounds

under aerobic conditions with an oxidation potential > 320 mV, and under anaerobic conditions with an oxidation potential < 320 mV. The removal of nitrogen is accompanied by an active removal of organic materials. RZB can also provide an integrated means for the treatment of sludge wastewater. The great evapotranspiration of reeds (about 1500 to 1800 mm) can be utilized in helping to dehydrate otherwise difficult sludges. (Peters-PTT)
W86-05122

BIOFILM ON REVERSE OSMOSIS MEMBRANES,

Orange County Water District, Fountain Valley, CA.
H. F. Ridgway, D. M. Rodger, and D. G. Argo.
Water & Waste Treatment, Vol. 29, No. 3 p 44, 46, 48, March 1986. 3 tab, 3 fig.

Descriptors: *Biofilm, *Reverse osmosis, *Fouling, California, Wastewater treatment, Secondary effluent, Bacteria, Bioassay, Mycobacterium, Detergents, Spectrophotometry, Surfactants.

The fundamental mechanism of the biofouling process in reverse osmosis (RO) plants is studied. An in vitro bacterial adhesion assay technique was applied to study the adhesion and fouling properties of specific fouling micro organisms. The organism is an acid fast Mycobacterium species, strain BT2-4, previously isolated from an early membrane biofilm. The bacteria were incubated and uniformly radio labelled with tritium so that concentrations of Mycobacteria could be identified with a liquid scintilation spectrometer. The washed radio labelled mycobacteria were diluted and introduced into vials covered by a cellulose acetate RO membrane disc. The vials were sealed, placed in an inverted position, adhesion was allowed to proceed at 30 C while the vials were gently shaken. At the end of the incubation period the RO membrane discs were rinsed clear and the bacteria adhering to the membrane determined through the use of a liquid scintillation counter. Octyl phenoxy polyethoxyethanol (Triton X-100) shows the best inhibition while two of the quaternary ammonium compounds promote adhesion. The best results were found when the surfactant was added prior to cell adhesion. A relationship exists between the structure of a detergent molecule and its ability to influence microbial adhesion to RO membranes surface. (Peters-PTT)
W86-05123

MONITORING AND EVALUATING COMPOSTING PROCESS PERFORMANCE,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5E.
W86-05130

MUNICIPAL SLUDGE COMPOSTING TECHNOLOGY EVALUATION,

Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5E.
W86-05131

ACCURACY AND PRECISION OF PLANT SCALE AND SHOP CLEAN WATER OXYGEN TRANSFER TESTS,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
C. R. Baillod, W. L. Paulson, J. J. McKeown, and H. J. Campbell, Jr.
Journal of Water Pollution Control Federation, Vol. 58, No. 4, p 290-299, April, 1986. 5 fig, 10 tab, 9 ref.

Descriptors: *Sludge conditioning, *Activated sludge process, *Aeration, *Performance evaluation, *Oxygenation, Dissolved oxygen, Regression analysis, Mathematical studies, Comparison studies, Oxygen transfer, Wastewater treatment, Activated sludge.

Accurate oxygen transfer rates at given power inputs of activated sludge aeration processes are necessary for evaluation and acceptance testing of equipment. This study evaluated the accuracy, precision, and applicability of such measurements made according to a clean water test standard developed by the American Society of Civil Engineers (ASCE) Oxygen Transfer Standards Committee. The standard requires that performance be evaluated by a minimum of three replicate tests with the measured standard oxygen transfer rate (SOTR) taken as the average of all valid replicates. The results of replicate shop and plant-scale clean water oxygen tests showed that the precision of the SOTR measurement is very good. Results of parallel but independent oxygenation and krypton stripping measurements on two plant-scale tests gave very good agreement between SOTR values. SOTR values given by the nonlinear regression (NLR), log deficit-measured saturation (LD), and best fit log deficit (BFLD) methods of parameter estimation generally agreed within = or - 3% of each other. The ASCE Clean Water Standard can be successfully applied to a wide variety of aeration equipment and tank configurations including coarse and fine bubble diffused air, single and multiple surface aeration, oxidation ditches and static tubes. (Geiger-PTT)
W86-05132

EVALUATION OF FACTORS AFFECTING THE OXYGEN TRANSFER FROM HIGH-SPEED FLOATING SURFACE AERATORS,

Eastman Kodak Co., Rochester, NY.
R. A. Poduska, and R. F. Hager, Jr.
Journal of Water Pollution Control Federation, Vol. 58, No. 4, p300-305, April 1986. 4 fig, 4 tab, 10 ref.

Descriptors: *Aeration, *Activated sludge process, *Oxygen transfer, *Dissolved oxygen, *Wastewater treatment, Aerators, Oxygenation, Performance evaluation, Oxygen uptake.

A study was conducted to evaluate the primary reason for a sudden and extended lack of adequate dissolved oxygen (DO) in an activated sludge system with only high-speed floating surface aeration. Based on preliminary evaluations that the influent biochemical oxygen demand (BOD) load had not increased during this imbalance, efforts were concentrated on identifying the cause of a decrease in the supply of oxygen from the aeration equipment of the wastewater treatment plant. Results of this evaluation showed that changes in the mechanical integrity of the aerators had a significant impact on the overall oxygen transfer capacity of the system. The DO deficit in the surface activated sludge system was the result of reduced aerator oxygen transfer efficiency caused by damage to the impellers. A periodic survey of individual aerator power, and necessary maintenance based on low values generates significant cost savings. (Geiger-PTT)
W86-05133

EFFECT OF BIOMASS ON OXYGEN TRANSFER IN RBC SYSTEMS,

Rome Univ. (Italy). Dept. of Chemical Engineering.
A. E. Paolini.
Journal of Water Pollution Control Federation, Vol. 58, No. 4, p 306-311, April, 1986. 4 fig, 2 tab, 15 ref.

Descriptors: *Oxygen transfer, *Aeration, *Biomass, *Biological membranes, *Oxygen uptake, *Wastewater treatment, Oxygenation, Turbulent flow.

The effect of reactor liquid turbulence in a rotating biological contactor (RBC) on oxygen transfer was studied when the aeration is occurring with and without biomass and at varying disk rotational speeds. In addition the enhancement of oxygen transfer that results from the biomass at different disk rotational speeds was examined. Three types of experiments were performed with laboratory-scale RBC systems. First, biological tests were performed at a fixed organic loading rate to study the effect of rotational speed on overall biochemical oxygen transfer coefficient. Second, physical oxygen transfer tests were performed to evaluate the overall physical oxygen transfer coefficient at different rotational speeds. Finally, the sulfite technique was adopted to estimate how the reactor liquid turbulence contributed to total oxygen transfer. Results showed that in the absence of biomass, aeration through the liquid film is the dominant mechanism for physical oxygen transfer only when bench-scale RBC units are operated at high disk rotational speeds. At low velocities, the contribution of reactor liquid turbulence is significant to total physical oxygen transfer. The biomass enhances the oxygen transfer rate with respect to the rate in clean water. This enhancement is especially significant at low rotational speeds and probably results from enhancement of oxygen diffusion through the liquid film as a consequence of the oxygen consumption by the biofilm and increased surface area for transfer. (Geiger-PTT)
W86-05134

DESIGN OF RAPID SMALL-SCALE ADSORPTION TESTS FOR A CONSTANT DIFFUSIVITY,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, J. K. Berrigan, and D. W. Hand.
Journal of the Water Pollution Control Federation, Vol. 58, No. 4, p 312-319, April, 1986. 4 fig, 3 tab, 37 ref. append. NSF Grant CEE-8300213.

Descriptors: *Separation techniques, *Wastewater treatment, *Water treatment, *Activated carbon, *Adsorption, Models, Pilot plants, Diffusion coefficients, Mathematical studies, Design criteria.

A rapid method for large-scale, fixed-bed adsorber design from small column studies, known as the rapid small-scale column test (RSSCT), was developed and evaluated. In the RSSCT method, mathematical models are used to scale-down the full-scale adsorber to an RSSCT and maintain perfect similarity between the performance of the adsorber. A dimension analysis on the dispersed flow, pore surface diffusion model (DFPSDM) was used to determine scaling factors because th DFPSDM includes many of the known transport and kinetic phenomena that occur in fixed-bed adsorbers. Results showed that full-scale adsorber performance may be predicted in less time and at less expense with RSSCT than with a pilot study by plotting the effluent concentration history in terms of the bed volumes fed. The RSSCTs use a smaller size GAC (granular activated carbon) that is prepared from GAC to be used in the full-scale process. Several RSSCTs may be used to rapidly evaluate several fluid residence times in the beds of important process configurations such as beds in series or in parallel. A laboratory verification of the RSSCT was conducted and good agreement was found between the laboratory pilot-scale adsorbers and the RSSCT breakthrough profiles. (Geiger-PTT)
W86-05135

MODELING AND PERFORMANCE OF THE ACTIVATED SLUDGE-POWDERED ACTIVATED CARBON PROCESS IN THE PRESENCE OF 4,6-DINITRO-O-CRESOL,

Universidad Autonoma Metropolitana, Mexico City. Dept. of Hydraulic Engineering.
J. H. Garcia-Orozco, H. R. Fuentes, and W. W Eckenfelder, Jr.
Journal of the Water Pollution Control Federation, Vol. 58, No. 4, p 320-325, April 1986. 9 fig, 2 tab, 21 ref.

Descriptors: *Mathematical models, *Activated sludge process, *Activated carbon, *Theoretical analysis, *Organic compounds, *Wastewater treatment, Performance evaluation, Activated sludge, Organic carbon, Models, Industrial wastes, Biodegradation, Separation techniques, Adsorption.

This study aimed to model the activated sludge-powdered activated carbon process (AS-PAC) and to determine any difference in performance parameters with respect to the activated sludge process in the presence of 4,6-dinitro-o-cresol (DNOC). Experimental results showed that the assumptions on which the overall removal model is based were satisfied. In the presence of activated carbon on a total organic carbon basis, the biodegradation rate coefficient increases and the nondegradable frac-

tion remaining decreases. In the model proposed to describe the organic removal in the presence of PAC in the activated sludge system, two mechanisms were responsible for the DNOC removal: biodegradation and carbon assumption. The main contribution to DNOC removal was adsorption. An expression was developed for DNOC to account for its removal in the AS-PAC process which was subject to a more realistic value of the adsorption capacity of the carbon. (Geiger-PTT)
W86-05136

PAC-ACTIVATED SLUDGE TREATMENT OF A STEEL MILL COKE-PLANT WASTEWATER,

China Steel Corp., Kaohsiung (Taiwan). Dept. of Research and Development.
Y. M. Chao, T. F. Yeh, and W. K. Shieh.
Journal of the Water Pollution Control Federation, Vol. 58, No. 4, p 333-338, April 1986, 8 fig, 3 tab, 26 ref.

Descriptors: *Activated carbon, *Activated sludge process, *Wastewater treatment, *Chemical oxygen demand, *Cyanide, *Separation techniques, Activated sludge, Industrial wastewater, Ammonia, Color, Organic compounds, Organic carbon, Nitrification, Nitrogen, Biodegradation, Biological wastewater treatment.

The efficacy of powdered activated carbon (PAC) addition for treatment of a coke-plant wastewater was evaluated in three completely mixed, continuous-flow activated sludge reactors with internal sludge recycle. Preliminary investigations were performed to select the PAC with the best removal of non-biodegradable organics, cyanide, and thiocyanate. Results showed that the treatment capacity of an existing conventional activated sludge process that treats coke-plant wastewater, with regard to chemical oxygen demand (COD), cyanide, and thiocyanate removal, was doubled with PAC addition to a mixed liquor PAC concentration of 300 mg/L. Adsorption of non-biodegradable organics by PAC seemed to be the main mechanism of improved COD removal in the PAC units. PAC addition stimulated the microbial oxidation of cyanide and thiocyanate in the activated sludge process. As a result, the effluent ammonia nitrogen concentration was higher than that originally contained in the feed when nitrification did not occur. A stoichiometric relationship existed between the amount of nitrogen released from the microbial oxidation of cyanide and thiocyanate and the incremental amount of ammonia nitrogen in the reactor effluent when nitrification was absent in the process. (Geiger-PTT)
W86-05137

PHOSPHORUS TRANSFORMATION IN A RAPID INFILTRATION COLUMN,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
D. R. Aulenbach, and M. Nie.
Northeastern Environmental Science, Vol. 4, No. 3-4, p 149-154, 1985. 7 fig, 3 tab, 9 ref.

Descriptors: *Phosphorous removal, *Wastewater treatment, *Trickling filters, *Sand filters, *Infiltration, Separation techniques, Phosphorous, Organic carbon, Filtration, Organic compounds, Chlorination, Biological wastewater treatment.

Little information is available concerning the mechanism of phosphorous removal from domestic wastewater in a rapid infiltration system consisting entirely of sand. The rapid infiltration systems of both Lake George Village and Bolton Landing consist entirely of sand with no clay present. Two columns were set up consisting of sand from the Lake George Sewer Plant. Trickling filter effluent from this plant was applied daily to a depth of 20 cm on one column. Samples were secured at approximately 60 cm depth intervals to 300 cm depth (the maximum depth of the column) and analyzed for total phosphorous, soluble P, organic P, and total organic carbon (TOC). After operation for two months, one column was sterilized using a strong chlorine dose. The treated wastewater applied was similarly treated to a high chlorine residual. Before sterilization, there was a significant production of organic P in the upper portion of the column. This disappeared completely after chlorination. Total P removal was slightly greater in the sterilized column. Some TOC removal was observed near the bottom of the column, indicating that complete sterilization was not achieved. The results indicate that phosphorous removal in a rapid infiltration system consisting entirely of sand is primarily a chemical reaction and is not enhanced by biological activity. (Geiger-PTT)
W86-05139

THERMAL REACTIVATION OF ACTIVATED CARBON WITH A TWO-STAGE FLUID BED REACTOR,

Stadtwerke Duesseldorf A.G. (Germany, F.R.).
W. Poggenburg, and J. Schubert.
Aqua AQUAAA, No. 2, p 69-71, 1986. 3 fig, 11 ref.

Descriptors: *Thermal reactivation, *Activated carbon, *Fluidized bed process, *Wastewater treatment, Fluidized bed process, Ozonation, Rhine River, West Germany, Dusseldorf.

The Stadtwerke Dusseldorf AG are treating Rhine River bank filtrate by ozone and activated carbon (65 million cu m/yr). 4,500 cu m, or about 1950 t of activated carbon have to be reactivated annually. Since 1976, a two-stage fluid bed reactor for thermal reactivation of activated carbon, with a capacity of 6 t/day, has been operated at the Dusseldorf-Holthausen waterworks. The on-site reactivation of activated carbon has been successful. Constant and satisfactory qualities of reactivated carbons are reached by continuous and automatic operation of the two-stage fluid bed reactor. Due to a high rate of utilization there are advantages in operation of the treatment plants and in the economy of reactivation. (Lantz-PTT)
W86-05144

REMOVAL OF AROMATIC NITRO-COMPOUNDS FROM WATER BY OZONATION,

Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
W. Baozhen, and Y. Jun.
Aqua AQUAAA, No. 2, p 86-93, 1986. 25 fig, 1 tab, 5 ref.

Descriptors: *Aromatic compounds, *Wastewater treatment, *Ozonation, Chemical analysis, Ultraviolet spectroscopy, Absorption, Benzene, Nitrotoluene, Nitroaniline, Nitrobenzene, Dinitrobenzene, Temperature effects, Chemical oxygen demand, Aromatic hydrocarbons.

Experimental studies were carried out on the removal of five species of aromatic nitro-hydrocarbons by ozonation. Ultraviolet spectrograms, with distinct absorption peaks, were graphed for them respectively. It was found that the absorbances of aqueous solutions containing single compounds mentioned above, increase to a different extent, at wavelengths ranging from 200 to 230 nm, with an increase of ozone dosage. This is ascribed to the nitrite ions splitting out of benzene rings and further oxidizing into nitrate ions by ozonation. It has been indicated that the removal of the five species of aromatic nitro-compounds by ozonation, can be expressed well mathematically, as a first order reaction equation. The reaction constants and half reduction periods for various species of tested nitro-compounds were calculated at different temperatures and pH. The ozonation effect index (OI) was developed in the study, as a method for expressing the degree of degradation of substrates by ozonation, by comparing the five aromatic nitrohydrocarbons with each other, and finally ranking them in the following order, from greatest to smallest degrees of degradation: p-nitroaniline > nitrobenzene > p-dinitrobenzene > p-nitrotoluene > m-dinitrobenzene. It was also found that the chemical oxygen demand (COD) m/M ratio increases with ozone doses. This means that some easily degradable intermediates are produced and increase in concentration with the increase of ozone dose in the ozonation process. The mechanisms for removing the five aromatic nitr-hydrocarbons are discussed from the viewpoint of the orienting effect of substitute groups on the aromatic rings. (Lantz-PTT)
W86-05148

CHEMICAL AND BIOLOGICAL CHANGES IN MODEL PONDS SUPPLIED WITH POST-WASTE WATER: III. PLANKTON, PERIPHYTON, BENTHOS,

Instytut Ksztaltowania Srodowiska, Warsaw (Poland).
L. Klekot-Tourron.
Ekologia Polska, Vol. 32, No. 4, p 149-164, 1985. 5 fig, 4 tab, 25 ref.

Descriptors: *Plankton, *Self-purification, *Ponds, Periphyton, Zooplankton, Phytoplankton, Wastewater disposal, Municipal wastewater, Seasonal variation, Organic matter, Chemical oxygen demand, Copepods, Crustaceans, Poland.

Communities of phytoplankton, zooplankton, animal periphyton and of bottom fauna were studied in a channel carrying post-waste water to ponds, and in the ponds themselves from spring to autumn in 1977 at a municipal sewage-treatment plant at Pruszkow near Warsaw. Model transit-flow ponds were continuously supplied with post-waste water flowing out of sedimentation chambers with active sludge. Communities of organisms present in the ponds and in the channel carrying water, were studied with regard to their role in the self-purification process. In the water to be discharged into the ponds and in the ponds themselves a total of 58 phytoplankton species, 52 microzooplankton (Ciliata) and macrozooplankton (Rotatoria and Crustacea) species, 12 animal periphyton taxa, and 12 taxa of bottom fauna were found. Seasonal variations of plankton species could only be seen in the ponds that were most distant from the source of the post-waste water. A directly proportionate relationship was seen between the number of poly- and x-mesosaprobic species, and the amount of organic matter in the pond water, as measured by chemical oxygen demand and suspended organic matter. In the ponds that were closer to the source of water large numbers of individuals were found, whereas in the ponds more distant from the source there was a large number of species in all the communities studied. Only the community of the pond closest to the post-waste water source was satisfactory for efficient self-purification. In the remaining ponds the phytoplankton was too poor, and it proved technically difficult to remove the copepods and cladocerans that occurred there in large masses. (Peters-PTT)
W86-05196

CHARACTERIZATION OF AEROBIC AND FACULTATIVE ANAEROBIC BACTERIA FROM THE LIQUID PHASE OF AN ANAEROBIC FIXED-BED DIGESTER TREATING A CHEESE WHEY SUBSTRATE,

European Centre for Medium Range Weather Forecasts, Reading (England).
J. de Haast, and T. J. Britz.
Microbial Ecology MCBEBU, Vol. 12, No. 2, p 173-180, June 1986. 1 fig, 22 ref.

Descriptors: *Biological wastewater treatment, *Aerobic bacteria, *Anaerobic digestion, *Food-processing wastes, *Acetic acid, Anaerobic bacteria, Cheese, Whey, Enterobacter, Klebsiella, Citrobacter, Pseudomonas, Methane bacteria.

Efforts were made to isolate, enumerate, and perform a preliminary characterization of the predominant aerobic and facultative anaerobic bacteria from the liquid phase of a mesophilic anaerobic fixed-bed digester fed with a whey substrate. Average counts of bacteria of 16.6 x 1,000,000 and 26.5 x 1,000,000/ ml, were obtained on the two media, with the nutritionally poorer of the two giving the highest average count. Seventy-five isolates from both media, incubated aerobically and in anaerobic jars, were obtained. These isolates and 13 reference strains were phenotypically characterized. The organisms were clustered using the unweighted pair group method, and the results presented as a simplified dendrogram. The isolates could be divided into 3 main groups: gram-negative fermentative rods, mainly Enterobacter, Klebsiella, and Citrobacter, with Klebsiella as the predominant genus;

gram-positive bacteria, mainly enterococci; and gram-negative nonfermentive rods of the genera Pseudomonas, Alcaligenes, and Acinetobacter. All the enterobacteria and enterococci were able to produce acetic acid, an intermediate in methanogenesis. (Peters-PTT)
W86-05199

TURBIDITY REMOVAL FROM CLAY SUSPENSIONS BY USE OF ORGANIC POLYMERIC FLOCCULANTS,

Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
S. Sakohara, H. Unno, and T. Akehata.
Journal of Chemical Engineering of Japan, Vol. 18, No. 4, p 331-336, August 1985. 11 fig, 3 tab, 9 ref.

Descriptors: *Turbidity removal, *Clay, *Organic compounds, *Wastewater treatment, Optical density, Flocculation, Turbidity, Suspended solids.

The removal of suspended substances from wastewater is one of the fundamental operations in water treatment. Turbidity removal from clay suspensions by use of organic polymeric flocculants was studied by relating the change in floc size, optical density through a flocculation tank and amount of flocculant absorbed onto suspended particles. A cylindrical vessel with six baffle plates was used to as a stirred tank. A six-blade flat turbine impeller was placed at the bottom. Floc size was observed photographically. Three sets of photometric measurement systems were installed on the tank to measure optical density. CdS photocells and a fluorescent lamp were used as photometric detectors and light source, respectively. The amount of flocculant adsorbed was calculated from the difference in amounts between injected and residual flocculant. Turbidity removal is represented by taking two regimes into consideration, i.e., the earlier period, appearing just after flocculant injection, when the flocculant adsorption rate controls the process, and the later period when a limited number of flocs named 'mother flocs' control the process. The turbidity removal rates in both regimes were evaluated easily from the modified optical density variation proposed in this work and represented by two different first-order processes with respect to the modified optical density. The rate constants in both regimes were related linearly to each other, and its proportional constant depended on the condition of agitation. (Main-PTT)
W86-05260

WATER CONTENT AND ELECTRIC POTENTIAL DISTRIBUTIONS IN GELATINOUS BENTONITE SLUDGE WITH ELECTOOSMOTIC DEWATERING,

Oyama National Coll. of Technology (Japan). Dept. of Industrial Chemistry.
H. Yoshida, T. Shinkawa, and H. Yukawa.
Journal of Chemical Engineering of Japan, Vol. 18, No. 4, p 337-342, August 1985. 14 fig, 4 ref.

Descriptors: *Electrical potential distributions, *Sludge drying, *Electroosmosis, *Dewatering, Wastewater treatment, Electric currents.

To analyze the electroosmotic dewatering process precisely, the variations of water content and electric potential distributions in the sludge are made clear. The distributions of water content and electric potential in gelatinous bentonite sludge with electroosmotic dewatering were studied experimentally under the conditions of both constant voltage and constant electric current. It is proved that the water content distribution is generally related to the electric potential distribution throughout the dewatering process. Electroosmotic dewatering under constant voltage is compared with that under constant electric current. Large voltage (E sub o) is not necessarily effective for dewatering throughout the sludge bed, as described previously. Electroosmotic dewatering combined with vacuum dewatering is also discussed and was found to be effective for dewatering throughout the sludge bed. (Main-PTT)
W86-05261

SOME RHEOLOGICAL FEATURES OF CONCENTRATED EXCESS ACTIVATED SLUDGE OF THIXOTROPIC NATURE,

Tokyo Inst. of Tech. (Japan). Dept. of Environmental Chemistry and Engineering.
H. Unno and, and T. Akehata.
Journal of Chemical Engineering of Japan, Vol. 18, No. 6, p 533-538, December 1985. 13 fig, 9 ref.

Descriptors: *Activated sludge, *Sludge excess, Organic matter, Sludge drying, Shear stress, Physical properties, Wastewater.

The flow behavior of excess activated sludge containing highly concentrated organic solids, and showing an extremely thixotropic nature, was investigated. The apparatus for rheological measurement was a rheometer equipped with a concentric cylindrical cell. The shear stress measurement was made at a constant shear rate which changed stepwise. The sludge was sampled from the tank of a wastewater treatment plant. The sampled sludge was screened and thickened centrifugally. The solid content was determined by filtering and drying within an air bath. By applying this method the relationship between shear rate and shear stress of structure sludge was obtained, and it was found that the relationship was very similar to that of a plastic fluid. The relationship was named the sludge structure curve (SSC). SSC was degenerated into one curve by using a yield stress which was characteristic of each structure. This curve was named the sludge characteristic curve (SCC), because SCC was uniquely determined by the concentration of solid and sludge conditioning agent, independently of sludge structure and temperature. (Main-PTT)
W86-05262

APPLICATION OF THE UPFLOW ANAEROBIC SLUDGE BED (UASB) PROCESS FOR TREATMENT OF COMPLEX WASTEWATERS AT LOW TEMPERATURES,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
I. W. Koster and, and G. Lettinga.
Biotechnology and Bioengineering, Vol. 27, No. 10, p 1411-1417, October 1985. 8 fig, 3 tab, 26 ref.

Descriptors: *Anaerobic digestion, *Upflow anaerobic sludge bed, Thermal effects, Wastewater treatment, Sludge, Chemical oxygen demand.

With the recently introduced modern anaerobic wastewater treatment processes such as the upflow anaerobic sludge bed (UASB) process the main bottleneck in the full-scale application of anaerobic wastewater treatment seems to be solved for a large variety of liquid wastes. The feasibility of the UASB process for the treatment of potato starch wastewater at low ambient temperatures was demonstrated by operating two 5.65-L reactors at 14 C and 20 C, respectively. The organic space loading rates achieved in these laboratory-scale reactors were 3 kg COD/cu m/day at 14 C and 4-5 kg COD/cu m/day at 20 C. The corresponding sludge loading rates were 0.12 kg COD/kg VSS/day at 14C and 0.16-0.18 COD/kg VSS/day at 20C. These findings are of considerable practical importance because application of anerobic treatment at low ambient temperatures will lead to considerable savings in energy needed for operating the process. As compared with various other anerobic wastewater treatment processes, a granular sludge upflow process represents one of the best options developed so far. (Main-PTT)
W86-05263

OZONE AND ACTIVATED CARBON FOR TERTIARY WASTEWATER TREATMENT,

Texas Univ. at Dallas, Richardson.
A. Netzer, J. L. McNutt, and R. P. Smith.
Ozone Science & Engineering, Vol. 7, No. 1, p 1-10, Winter, 1985. 5 tab, 8 ref.

Descriptors: *Ozone, *Activated carbon, *Wastewater treatment, Oxygenation, Ozonation, Garland, Texas.

Preozonation of biologically or physically-chemically treated wastewater effluents, followed by passage through granular activated carbon (GAC) for tertiary wastewater treatment was studied at the Duck Creek Wastewater Treatment in Garland, Texas. Whereas the average period of operation for the GAC before exhaustion without ozone pretreatment was 70 days, pretreatment with ozone or with oxygen alone extended GAC operation to at least 480 days, without exhaustion. Effluent streams consistently met applicable discharge standards during this period of time, without the necessity of regenerating the GAC. (Author's abstract)
W86-05269

CATALYTIC EFFECTS OF ULTRAVIOLET LIGHT AND/OR ULTRASOUND ON THE OZONE OXIDATION OF HUMIC ACID AND TRIHALOMETHANE PRECURSORS,

Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
R. A. Sierka and, and G. L. Amy.
Ozone Science & Engineering, Vol. 7, No. 1, p 47-62, Winter, 1985. 2 fig, 8 tab, 25 ref.

Descriptors: *Ozonation, *Humic acid, *Trihalomethane, *Ultrasonics, *Ultaviolet light, Wastewater treatment, Alkalinity, Total organic carbon.

Humic substances represent the most important group of trihalomethane (THM) precursors and account for roughly 50% of the dissolved organic carbon in surface waters. Ozone has been used for THM precursor destruction. This paper describes the singular and composite effects of two catalysts; ultraviolet (UV) light and ultrasound (US) on the ozone (O sub 3) oxidation of a purified solution of a commercially available humic acid with the objective of minimizing THM formation potential (THMFP). The principal findings are that: (1) the most effective reactor conditions for both the destruction of nonvolatile total organic carbon (NVTOV) and THMFP utilized both US and UV in combination with ozone, and (2) bicarbonate alkalinity reduces the oxidation efficiency of the US-UV-O sub 3 system apparently as a consequence of radical scavenging. (Main-PTT)
W86-05270

PRINCIPLES OF OZONE OXIDATION AND DISINFECTION DESIGN,

Societe Degremont, Rueil-Malmaison (France).
Y. Richard.
Ozone Science & Engineering, Vol. 7, p 63-76, 1985. 11 fig, 19 ref.

Descriptors: *Ozonation, *Disinfection, *Water treatment, *Design standards, Wastewater treatment, Deep-U-Tube contactor.

The efficiency of ozone for different purposes can be determined by different laboratory tests. It is necessary to use a specific test for each aim of ozonation. The two methods for studying the removal of pollutants in the laboratory, the flask method and column method, are discussed as are apparatuses used for the inactivation of viruses. Over the past few years, two systems have been used in the application of ozone in treatment lines, a single contact chamber and a two chamber contact system. It is absolutely necessary to use a two chamber contact system for the application of ozone as a virucide. Various operational systems and their efficiencies were investigated. The design of commercial ozone-water contact systems can be determined in relation with the purpose of ozonation; virucide effect, oxidation of pollutant, clarification improvement or wastewater disinfection. The system of successive contact columns seems to be the best adapted to achieve the virucidal effect recommended by hygiene specialists, and the techniques required for reliable monitoring of this technique are now available. (Main-PTT).)
W86-05271

CONTROL OF A FULLY AUTOMATED OZONE APPLICATION SYSTEM,

Harkin Environmental Systems, Inc., Montreal (Quebec).
D. R. MacKay.

Ozone Science & Engineering, Vol. 7, p 77-84, 1985. 5 fig.

Descriptors: *Ozonation, *Automation, Computers, Computer programs, Optimization, Pont Viau, Quebec, Water treatment facilities.

A fully automated system at Pont Viau, Quebec is controlling a two-stage ozonation system treating 140 x 10 to the 3rd power cu m/h of potable water in a full-scale water treatment plant. This plant presented problems with respect to implementation of automatic dosage control. The solution, used at Pont Viau, to this dilemma was to implement an intelligent control system which determines the total ozone requirement for the three contactors, selects the optimum equipment configuration to produce that much ozone, and delivers the appropriate quantity of ozone to each contactor. The highest level of control is the supervisory computer which has a data communications path to each of six ozone generators and a direct link to the ozone destruct system. The intermediate level of control is provided by microprocessor-based programmable controllers associated with each of the ozone generators, and the lowest level of control is the manual override. The optimization algorithm of the system is designed to minimize system power consumption and equalize equipment runtimes. This optimization scheme makes it possible to achieve a step-like power consumption curve for the total system. Total ozone requirement is calculated, the most power-efficient equipment configuration is selected, and the flow of ozone to each contractor is controlled. In addition, graphic display of equipment status and process variables is provided, system events are logged, and strip charts and reports are produced. A supervisory computer with control capabilities can achieve significant energy savings in an ozone generation system comprised of several trains of equipment. At the same time, maximum flexibility of equipment utilization can be achieved along with complex dosage control. (Main-PTT)
W86-05272

TREATMENT EFFICIENCY OF AN IMPROVED OZONATION UNIT APPLIED TO FISH CULTURE SITUATIONS,

Biologische Anstalt Helgoland (Germany, F.R.)
For primary bibliographic entry see Field 5F.
W86-05273

POWERED ACTIVATED CARBON AND OZONE-ASSISTED ACTIVATED SLUDGE TREATMENT FOR REMOVAL OF TOXIC ORGANIC COMPOUNDS,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, A. Fazel, and D. F. Kincannon.
Ozone Science and Engineering, Vol. 7,No. 3, p 191-203, Summer 1985. 2 fig, 6 tab, 12 ref.

Descriptors: *Activated carbon, *Ozonation, *Activated sludge, *Organic compounds, Wastewater treatment, Acrylonitrile, 2,4-dinitrophenol, 1,2-dichloropropane, Pretreatment of water.

Industrial wastewater effluent standards in the United States are being established in terms of both conventional parameters like BOD and specific organic compounds called priority pollutants. Wastewater treatment processes must be designed based on achieving the conventional parameters and specific chemical limitations. Some compounds are difficult to treat biologically and the removal mechanisms may include biodegradation, stripping, sorption, or combinations of these mechanisms. The treatability and fate of specific organic compounds during treatment by complete-mix activated sludge systems is addressed. Bench-scale, continuous flow, complete-mix activated sludge reactors were used for all investigations. The compounds investigated were acrylonitrile, 2,4-dinitrophenol, and 1,2-dichloropropane. Data from controlled activated sludge systems, systems receiving powdered activated carbon, and systems with preozonation assist are included. The constituents in a particular wastewater will determine whether biological treatment assists such as activated carbon or preozonation can significantly enhance the treatment or removal of those compounds. Activated carbon and ozone are not necessarily 'cure alls' for difficult to biodegrade organic compounds and should not be applied indiscriminately. (Main-PTT)
W86-05274

TREATMENT OF AN IN-SITU OIL-SHALE RETORT WATER,

University of Wyoming Research Corp., Laramie. Western Research Inst.
For primary bibliographic entry see Field 5F.
W86-05285

NEW APPROACH TO IN-SITU TREATMENT OF CONTAMINATED GROUNDWATERS,

Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W86-05286

LIMITATIONS OF SLUDGE FILTRATION THEORY AT CONSTANT VACUUM PRESSURE,

Nigeria Univ., Nsukka. Dept. of Civil Engineering.
J. O. Ademiluyi.
Effluent and Water Treatment Journal, Vol. 26, No. 1, p 19-22, January 1986. 1 fig, 28 ref.

Descriptors: *Filtration, *Wastewater treatment, *Sludge filters, Vacuum filtration, Theoretical analysis, Mathematical studies, Mathematical equations.

A brief development of the sludge filtration theory proposed in recent years is presented and the limitations of this theory are highlighted. The concepts of specific resistance, Carman's equations, and filtration theory are outlined. After a review of both Poiseuille's and D'Arcy's laws, it is concluded that an acceptable equation which governs the filtration process has not been derived. Such an equation must contain the compressibility coefficient and this coefficient must be clearly defined and should agree with the theory throughout the range of dilutions. Also the equation must not include the area A of filter bed since the effective area to be used, cannot be easily evaluated. Above all, the equation must be useful in the laboratory evaluation of specific resistance. (Master-PTT)
W86-05287

NEUTRALIZATION OF WASTEWATERS CONTAINING CYANIDES; PART II: ELIMINATION BY CHEMICAL OXIDATION IN SOLUTION,

Marie Curie-Sklodowska Univ., Lublin (Poland). Dept. of Environmental Chemistry and Technology.
R. Gierzatowicz, L. Pawlowski, and E. Smulkowska.
Effluent and Water Treatment Journal, Vol. 26, No. 1, p 26-31, January 1986. 3 fig, 1 tab, 13 ref.

Descriptors: *Neutralization, *Wastewater treatment, *Wastewater *management, *Cyanide, *Oxidation, Decomposition, Potassium permangenate, Potassium chromate, Hydrogen ion concentration.

The classic method of cyanide oxidation with chlorine or, more often with hypochlorite, is described. Nine intermediate reactions between the oxidizing agent and cyanides are detailed. Two flowsheets of cyanoalkaline wastes decomposition installations, one for a continuous system and the other for a batch system, are discussed in terms of function and in terms of the cost of cyanide decomposition process per 1 kg CN. The agents which cause cyanide waste decomposition include: peroxy compounds (such as hydrogen peroxide, Caro's acid, peracetic acid, potassium persulfate, perborates, percarbonates and organic peroxides), and potassium permanganate or potassium chromate. The chemical reactions involved are described and the respective equations are given. The efficiency of each process is related to the pH range and the influence of waste reaction on oxidation is discussed. (Master-PTT).)
W86-05289

WASTEWATER TREATMENT USING AQUATIC PLANTS. SURVIVABILITY AND GROWTH OF SALVINIA MOLESTA (MITCHELL) OVER WATERS TREATED WITH ZINC (II) AND THE SUBSEQUENT UTILIZATION OF THE HARVESTED WEEDS FOR ENERGY (BIOGAS) PRODUCTION,

Centre for Water Resources Development and Management, Kunnamangalam (India).
S. A. Abbasi, and P. C. Nipaney.
Resources and Conservation, Vol. 12, No. 1, p 47-55, August 1985. 2 fig, 4 tab, 29 ref.

Descriptors: *Wastewater treatment, *Aquatic plants, *Zinc, Salvinia molesta, Biogas, Well water, Energy sources.

Utilization of the weed Salvinia molesta, which is very common in several parts of the world, would compensate for the cost of its mechanical removal. The potential of the weed in treating wastewaters containing zinc(II), and the subsequent conversion of the harvested weed into energy, have been explored with the end-objective of developing an energy-saving water pollution control system, with respect to zinc(II). Filtered well water was used for the growth study. Standard tests failed to detect zinc in the well water. Healthy Salvinia plants of free-floating growth stage were collected, acclimated, and treated with zinc solution. The average gas yield from uncatalyzed Salvinia was 30.4 L/kg (fresh weight of Salvinia). The 35-day average yield in presence of zinc(II) works out to be 40.3 L/kg (fresh weight) of Salvinia. There was a 33% enhancement in yield in the presence of zinc(II). It appears that zinc causes a stimulation in the growth of cellulolytic and methanogenic bacteria at trace levels, and also catalyzes some of the biochemical reactions involving electron transfer. (Master-PTT)
W86-05294

EVALUATION OF THE WATER SUPPLY AND SANITATION PROBLEMS IN NIGERIA,

Ibadan Univ. (Nigeria). Coll. of Medicine.
For primary bibliographic entry see Field 5F.
W86-05300

MERSEY ESTUARY POLLUTION ALLEVIATION SCHEME,

North West Water Authority, Warrington (England).
A. Dixon.
Institution of Water Engineers and Scientists Journal, Vol. 39, No. 5, p 401-413, October 1985. 5 fig, 1 tab, 4 ref.

Descriptors: *Mersey estuary, *Pollution, *Water pollution control, Water quality, Wastewater, Regional planning, England, Effluents, Odor control, Industrial wastewater.

The Mersey Estuary receives surface drainage (4535 sq km), sewage, and trade waste flows from the catchments of the Mersey and Weaver Rivers. The area is highly urbanized and industrialized with a total population of 5 million. The estuary is 50 km long with poor or bad water quality resulting from crude sewage, strong trade effluents, partially treated sewage, and polluting fresh water inputs. The North West Water Authority was formed in 1974 and has developed a plan to significantly improve estuary water quality by 1995-96. The water quality objectives for the estuary were stated as: 1) the estuary should at all times contain dissolved oxygen in order to obviate odor nuisance; and, 2) the foreshore and beaches should not be subject to fouling by crude sewage or solids or fats from industrial effluents. (Lantz-PTT)
W86-05304

'UASB' PROCESS FOR DOMESTIC WASTEWATER TREATMENT IN DEVELOPING COUNTRIES,

Haskoning B.V., Nijmegen (Netherlands).
J. L. Kooijmans, G. Lettinga, and G. Rodriguez Parra.
Institution of Water Engineers and Scientists Journal, Vol. 39, No. 5, p 437-451, October 1985. 9 fig, 11 ref.

Descriptors: *Domestic wastewater, *Wastewater treatment, *Developing countries, Tropical regions, Agrarian wastes, Cali, Colombia, Anaerobic treatment, Sludge digestion.

Application of conventional, advanced wastewater treatment technologies are not economically feasible in developing countries due to high investment and operating costs and the lack of skilled staff for operation and maintenance. One new technology, which has a lower operating cost, and easier maintenance and operation standards, is the Upflow Anaerobic Sludge Blanket (UASB), which was developed some 12 years ago at the Agricultural University of Wageningen, in the Netherlands, as a pre-treatment of medium and high strength agro-industrial wastes (in terms of COD), mainly of agrarian origin. Since the optimum process temperatures are in the range of 30-40 C, the anaerobic process was not considered to be feasible for treatment of low strength domestic sewage, particularly not under climatological conditions where the temperature may drop to 8-10 C or even lower. This paper gives a short description of the UASB process and its characteristics, and of the pilot plant research performed in Cali, Columbia, and the main results obtained so far. The first phase of the project, which also included some post-treatment research, was terminated at the end of 1984, but the research will be continued. In the second phase emphasis will be put on the treatment of combined domestic-industrial flows, upscaling, and reuse of the effluent for irrigation after post-industrial flows, upscaling, and reuse of the effluent for irrigation after post-treatment and sludge disposal. (Lantz-PTT)
W86-05305

ORGANIC LOADING STUDY OF FULL-SCALE SEQUENCING BATCH REACTORS,

Notre Dame Univ., IN. Dept. of Civil Engineering.
R. L. Irvine, L. H. Ketchum, Jr., M. L. Arora, and E. F. Barth.
Water Pollution Control Federation Journal, Vol. 57, No. 8, p 847-853, August 1985. 1 fig, 11 tables, 16 ref.

Descriptors: *Sequencing batch reactors, *Organic loading, *Wastewater treatment, Phosphorus, Flow rate, Energy Use, Biochemical oxygen demand, Sludge disposal, Sludge digestion.

Sequencing batch reactors are a time-oriented activated sludge system shown in full scale to be capable of achieving biochemical oxygen demand, suspended solids and nitrogen removal, biological phosphorus removal, and the treatment of hazardous waste. Test data are presented for both low and high organic loading. The SBR demonstrated high treatment performance for biological oxygen demand (BOD) and suspended sediment (SS) removal. Effluent limits of 10 mg/L BOD and SS were easily attainable and biological phosphorus removal was readily achieved. A wide range of operating potential was also demonstrated by showing similar performance from two parallel SBRs: one with a sludge age of 9.5 days, a yield of 0.82 kg sludge wasted/kg BOD applied, and an organic loading of 0.42 kg BD/kg mixed liquid volatile suspended solids (MLVSS)/d on an aeration time adjusted basis; and the other with a sludge age of 38 days, a yield of 0.56 kg/kg and a corresponding loading of 0.16 kg BOD/kg MLVSS/d. Aeration energy use in kWh/kg BOD applied ranged over a wide spectrum; 60% more energy was needed per kilogram BOD applied in the North SBR than the South SBR. However, the kilowatthours needed for each kilogram BOD actually oxidized (not carried off with the waste sludge) was quite similar; 6.0 kWh/kg BOD oxidized was needed for the North SBR, and 6.7 kWh/kg was needed for the South SBR. Two major conclusions can be drawn from this study. First, effluent quality from both SBRs was excellent. Second, energy use in the more highly loaded system was about 30% less than that for the system with lower loading, based on kilogram BOD, applied. (Lantz-PTT)
W86-05308

TECHNOLOGY EVALUATION OF SEQUENCING BATCH REACTORS,

Montgomery (James M.), Inc., Pasadena, CA.
M. L. Arora, E. F. Barth, and M. B. Umphres.
Water Pollution Control Federation Journal, Vol. 57, No. 8, p 867-875, August 1985. 3 fig, 2 tab, 20 ref. EPA Contract No. 68-02-1821.

Descriptors: *Sequencing batch reactors, *Evaluations, *Wastewater treatment, Activated sludge, Design standards, Operating policies, Wastewater facilities.

One beneficial innovative and alternative wastewater treatment technology is the sequencing batch reactor (SBR). The major obstacle to bringing SBR technology from the research stage to broader practical application is a lack of widely accepted design standards. The results of a post-construction evaluation of 8 facilities indicate that all plants are producing effluent of acceptable quality. Different carbon, nitrogen, and phosphorus removals are achieved by changes in operating strategy. All operators report that SBR is easier to operate than conventional continuous-flow systems. All U.S. plants have experienced problems with decanter mechanisms. (McFarlane-PTT)
W86-05309

USING ATP TO DETERMINE THE CHLORINE RESISTANCE OF FILAMENTOUS BACTERIA ASSOCIATED WITH ACTIVATED SLUDGE BULKING,

California Univ., Berkeley. Dept. of Civil Engineering.
J. B. Neethling, K. M. Johnson, and D. Jenkins.
Water Pollution Control Federation Journal, Vol. 57, No. 8, p 890-894, August 1985. 7 fig, 1 tab, 32 ref. NSF Grant No. CME-8006295.

Descriptors: *Adenosine triphosphate, *Chlorine resistance, *Filamentous bacteria, *Activated sludge, *Bulking, Bioluminescence, Microbiological studies, Chlorine, Disinfection, Dissolved oxygen.

Activated sludge bulking is caused by the uncontrolled growth of filamentous microorganisms in activated sludge, and controlled by doses of chlorine. Standard enumeration techniques cannot be used with organisms growing in flocs, so ATP concentration was used in this study, using a new luciferin/luciferase method. The observed effects of a disinfectants on microorganisms depends on enumerative techniques. In this study, plate counting was more sensitive than ATP measurement. The filaments associated with low food-to-microorganism (F/M) bulking showed more resistance to monochloramine than those associated with low dissolved oxygen bulking. Thus higher chlorine doses may be needed to control low F/M bulking. (McFarlane-PTT)
W86-05310

CHEMICAL QUALITY OF PERCHED SEPTIC TANK EFFLUENT FOR PLANT USE AND RECHARGE,

Agricultural Research Service, Fresno, CA. Water Management Research Lab.
H. I. Nightingale, and R. L. McCormick.
Water Pollution Control Federation Journal, Vol. 57, No. 9, p 916-920, September 1985. 4 fig, 4 tab, 27 ref.

Descriptors: *Water quality, *Septic tank effluent, *Water reuse, *Water recharge, Nitrates, Fertilizers, Irrigation, Leach field, Well water, Chlorides, Chemical analysis.

Abstract: Septic tank and soil absorption systems have a significant role in onsite domestic waste disposal strategies but their impact on groundwater quality is variable. A new rural, residential home with onsite domestic water well, septic tanks, and leach lines was studied. After 3 years, the mean NO3(-)-N in the perched water was 1.2, 27.6, and 30.1 mg/l at 0.5, 3.5, and 6.5 m, respectively from the leach lines. Measurements for perched water elevations within the leach field indicated that the recharge mound stayed within the lot boundaries; thus, slow percolation of the perched water through the restricting sublayer was occurring. Soil sampling from the 80- to 140-cm root zone at three sampling sites within the leach field showed a 333% increase in soil NO3(-)-N (1.2 to 5.2 mg/kg) and a 156% increase in CL(-) (4.0 to 10.3 mg/kg) during the 3-year period. Once front yard vegetation has been planted and develops, the NO3(-) and perched water could be used to reduce the requirement for both nitrogen-fertilization and supplemental irrigation (Lantz-PTT)
W86-05311

BIOASSAY SYSTEM FOR INDUSTRIAL CHEMICAL EFFECTS ON THE WASTE TREATMENT PROCESS: PCB INTERACTIONS,

T. Vitkus, P. E. Gaffney, and E. P. Lewis.
Water Pollution Control Federation Journal, Vol. 57, No. 9, p 935-941, September 1985, 2 fig, 8 tab, 25 ref.

Descriptors: *Bioassay, *Industrial chemicals, *Chemical effects, *Waste treatment, *Polychlorinated biphenyls, Biomonitoring, Toxicity, Arochlor 1254, Biological oxygen demand, Chemical oxygen demand.

This research presents the results of an investigation using a lab-scale, fixed-film biomass to evaluate the long-term effects of continuous exposure to polychlorinated biphenyls (PCB). The investigation was stimulated by the discovery of PCB in a municipal waste treatment facility influent in conjunction with an operation record that exhibited very poor biochemical oxygen demand (BOD) removal during secondary treatment (trickling filters). Results concluded that: 1) The lab-scale waste treatment model developed was an efficient for wastewater treatment and for evaluating effects of an industrial chemical on these processes; 2) The chronic and acute exposures to Aroclor 1254, from 1 to 1000 microgram/L and 2000 to 200 000 micrograms/L, respectively, did not alter waste treatment efficiency, nor did the Aroclor doses result in any visible manifestations of toxicity to the biomass; 3) There was no evidence of biodegradation of Aroclor 1254; 4) The biomass accumulated an estimated Aroclor 6,200,000 micrograms/kg (dry weight) during the study; and 5) Volatility of Aroclor 1254 most likely accounted for the 30 to 39% loss of PCB administered to the model system. (Lantz-PTT)
W86-05312

COOLING TOWER EVAPORATION OF TREATED COAL GASIFICATION WASTEWATERS,

Pittsburgh Univ., PA. School of Engineering.
R. D. Neufeld, M. R. Debes, C. Moretti, J. Mayernik, and G. Keleti.
Water Pollution Control Federation Journal, Vol. 57, No. 9, p 955-964, September 1985. 3 fig, 11 tab, 16 ref. DOE Contract No. DE-AC18-81FC10299.

Descriptors: *Cooling tower, *Coal gasification, *Wastewater treatment, Biological pretreatment, Polycyclic aromatic hydrocarbons, Blowdown water, Daphnia, Bioaccumulation, Organic compounds, Water pollution effects, Bioindicators, Toxicity.

The objective of this study was to characterize cooling tower makeup, blowdown, evaporate, and drift when fixed-bed North Dakota lignite coal gasification wastewaters were pretreated with solvent extraction, free ammonia stirring, and aerobic biological processing. There were tendencies for calcium carbonate deposition and chemical corrosion, under-deposit corrosion potentials, and severe foaming in cooling tower recirculation waters. Foaming was reduced by aerobic biological processing. Significant quantities of ammonia, phenolics, and total organic carbon were lost selectively to the atmosphere from the cooling tower. Water, air and ash samples yielded mostly negative Ames tests. Biological pre-treatment had little effect on blowdown toxicity but did remove organic compounds from makeup waters. Bioaccumulative polycyclic aromatic compounds were found in makeup and blowdown waters thus air pollution potential exists from this cooling tower source. (McFarlane-PTT)

W86-05313

SELECTING EFFECTIVE SOFTWARE FOR WATER AND WASTEWATER TREATMENT FACILITIES,

Engineering-Science, Inc., Atlanta, GA.
M. R. D'Alessandro.
Public Works, Vol. 117, No. 2, p 42-44, February 1986.

Descriptors: *Computers, *Wastewater treatment, *Training, Management planning, Computer programs, Automation, Process control, Water treatment.

This article focuses on the implementation of computer hardware and software to get the operator of a wastewater or water treatment plant to use computers to streamline operation, maintenance, and management procedures to enhance process performance and reduce the hours required for various tasks. During system design, it is necessary to recognize those aspects of treatment management that are improvable by use of a computer. Three treatment operational areas that are well suited for implementation of a microcomputer are data management and evaluation, process control, and total maintenance. User considerations to look for in the computer software system include key-trapping, error-trapping, and program movement features. Implementation considerations should also be accounted for at the time of software and hardware installation. Installation plans should include a well-designed training program that features an initial review of the operating manual, classroom instruction for review of system capabilities, hands-on training with actual microcomputer operation, review of system security for managers, and hands-on training of managers for system utilities such as data file management. (Geiger-PTT)
W86-05319

DISTRIBUTION OF RETENTION TIMES IN MODEL BIOLOGICAL FILTERS CONTAINING PACKED SPHERES,

Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
Y. Muslu.
Water Research, Vol. 20, No. 3, p 259-265, March 1986. 5 fig, 1 tab, 25 ref.

Descriptors: *Wastewater treatment, *Models, *Biological filters, *Retention time, *Trickling filters, *Theoretical analysis, Flow velocity, Flow rates, Mathematical models, Mathematical studies, Packed beds.

A major element of substrate utilization in biological filters is the liquid retention time. Biological efficiency is influenced by retention time rather than the form of the C-curves (flow-through curves). A theory developed for computing flow time using the velocity equation of the laminar regime was experimentally verified and the ranges of validity of dispersed plug flow and mixed flow were determined to compute the retention time. Mean residence time when plotted vs. hydraulic loading on a log-log paper provides straight lines. To reach this result, the hydraulics of falling films and jets was used. (Geiger-PTT)
W86-05329

FEEDFORWARD CONTROL OF A WASTEWATER PLANT,

Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
G. D. Corder, and P. L. Lee.
Water Research, Vol. 20, No. 3 p 301-309, March 1986. 14 fig, 1 tab, 16 ref.

Descriptors: *Wastewater treatment, *Process control, *Activated sludge process, *Models, *Aeration, *Dissolved oxygen, Aeration tanks, Wastewater facilities, Simulation analysis, Spectral analysis, Cost analysis, Mathematical models, Oxygen demand.

A feedforward control strategy to compensate for disturbances in the applied biological load to the activated sludge plant was designed. This strategy was generated from Laplace-domain transfer function models predicting the dissolved oxygen concentration at the end of the aeration tank from the applied biological load and the air flowrate. In producing these models, the Luggage Point Wastewater Treatment Plant was used to obtain plant data. After conducting a series of computer simulation tests, the improvement in performance using the new control scheme compared to the existing dissolved oxygen feedback controller resulted in a 20% reduction in air flowrate. It is estimated the new strategy would give a payback period of less than 15 months. (Author's abstract)
W86-05335

ROLE OF AQUATIC PLANTS IN WASTEWATER TREATMENT BY ARTIFICIAL WETLANDS,

San Diego Water Reclamation Agency, Santee, CA.
R. M. Gersberg, B. V. Elkins, S. R. Lyon, and C. R. Goldman.
Water Research, Vol. 20, No. 3, p 363-368, March 1986. 3 fig, 2 tab, 23 ref. CA Dept. of Water Resources grant B-53459 AM IV and EPA grant CR-807299-03-0.

Descriptors: *Aquatic plants, *Wastewater treatment, *Wetlands, *Nitrogen removal, *Denitrification, Ammonia, Biochemical oxygen demand, Suspended solids, Nitrification, Bulrushes, Cattails, Root zone, Rhizosphere, Advanced wastewater treatment.

This report describes studies using artificial wetlands which quantitatively assess the role of each of three higher aquatic plant types (bulrush, common reed, and cattail) in the removal of nitrogen (via sequential nitrification-denitrification), BOD and total suspended solids (TSS) from primary municipal wastewaters. During the period August 1983-December 1984, the mean ammonia concentration of 24.7 mg/liter in the primary wastewater inflow (hydraulic application rate = 4.7 cm/day) was reduced to mean effluent levels of 1.4 mg/liter for the bulrush bed, 5.3 mg/liter for the reed bed and 17.7 mg/liter for the cattail bed. For all three vegetated beds, the mean effluent ammonia values were significantly below that for the unvegetated control bed and for the inflow. The bulrushes and reeds proved to be superior at removing ammonia, both with mean effluent levels significantly below that for the cattail bed. The high ammonia-N and total N removal efficiencies of the bulrush and reed beds are attributed to the ability of these plants to translocate oxygen from shoots to roots, which in turn stimulates sequential nitrification-denitrification. BOD removal efficiencies were also highest in the bulrush and reed beds. These findings suggest that higher aquatic plants can play a significant role in secondary and advanced wastewater treatment by wetland systems. (Geiger-PTT)
W86-05342

EFFECT OF TRACER DIFFUSION IN BIOFILM ON RESIDENCE TIME DISTRIBUTIONS,

Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
D. K. Stevens, P. M. Berthouex, and T. W. Chapman.
Water Research, Vol. 20, No. 3, p 369-375, March 1986. 6 fig, 3 tab, 8 ref.

Descriptors: *Tracers, *Wastewater treatment, *Dye releases, *Dyes, *Biofilters, *Biological membranes, *Fluidized beds, Error analysis, Models, Mixing, Diffusion coefficient, Temporal distribution.

Estimating fixed-film biological reactor characteristics is often complicated by interaction of the tracer that is used in residence time distribution (RTD) studies with the biofilm in a way that causes the RTD curve to have a long tail. This tail can result from hold-up of tracer within the biofilm. A reactor model that ignores the diffusion rate at which tracer enters and leaves the biofilm may be seriously in error. Data from RTD studies in a fluidized bed reactor are presented and a model that accounts for diffusion of tracer in the biofilm is used to explain the experimental data. A material balance on inorganic nitrogen is also given to verify the organic dye tracer results. The conditions under which diffusion of tracer will cause large distortions are defined. (Author's abstract)
W86-05343

ALGAE REMOVAL BY FINE SAND/SILT FILTRATION,

Louisiana Dept. of Transportation and Development, Baton Rouge.
For primary bibliographic entry see Field 5F.
W86-05344

METHANOGENIC DIGESTION USING MIXED SUBSTRATE OF ACETIC, PROPIONIC AND BUTYRIC ACIDS,

Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
Ch.-Y. Lin, K. Sato, T. Noike, and J. Matsumoto.
Water Research, Vol. 20, No. 3, p 385-394, March 1986. 10 fig, 4 tab, 33 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Biological wastewater treatment, *Organic acids, *Methane, *Retention time, Methane bacteria, Digestion, Organic compounds, Acetic acid, Butane, Propane, Chemical oxygen demand, Anaerobic conditions, Performance evaluation.

Experiments on methanogenic digestion using high concentrations of mixed substrates were conducted. The major intermediate products of anaerobic digestion such as acetic, propionic and butyric acids were mixed in a ratio of 2:1:1 (COD basis), respectively, and used as a substrate for feeding into continuous-flow chemostat reactors maintained at 35 degrees. These reactors were operated stably at higher feed substrate concentrations and shorter hydraulic retention times (HRT) than those using a single component of volatile fatty acids as a substrate. At an HRT of 4.43 days, the methanogenesis occurred normally up to a feed substrate concentration of 70,000 mg COD/liter. At a feed substrate concentration of 20,000 mg COD/liter, the methanogenesis occurred normally up to an HRT of 2.91 days and the minimum SRT for microbial populations was calculated to be 2.42 days. An increase in feed substrate concentration adversely affected the propionate degradation strikingly, while a decrease in HRT significantly adversely affected the acetate and propionate degradation. The methane production was 0.30 liter/g COD utilized, and it was independent of the feed substrate concentration and HRT. Bacilli were predominant in all reactors, but sarcinae appeared in the reactors with high feed substrate concentrations and short HRTs. Phenomena in digester failure due to methanogen washout were also observed. (Author's abstract)
W86-05345

REMOVAL OF PARAQUAT, DIQUAT, AND AMITROLE FROM AQUEOUS SOLUTION BY CHEMICALLY MODIFIED PEAT,

Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 5G.
W86-05383

BACTERIAL PROFILE OF PETROCHEMICAL INDUSTRY EFFLUENTS,

Baroda Univ. (India). Dept. of Biochemistry.
H. D. Goud, L. J. Parekh, and C. V. Ramakrishnan.
Environmental Pollution (Series A), Vol. 39, No. 1, p 27-37, 1985. 1 fig, 4 tab, 26 ref.

Descriptors: *Biodegradation, *Path of pollutants, *Fate of pollutants, *Industrial wastewater, *Hydrocarbons, *Bacteria, *Heavy metals, Bacillus, Pseudomonas, Aeromonas, Azotobcter, Cobalt, Copper, Lead, Mercury, Molybdenum, Zinc, Effluents, India.

The microbial profile of petrochemical industry effluents was investigated at different points in an activated sludge wastewater treatment plant in

Baroda, India. Chemical oxygen demand was higher than biological oxygen demand (BOD) in all samples. Among the 92 isolates, four bacterial cultures, Pseudomonas spp. P-51, Bacillus spp. P-79, Aeromonas spp. P-71 and Azotobacter spp. P-23, grew well on petrochemicals such as benzene, butanol, ethylene glycol, n-heptane, methanol, acetonitrile, phenol and xylene, and showed resistance to heavy metals such as cobalt, copper, lead, mercury, molybdenum and zinc. Preliminary studies using a mixture of the four bacteria showed a reduction in BOD in a sample petrochemical waste from 350 microgram/ml to 150 microgram/ml in 48 hr at 30 C. It is suggested that these bacteria may play an important role in the purification of petrochemical industry effluents. (Peters-PTT)
W86-05393

WASTE-WATER INJECTION: GEOCHEMICAL AND BIOGEOCHEMICAL CLOGGING PROCESSES,
San Jose State Univ., CA.
For primary bibliographic entry see Field 5E.
W86-05402

ELECTROCHEMICAL TREATMENT OF INDUSTRIAL WASTEWATER,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Moscow (USSR).
V. E. Cenkin, and A. N. Belevtsev.
Effluent and Water Treatment Journal, Vol. 25, No. 7, p 243-44, 246-247, July 1985. 4 fig.

Descriptors: *Electrodialysis, *Electrolysis, *Wastewater treatment, Industrial wastewater, Electrodes, Chromium, Cyanide, Electrochemistry, Advanced wastewater treatment, Wastewater oxidation, Coagulation, USSR, Organic compounds, Pulp and paper industry, Chemical wastes, Mine wastes, Dyes.2274.

Electrochemical wastewater treatment processes used in the USSR are discussed. Direct anodic oxidation entails the destruction of dissolved (usually organic) impurities in electrolysis units at high current densities. The process can be combined with cathodic reduction to treat wastewater containing cyanides, amines, aldehydes, azo dyes, mercaptans, and other by-products of the refining, pulp and paper, and chemical industries. Electrodialysis, used to treat mine waste effluents and to regenerate products from spent process solutions, involves separating inorganic salt ions from wastewater in multi-cell unit employing ion-exchange membranes. Electrocoagulation (Using Soluble Fe and Al anodes to form insoluble precipitates with contaminants) and electroflotation (with insoluble electrodes) are efficient agains dispersed impurities that form stable collodial systems in liquid: e.g., chromium compounds; sulfide, phosphate or fluoride ions. The efficiency and energy requirements of the processes are analyzed. (Robinson-PTT)
W86-05403

5E. Ultimate Disposal Of Wastes

EVALUATING THE IN-VESSEL COMPOSTING OPTION, PART I,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5D.
W86-04716

DENVER'S DUAL UTILIZATION SLUDGE PROGRAM,
Black and Veatch, Aurora, CO.
P. J. Pearis, and R. Tardy.
Biocycle BCYCDK, Vol. 27, No. 4, p 28-30, April 1986. 7 tab.

Descriptors: *Denver, *Sludge disposal, *Composting, *Land application, *Liquid sludge, Metrogro, Municipal wastewater, Colorado.

The Denver (Colorado) Sewage Disposal District No. 1's 'Dual Utilization' (DU) concept of sludge disposal is described. The District's Central wastewater treatment plant currently produces approximately 60-70 tons of anaerobically digested sludge per day, with a sludge load anticipated in the year 2004 by 100 dry tons/day. The DU concept, which consists of a combined approach of composting and land application, was chosen in 1981 as the best among the alternatives in the sludge management plan. Two products will be produced and marketed in 1986: compost and liquid, which are marketed under the trademark 'Metrogro.' The liquid constitutes 40% of the output applied to agricultural land. The District believes that the success of Metrogro Liquid is an example of what can be accomplished through public relations and promotion. The liquid portion of the program has gone from intense public resistance to an overwhelming success. (Rochester-PTT)
W86-04717

SLUDGE MANAGEMENT ALTERNATIVES FOR SAN DIEGO,
Nolte (George S.) and Associates, Sacramento, CA.
R. W. Crites and D. Richard.
Biocycle BCYCDK, Vol. 27, No. 4, p 50-55, April 1986. 2 fig, 5 tab, 6 ref.

Descriptors: *Sludge disposal, *San Diego, *Composting, *Land application, *Management planning, Sod farming, Site selection, Landfilling, California.

The difficulties presented to the City of San Diego, California, by the need to move its sludge drying operation are described and management alternatives are discussed. A master plan is being prepared that examines alternatives to landfilling of dewatered sludge, including dedicated land disposal, agriculture use, land reclamation, composting, and ocean disposal. Considerable interest has been expressed in the beneficial use of sludge for agriculture, land reclamation, and distribution of compost. The present recommendation is for a sludge reuse program with multiple options that include distribution of compost as well as agricultural land application, land reclamation, and reuse in sod farming. Existing sludge management in San Diego, site selection, sludge characteristics, land application, and composting are discussed. (Rochester-PTT)
W86-04718

SULFUR OXIDES CONTROL TECHNOLOGY SERIES: FLUE GAS DESULFURIZATION; LIME/LIMESTONE PROCESSES,
Radian Corp., Austin, TX.
For primary bibliographic entry see Field 5D.
W86-04819

USE AND DISPOSAL OF MUNICIPAL WASTEWATER SLUDGE,
Eastern Research Group, Inc., Arlington, MA.
For primary bibliographic entry see Field 5D.
W86-04826

SEPTAGE TREATMENT AND DISPOSAL: HANDBOOK,
Weston (Roy F.), Inc., West Chester, PA.
For primary bibliographic entry see Field 5D.
W86-04828

ESTIMATING SLUDGE MANAGEMENT COSTS,
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5D.
W86-04829

MUNICIPAL WASTEWATER SLUDGE COMBUSTION TECHNOLOGY,
Environmental Protection Agency, Cincinnati, OH. Center for Environmental Research Information.
For primary bibliographic entry see Field 5D.
W86-04835

PROCESS DESIGN MANUAL FOR LAND TREATMENT OF MUNICIPAL WASTEWATER: SUPPLEMENT ON RAPID INFILTRATION AND OVERLAND FLOW,
Environmental Protection Agency, Cincinnati, OH. Office of Water Program Operations.
For primary bibliographic entry see Field 5D.
W86-04840

RAPID INFILTRATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 5D.
W86-04841

OVERLAND FLOW,
ERM-Southeast, Inc., Brentwood, TN.
For primary bibliographic entry see Field 5D.
W86-04842

ENVIRONMENTAL ASPECTS OF THE COMBUSTION OF SEWAGE SLUDGE IN A UTILITY BOILER,
Stone and Webster Engineering Corp., New York.
D. Samela, G. M. Tsoumpas, G. K. Welshans, and M. L. Zwillenberg.
Environmental Progress, Vol. 5, No. 2, p 110-115, May 1986. 7 tab, 11 ref.

Descriptors: *Sludge disposal, *Combustion, *Air emissions, Pollutants, Leachates, Arsenic, Barium, Dewatering, Cadmium, Chromium, Lead, Mercury, Selenium, Silver, Zinc, Secondary wastewater treatment, Primary wastewater treatment.

The combustion of three dewatered municipal sewage sludges which were representative of sludges that could be considered for co-firing in a utility boiler was studied. Milorganite sludge (M sludge, Milwaukee, WI) is typically a residential-type sludge which has received secondary treatment and chemical treatment using ferric chloride (FeCl3). M sludge is packaged and sold commercially as an organic fertilizer. The Atlantic City (NJ) sludge (A sludge) is also a residential type sludge; however, it is a primary treatment sludge that has not been biologically treated. The World Resources (Phoenix, AZ) Sludge (P sludge) is an industrial-type sludge which has received secondary treatment. The forms in which metals are found in sludge will influence their behavior on firing. High efficiency electrostatic precipitators or baghouses would be required to control total suspended particulate emissions. The emissions for CO, NO2, and trace metals increased with sludge firing. The SO2 emissions decreased for sludge/oil firing, but increased for sludge/coal firing. However, the SO2 PSD (Prevention of Significant Deterioration) incremental consumption was well below the allowable limit for sludge coal firing. Air quality impacts were all well below the National Ambient Air Quality Standards. The quantity of solid wastes requiring handling and disposal increased significantly. The tested sludges did not demonstrate hazardous waste characteristics. However, there is a potential for a wide variability in the sludge composition due to differences in the quantity and character of the industrial wastes in the community, and the unit operations employed at the sewage treatment plant. (Peters-PTT)
W86-04948

FILTRATE AND CAKE QUALITY IN SLUDGE DEWATERING,
Nigeria Univ., Nsukka. Dept. of Civil Engineering.
J. O. Ademiluyi.
Effluent and Water Treatment Journal, Vol. 26, No. 3/4, p 114-117, March/April 1986. 4 fig, 25 ref.

Descriptors: *Sludge, *Dewatering, *Filtrate, Cake quality, Oil waste sludge, Beef sludge, Domestic sludge, Oxidation pond, Food-processing wastes, Industrial wastewater, Domestic wastes.

Sludge-dewatering factors such as pressure and sludge conditioning, were studied for their effects on sludge filtrability,as well as filtrate and cake qualities at constant vacuum pressure, especially

when the filtrate or cake is the primary product of filtration. Pressure and chemical conditioning affect the resulting cake and filtrate concentrations during sludge filtration. Cake concentration increases with increasing pressure. In the three sludges tested, oil waste, beef (from a slaughtering house), and domestic, different values were obtained for pressure versus filtrate concentration. Filtrate concentration can increase with the pressure, as shown by the oxidation pond and the beef sludges tested. A decrease in filtrate concentration with increasing pressure is obtained with the oil waste sludge tested. If the ultimate objective of a dewatering process is to obtain a high quality cake, high filtration pressure must be used, even through filtrability is low at such pressures. (Peters-PTT)
W86-04934

SANITARY LANDFILL LEACHATE RECYCLE,

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
G. F. Lee, R. A. Jones, and C. Ray.
Biocycle BCYCDK, Vol. 27, No. 1, p 36-38, January 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Sanitary landfills, *Groundwater pollution, *Recycling, *Surface water, *Leachates, Monitoring, Remedies, Wastewater treatment, Landfills.

A general overview of the problems of landfill leachate recycle is presented. Leachate recycle can increase the rate of landfill stabilization and be used for leachate treatment and disposal, but may lead to increased groundwater contamination. Concentration ranges for components of landfill leachate and a suggested design for landfill leachate recycle system with gas reclamation are included. In general sanitary landfill leachate recycle will not likely provide a leachate that is sufficiently well-treated so that it may enter groundwater without fear of contamination problems or may be discharged into surface waters without further treatment. Basically, therefore, leachate recycle will reduce, to some extent, some contaminants in the leachate, but will require additional treatment by more conventional means. Rigorous monitoring and remediation programs must be conducted indefinitely to ensure that surface and/or groundwater contamination does not occur. Leachate recycle is likely to be most readily practiced at new landfills that have been properly designed and operated with a double-lined leachate collection system to minimize the likelihood of groundwater contamination. (Rochester-PTT)
W86-04971

EVALUATING MATURITY AND METAL TRANSFER OF MSW COMPOST,

Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium).
P. J. Anid.
Biocycle BCYCDK, Vol. 27, No. 1, p 46-47, January 1986. 9 ref.

Descriptors: *Composting, *Trace metals, *Horticulture, *Soil tests, *Land disposal, *Municipal wastes, Toxicity, Crop yield, Thermophilic bacteria, Monitoring, Decomposition, Lettuce, Spinach, Rye, Zinc, Nickel.

Procedures were developed to monitor the decomposition of municipal sewer waste compost and to assess stabilization of composting material. The effects of various compost loadings on the quantitative and qualitative yields of spinach, rye grass, and lettuce were determined. In addition, the relation, if any, between soil metal content, conventionally extracted to actual crop uptake, and compost levels to avoid phytotoxicity were defined. Thermophilic bacteria may be at the origin of compost toxicity experienced during early stages of decomposition. The metal concentrations encountered in soil-compost mixtures and plant tissues were not sufficiently high to inhibit growth. Rye grass tolerates high compost applications, whereas a moderate application (20%) appears appropriate for sensitive crops such as lettuce and spinach, because their uptake capacity for trace elements, especially Zn and Ni, is high. Trace element contents in soil indicate the concentration potentially available, but cannot be used for predicting quantitative absorption by crops. (Rochester-PTT)
W86-04972

FEEDLOT MANURE USE ON DESERT CROPLAND,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. Hathorn, III, and W. H. Fuller.
Biocycle BCYCDK, Vol 27, No. 1, p 48-51, January 1986. 3 tab, 15 ref.

Descriptors: *Feedlot wastes, *Deserts, *Soil organic matter, *Heavy metals, *Cropland, Sorghum, Barley, Salts, Manure, Crop yields, Loading rate, Waste management, Waste load, Waste disposal, Arizona, Pima loam soils, Phosphorus, Ammonia, Nitrogen, Arid lands. (Rochester-PTT).

The effects of feedlot steer manure loading rate and cropping pattern upon the soil fertility status of arid land were determined, using the following evaluation criteria: optimal fertility on arid land; maximum manure utilization as a waste management alternative; and avoidance of excessive heavy metal accumulation in crops. Manure applications up to an approximate optimal rate of 178 metric ton/hectare will increase soil fertility/small grain yield benefit if production practices are adjusted to properly manage manure-borne salts (and/or ammonia). Even after following for 2 yr after manure application, residual soil fertility benefit and salinity hazard will be comparable to those expected from a planting immediately after manuring. A single 178 metric ton/hectare manure application will sustain overall soil fertility for economic yields of three consecutive small grain crops, after which soil N may be yield-limiting. Even a single manure application of 45 metric ton/hectare will increase and sustain desert soil organic matter and plant-available P to levels equal to or greater than native levels for at least 2 yr of small grain double-cropping. Manuring rates as great as 448 metric tons/hectare on Pima loam soils (Arizona, USA) did not result in statistically significant concentration of heavy metals in small grain commodities. (Rochester-PTT)
W86-04973

OMAHA MOVES FROM 'DISPOSE ALL' TO MANAGEMENT,

Omaha Public Works Dept., NE. Quality Control Div.
K. Stevens.
Biocycle BCYCDK, Vol. 27, No. 2, p 26-27, February 1986. 2 fig.

Descriptors: *Composting, *Organic wastes, *Recycling, *Sludge, *Management planning, *Omaha, Nebraska, Cost analysis, Wastewater treatment, Landfills, Nonstructural alternatives, Monitoring, Industrial wastes, Grass, Brush, Race track bedding, Marketing, Farm management, Horticulture, Soil reclamation, Turf maintenance.

The philosophy of management, 'organic processing centers', compost trials, and other activities employed by Omaha, Nebraska, wastewater treatment plants are described. The present program generates and applies to land 40,0900 cubic yd of dewatered, digested sewage sludge on 9 farms in 2 counties at a cost of $6.00 per yard, including costs of hauling, spreading, monitoring, and management. Major components of the program currently underway or soon to start include: source separation of grass clippings, chipped brush, race track bedding, and selected industrial wastes for composting at a regional facility, separate collections of organics in selected areas, a market survey intended to aid in targeting the most practical fraction of the market for the compost, policy development for landfilling and recycling, and creation of an incentive system to encourage haulers to compost rather than landfill organics. Compost trials are being conducted to determine effective use of compost in agriculture, turf maintenance, horticulture, and soil reclamation. Other efforts include development of a landfill ordinance to control illegal dumping and other planning activities concerned with recycling organics. (Rochester-PTT)
W86-04974

UPGRADING WITH SPRAY IRRIGATION,

Tatman and Lee Associates, Wilmington, DE.
M. F. Prouty.
Biocycle BCYCDK, Vol. 27, No. 2, p 54, February 1986. 1 fig.

Descriptors: *Water reuse, *Spray irrigation, *Wastewater lagoons, Fire fighting, Hay, Oxford, Pennsylvania, Wastewater facilities, Wastewater renovation, Disinfection, Orchard grass, Pine trees, Federal funding, Cost sharing, Costs.

Improvements in the new spray irrigation system at Oxford, Pennsylvania, include deeper storage lagoons, complete water recycling, fire fighting capacity, and a hay crop. The basic components of the plant are collection sewers, a lift station, three treatment and storage lagoons, an operations building with laboratory and effluent pumps. The wastewater collected in the lagoons is treated and disinfected. It is then sprayed onto fields planted with orchard grass and pine trees. The treatment plant is capable of treating and irrigating 600,000 gallons of sewage per day. The facility received 85% federal funding of a total cost of $4,278,300. (Rochester-PTT)
W86-04975

LEACHING TESTS OF HEAVY METALS STABILIZED WITH PORTLAND CEMENT,

New Hampshire Univ., Durham.
W. Shively, P. Bishop, D. Gress, and T. Brown.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 234-241, March 1986. 5 fig, 2 tab, 38 ref.

Descriptors: *Waste disposal, *Leaching, *Heavy metals, *Portland cements, *Stability analysis, *Equilibrium, Sludge, Water pollution sources, Hydrogen ion concentration, Chemical analysis, Chemical reactions, Alkalinity, Arsenite, Calcium, Cadmium, Aluminum, Chromium, Iron, Lead, Acetic acid, Nitric acid, Silicon.

The leaching of heavy metals sludges was substantially reduced by solidification and stabilization with Portland cement. Heavy metal concentrations in the 15 tested extractions were 100 to 10,000 times less than concentrations predicted for equilibrium solubility of stable hydroxide solids. All samples passed the EPA EP-toxicity test and are not considered hazardous waste. Heavy metals in the sludges were diluted by the stabilization process, and this dilution by salts, hydroxides, and cement compounds helped the stabilization process. Release of heavy metals proceeded in three phases during the sequential extractions. During the first phase, calcium hydroxide neutralized all acid in the leachate and the final pH was greater than 10.0. Little degradation of the solid cement paste occurred. Precipitation and soprtion removed small amounts of heavy metals extracted. Peak releases for the more soluble metals occurred as the pH dropped to less than 6.0. The pH of subsequent extractions remained less than 6.0 and the less soluble metals began to be released in small but increasing amounts. The heavy metals released in each extraction were related to the amount in each sample, and releases occurred during the same extraction regardless of concentration in the sample. Substantial amounts of heavy metals remained in the silicon-rich solids after the alkalinity had been neutralized during the 15 extractions. Arsenite, calcium, and cadmium were primarily leached during the extractions. Most of the aluminum, chromium, iron, and lead were leached during the acetic and nitric acid digestions. Acid flux was strongest during these digestions, and leaching was probably related to cement paste decomposition. Silicon remained in the solids after the other elements had leached and was dissolved by the hydrofluoric acid digestion. The stabilized wastes exhibited large buffering capacities; the average was 18.3 microequivalents/g. Alkalinity was provided primarily by calcium hydroxide in the cement paste. The high alkalinity was integral to part of the stabilization process. (Lantz-PTT)
W86-05054

SLUDGE MANAGEMENT GOES THE DISTANCE,

Brown and Caldwell, Denver, CO.
S. Berg.
Water/Engineering & Management, Vol. 133, No. 4, p 26-27, April 1986.

Descriptors: *Sludge disposal, *Colorado Springs, *Wastewater management, *Pipelines, National Pollutant Discharge Elimination Systems, Wastewater facilities, Regulations, Anaerobic digestion, Computers, Stabilization ponds, Land disposal, Monitoring.

A new concept 18 mile sludge pipeline saves half a million dollars in trucking fees each year and provides Colorado Springs with long term wastewater relief. In 1978, after the EPA filed a civil suit against Colorado Springs for noncompliance with the National Pollutant Discharge Elimination System (NPDES), the city endorsed a comprehensive program to bring the treatment system into compliance and to develop a 20 year master facilities plan for wastewater management. From the 1973 start up, sludge had been a problem. The 20 year master plan includes a solids management plan, a facility planning study, an interim sludge handling and disposal study, and later, design and construction management services. The new handling system is compatible with the treatment system, but not with the treatment plant's confined site. It was recommended that the solids handling and disposal system be located on a separate site, the city owned Hanna Ranch, 18 miles to the south. A 17.7 mile dual pipeline transfers a thickened blend of primary and secondary raw sludge from the plant to four new 1.8 mg anaerobic digesters at the ranch and carries supernatant back to the plant for treatment. The ranch site also contains six 21 mg facultative sludge basins to further stabilize and store the digested sludge, a 200 acre dedicated land disposal site for subsurface injection of sludge, and an operations building. An activated sludge wastewater treatment plant processes flows up to 30 mgd in a trouble free operation, producing 22 dry tons per day of sludge, which is processed at a cost of about $120 per dry ton. At Hanna Ranch, an operator sits at a computerized graphic control panel and monitors process functions and plant support equipment 12 hours a day. During unmanned hours, computerized alarms alert an operator in the activated sludge plant control room. The two facilities maintain their compatibility, communicating the 18 miles through a microwave link. (Peters-PTT)
W86-05121

AT THE ROOT OF THE MATTER,

For primary bibliographic entry see Field 5D.
W86-05122

SOIL AND SLASH PINE RESPONSE TO SLUDGE APPLICATIONS IN FLORIDA,

North Dakota State Univ., Fargo. Dept. of Soil Science.
M. C. Lutrick, H. Riekerk, and J. A. Cornell.
Soil Science Society of America Journal, Vol. 50, No. 2, p 447-451, March/ April 1986. 8 tab, 2 fig, 15 ref.

Descriptors: *Sludge disposal, *Pine trees, *Minerals, Sandy soil, Toxic metals, Heavy metals, Zinc, Mercury, Cadmium, Lead, Nitrogen, Potassium, Calcium, Magnesium, Nickel, Florida, Phosphorous, Leaching, Soil profiles, Nutrients, Sandy loam, Nitrates.

The response of slash pine (Pinus elliottii Engelm.) to sludge applications on a Troup fine sandy loam (Grossarenic Paleudults) and the subsequent movement of nutrients and other elements into the growing trees and through the soil profile were determined. The sewage sludge contained 26 g/kg (2.6%) solids. The sludge was applied only once to an area planted to pine seedlings, at rates of 0, 20, 40, 60, 80, and 100 Mg/ha dry matter. The large amount of N (730-3650 kg/ha) in the sludge treatment limited the amount of sludge that could be applied to slash pine grown on a Troup fine sandy loam (Grossarenic Paleudults), since NO3 could leach into the ground if sludge were applied in excessive amounts. Large amounts of P and Zn also were added to the soil from the sludge, but neither moved down the soil profile beyond the 90 cm sampling depth. After 4 yr of growth, the N and P concentration in pine needles had increased significantly from the sludge treatments, but after 8 yr, the N and P concentration in needles was not significantly different among treatments. However, the Ca concentration in pine needles increased due to treatment after 4 years. Addition of sludge increased individual tree growth by 0.8 cu dm/yr and increased annual yield by 1.0 cu m/ha per 10 Mg/ha sludge. (Peters-PTT)
W86-05127

FEASIBILITY OF CONSTRUCTING A WASTE-TO-ENERGY INCINERATOR TO GENERATE ELECTRICITY FOR A COLOCATED WASTEWATER TREATMENT PLANT,

Dayton Univ., OH. Dept. of Civil Engineering.
G.B. Shaw, J. W. Norton, and B. S. Middlebrooks.
Journal of the Water Pollution Control Federation, Vol. 58, No. 4, p 267-271, April 1986. 1 fig, 7 tab, 1 ref.

Descriptors: *Incineration, *Solid waste disposal, *Municipal wastes, *Cost analysis, *Electric power costs, *Wastewater treatment, Waste disposal, Landfills, Energy conversion, Energy, Feasibility studies, Electric power production.

The Montgomery County, Ohio Eastern Regional wastewater treatment plant is undergoing extensive improvements to increase its capacity from 37,850 cu m/d to 49,205 cu m/d. The county studied the feasibility of constructing a small scale waste-to-energy incinerator near the wastewater treatment to use municipal solid waste to run the plant. After analyzing controlled air and excess air incineration technologies, a 227-ton/d excess air refractory wall system was chosen for implementation at the Eastern Regional site. This system combines low capital costs and operating and maintenance costs, high availability and reliability, long life span, a first-year tipping fee (solid waste deposition fee) comparable to landfill costs, and the greatest opportunity for revenues from the sale of excess electricity. Ash from the resource recovery facility is not expected to be toxic and odors and noise should not present problems. Cost savings realized by the waste-to-energy facility could yield a number of benefits for county residents. (Geiger-PTT)
W86-05129

MONITORING AND EVALUATING COMPOSTING PROCESS PERFORMANCE,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
M. S. Finstein, F. C. Miller, and P. F. Strom.
Journal of Water Pollution Control Federation, Vol. 58, No. 4, p 272-278, April 1986. 2 fig, 47 ref.

Descriptors: *Sludge disposal, *Composting, *Waste disposal, *Monitoring, Process control, Performance evaluation, Drying, Decomposition, Microbial degradation.

The use of composting as a sludge treatment process has developed rapidly, but without the benefit of a specific, objective criterion of process performance. This has led to unnecessary expense and widespread problems, particularly with odor generation. This study explores possible means of assessing decomposition rate in field practice. Tests involving organic content include total organic carbon, volatile solids, carbon-to-nitrogen ratio, chemical oxygen demand, biochemical oxygen demand, materials balance, starch, cellulose, and other tests. These tests have proven inadequate, mainly because of poor specificity and sensitivity, while tests involving manifestations of decomposition are not applicable to field-scale systems. Two approaches unique to composting which seem very promising are ventilation demand and course of drying. The demand for ventilation stems from heat generation, which is directly related to decomposition. Although limited to systems using temperature feedback control, it is the preferred method for routine monitoring because of its ease and instantaneous results. The course of drying depends on water vaporization, which results mainly from heat generation. It is useful in any system as long as conduction heat loss is not a major heat removal mechanism. (Geiger-PTT)
W86-05130

MUNICIPAL SLUDGE COMPOSTING TECHNOLOGY EVALUATION,

Brown and Caldwell, Walnut Creek, CA.
A. H. Benedict, E. Epstein, and J. N. English.
Water Pollution Control Federation Journal, Vol. 58, No. 4, p 279-289, April, 1986. 5 fig, 9 tab, 15 ref. EPA contract 68-03-1818.

Descriptors: *Composting, *Comparison studies, *Municipal wastes, *Sludge disposal, Performance evaluation, Aeration, Drying, Cost analysis, Digested sludge, Solid waste disposal, Waste disposal.

Five municipal sludge composting facilities were evaluated for operation, performance, and cost features. Three were static pile facilities, one used conventional operations, and the other remaining facility used aerated windrow operations. In general it was concluded that unit operating areas of about 0.03 to 0.08 ha/wet mg/d are required based on the 45- to 450-wet mg/d facilities studied. Moisture control, combined with effective mixing, during day-to-day operation was the single most important factor for effective composting. Flexibility to respond to variable sludge loadings, weather conditions, and day-to-day problems was also an important operating requirement. Under optimum conditions, wood chip recoveries of 80 to 90%, based on unscreened compost volume, can be achieved during screening. The integration of treatment plant and composting operations is important for effective composting. Based on experience at the conventional windrow facility, preliminary mixing with front-end loaders before windrow formation was not completely effective; pugmill mixing is being considered as an alternative. At the aerated windrow facility, induced aeration improved drying by about 2 to 3% over conventional windrowing. Sustained finished compost production was equivalent to about 0.6% to 2.2 dry mg/dry mg sludge processed. Finished compost production was affected by the type of sludge processed, but not the composting technology. The chief environmental problem at the facilities studied was odor generation and its resulting off-site impact. Operating and maintenance costs were $28-$40/wet mg for static pile facilities. (Geiger-PTT)
W86-05131

PRACTICAL APPLICATIONS OF GEOLOGICAL METHODS AT THE WEST VALLEY LOW-LEVEL RADIOACTIVE WASTE BURIAL GROUND, WESTERN NEW YORK,

New York State Geological Survey/State Museum, Albany.
R. H. Fakundiny.
Northeastern Environmental Science, Vol. 4, No. 3-4, p 116-148, 1985. 15 fig, 1 tab, 57 ref.

Descriptors: *Radioactive waste disposal, *Landfills, *Geology, *Leaching, Infiltration, Waste disposal, Land disposal, Groundwater movement, Clay, Flooding, Path of pollutants, Monitoring, Trenches.

Geologic studies of a radioactive-waste landfill in northern Cattaraugus County, New York evaluated the feasibility of low-level radioactive waste disposal by shallow burial in glacial deposits of the humid northeastern United States. Major topics addressed on the studies included regional geology of glacial deposits, site stratigraphy and petrography, engineering and fluid properties of burial-host material measured in situ and in the laboratory, geomorphic processes, groundwater movement and chemistry, burial-trench dynamics in relation to atmospheric pressure and precipitation, surface-water flow, and biological paths for radionuclide movement. The 8-year series of studies has shown that, although remedial maintenance at the site is safe and necessary, the technique is safe and feasible if the waste is catalogued properly upon arrival and is compacted and buried in a manner that prevents later changes in waste volume and if

water is prevented from infiltrating the burial trench. (Geiger-PTT)
W86-05138

SIMULATION OF FLUID FLOW AND ENERGY TRANSPORT PROCESSES ASSOCIATED WITH HIGH-LEVEL RADIOACTIVE WASTE DISPOSAL IN UNSATURATED ALLUVIUM,

Geological Survey, Reston, VA.
D. W. Pollock.
Water Resources Research WRERAO, Vol. 22, No. 5, p 765-775, May 1986. 12 fig, 4 tab, 21 ref.

Descriptors: *Simulation analysis, *Fluid flow, *Energy transfer, *Radioactive waste disposal, *Alluvium, Unsaturated flow, Great Basin, Nevada, Path of pollutants, Groundwater pollution, Mathematical models, Permeability, Prediction.

A mathematical model accounting for the coupled transport of energy, water (vapor and liquid), and dry air was used to analyze one-dimensional, vertical transport above and below an areally extensive repository of the Great Basin. Numerical simulations were conducted for a hypothetical repository containing spent nuclear fuel and located 100 m below the land surface. Initial steady state downward water fluxes of zero (hydrostatic) and 0.0003 m/yr, were considered in an attempt to bracket the likely range in natural water flux. Predicted temperatures within the repository peaked after approximately 50 years and declined slowly thereafter in response to the decreasing intensity of the radioactive heat source. The alluvium near the repository experienced a cycle of drying and rewetting in both cases. The extent of the dry zone was strongly controlled by the mobility of liquid water near the repository under natural conditions. In the case of initial hydrostatic conditions, the dry zone extended approximately 10 m above and 15 m below the repository. For the case of a natural flux of 0.0003 m/yr, the relative permeability of water near the repository was initially more than 30 times the value under hydrostatic conditions, consequently the dry zone extended only about 2 m above and 5 m below the repository. In both cases a significant perturbation in liquid saturation levels persisted for several hundred years. This analysis illustrates the extreme sensitivity of model predictions to initial conditions and parameters, such as relative permeability and moisture characteristic curves, that are often poorly known. (Lantz-PTT)
W86-05223

LAND APPLICATION OF DOMESTIC WASTEWATER, WOOD PRODUCTION, AND SLUDGE COMPOSTING: AN INTEGRATED DESIGN,

Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W86-05293

AVAILABILITY OF APPLIED HEAVY METALS AS A FUNCTION OF TYPE OF SOIL MATERIAL AND METAL SOURCE,

Maryland Univ., College Park. Dept. of Agronomy.
R. F. Korcak, and D. S. Fanning.
Soil Science, Vol. 140, No. 1, p 23-34, July 1985. 2 fig, 7 tab, 23 ref.

Descriptors: *Sludge disposal, *Soil amendments, *Heavy metals, *Soil types, *Corn, Cadmium, Copper, Nickel, Zinc, Adsorption, Digested sludge, Land disposal, Plant tissues.

Cd, Cu, Ni, and Zn were applied as sulfate salts and digested sewage sludge to surface and subsurface horizon materials of six Maryland soils in the greenhouse. Metal levels were monitored in soil and corn grown for 30 days, 13 months after treatment application. Compared with limed and fertilized controls, yields of plant material were generally enhanced by sludge and suppressed by metal salts. Tissue levels of both Cd and Zn were considerably elevated, compared with the limed control, by both metal salts and sludge. Diethylenetriaminepentaacetic acid-extractable levels of metals were elevated by both metal salts and sludge, compared with limed controls. High-CEC soil materials and materials higher in Fe and Mn oxides generally gave lower diethylenetriaminepentaacetic acid-extractable metal values with both metal salts and sludge and the lowest levels of tissue metals with metal salt treatment. An interaction between type of soil material and source of metal on plant tissue metal levels was observed. Inert soil materials tended to produce tissue with the highest metal levels when metal-salt-treated, but with the lowest metal levels when sludged. Conversely, reactive soil materials tended to produce tissue with relatively lower levels of metals than other materials when metal-salt-treated, but with relatively high levels when sludged. (Geiger-PTT)
W86-05299

EVIDENCE FOR MOVEMENT OF HEAVY METALS IN A SOIL IRRIGATED WITH UNTREATED WASTEWATER,

Chile Univ., Santiago. Dept. of Analytical Chemistry.
T. Schirado, I. Vergara, E. B. Schalscha, and P. F. Pratt.
Journal of Environmental Quality, Vol. 15, No. 1, p 9-12, January-March 1986. 7 tab, 20 ref.

Descriptors: *Wastewater disposal, *Leaching, *Heavy metals, *Wastewater irrigation, *Fate of pollutants, *Arid lands, *Soil profiles, Cadmium, Cobalt, Chromium, Copper, Manganese, Zinc, Path of pollutants.

This paper presents data for heavy metals in a soil located in an arid area that had been irrigated exclusively with untreated municipal sewage for over 50 yr along with indirect evidence of the downward movement of these metals. A Vertisol irrigated for over five decades with an untreated municipal wastewater had elevated levels of diethylenetriaminepentaacetic acid extractable Cd, Co, Cu, Mn, Ni, and Zn in the cultivated layer of the soil as compared to lower layers. Total Co, Ni, and Zn were uniformly distributed in the 150-cm depth of the soil profile while Cu increased with depth. Total Cd, Cr and Mn had higher concentrations in the cultivated layer than in some deeper layers. Assuming that the added metals had accumulated in the cultivated layer of the soil and assuming uniform distributions of metals in the soil profile at the start of irrigation with wastewater, the amounts of metal added would have produced increased concentrations in the cultivated layer. Except for Mn, these expected differences were not found. These results suggest that the metals Cd, Co, Cr, Cu, Ni, and Zn may have migrated downward from the cultivated layer and are now distributed throughout the soil profile or leached below the depth of sampling. (Geiger-PTT)
W86-05322

SEWAGE SLUDGE AS A COAL MINE SPOIL AMENDMENT FOR REVEGETATION IN COLORADO,

Colorado State Univ., Fort Collins. Dept. of Agronomy.
K. F. Topper, and B. R. Sabey.
Descriptors: *Soil amendments, *Land disposal, *Municipal wastes, *Sludge Revegetation, Coal mines, Land reclamation.

Descriptors: Revegetation, Coal mines, Land reclamation.

Use of digested municipal sewage sludge as an amendment for revegetation of a Colorado coal mine spoil was evaluated as a function of application rate. Plant growth responses to sewage sludge additions were compared to inorganic nitrogen (N) and phosphorus (P) fertilizer treatments on a grass pasture mixture. Sewage sludge additions resulted in significant increases in aboveground biomass and percent canopy cover over the control for two seasons of growth following sludge application. Sewage sludge rates 83 mg/ha yielded greater plant growth than any of the inorganic N and P fertilizer treatments for both growing seasons. However, the lowest level of sewage sludge (14 mg/ha) resulted in equivalent total N and total P concentrations of the seeded grasses when compared to the highest inorganic fertilizer treatments. The superior growth associated with sewage sludge additions at less than 83 mg/ha was due to measured increases in nutrient availability, improved physical condition of the spoil and a possible stimulation of microbial activity. The highest level of sewage sludge (83 mg/ha) was detrimental to seeded grass growth when compared to the lower sludge rates in 1984. This may have been due to increased soluble salt concentrations, an increase in competition by invading annual forbs, and/or elemental toxicities. Further research is necessary to determine the exact causes. (Author's abstract)
W86-05323

SAFE USE OF THE ASSIMILATIVE CAPACITY OF THE MARINE ENVIRONMENT FOR WASTE DISPOSAL - IS IT FEASIBLE.

Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
For primary bibliographic entry see Field 5G.
W86-05376

EFFECTS OF FERTILIZER, PIG MANURE, AND SEWAGE SLUDGE ON TIMOTHY AND SOILS,

Nova Scotia Agricultural Coll., Truro.
P. R. Warman.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 95-100, April-June 1986. 9 tab, 32 ref.

Descriptors: *Fertilizers, *Manure, *Wastewater disposal, *Timothy, Soil organic matter, Soil fertility, Wastewater treatment, Sludge, Plant tissue, Tissue analysis, Grasses, Agricultural chemicals, Quebec, Soil amendments.

Research determined the effect of fertilizer, sewage sludge and pig (Sus scrofa domesticus) manure on timothy (Phleum pratense L.) yield, tissue composition, and soil fertility from 1979 to 1982. Field plots in Quebec on sandy loam and clay loam soils compared no fertilizer with annual applications (1979-1981) of two rates of fertilizer (F1, F2 = 110-50-85, 220-50-85 kg/ha N-P2O5-K2O), pig manure (PM1, PM2 = 75 150 wet mg/ha) or aerobically digested sewage sludge (SS1, SS2 = 150 300 wet Mg/ha). The F2, PM2, and SS2 amendments produced similar yields and plant uptake of nutrients all 3 years. Although nutrient uptake by timothy was generally higher on the clay loam, due to higher soil fertility and less leaching losses, the percent recovery of the applied nutrients (excluding N and Mn) was similar at both sites. Based on the K:(Ca + Mg) content and regardless of the treatment applied, a potential grass tetany problem exists in the timothy grown in the clay loam. No metal contamination was found in the soil or timothy following the application of any amendment. Of 11 measured soil chemical properties, only four were influenced by the treatments on either soil. The PM2 treatment increased NO3(-)-N, Bray P sub 2 and extractable K. The SS2 treatment increased Bray P sub 2 and DTPA (diethylenetriaminepentaacetic acid) Cu. It is therefore recommended that the amendments be applied to the timothy at either of the two rates. (Lantz-PTT)
W86-05382

EVALUATION OF NITROGEN AVAILABILITY INDEXES FOR A SLUDGE COMPOST AMENDED SOIL,

Maryland Univ., College Park. Dept. of Agronomy.
B. E. O'Keefe, J. Axley, and J. J. Meisinger.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 121-128, April-June 1986. 2 fig, 7 tab, 22 ref.

Descriptors: *Nitrogen, *Nutrient availability, *Sludge, *Compost, *Wastewater farming, Land disposal, Silt, Loam, Beltsville, Maryland, Corn plants, Chemical analysis, Biological analysis, Regression analysis, Statistical analysis.

Several N availability methods were evaluated on a sludge amended soil, since sludge applications are

usually based on N availability and a soil N evaluation to optimize loading rates. Yearly amendments of composted, lime-stabilized, raw sludge were applied, at 0, 56, 112, and 224 mg/ha, to an Elkton silt loam soil (Typic Ochraquults), in Beltsville, MD, as follows: whole plots (1975-1977), half plots (1978), and no plots (1979-1981). In 1978 and 1981, surface and subsurface soil samples were collected, and maize (Zea mays L.) total N uptake was determined. The biological method (total nitrogen mineralization (NT)) of assessing soil N availability revealed an initial rapid mineralization phase (NE) over the first 28 weeks and a constant phase thereafter. The chemical methods were total soil N (TN), acid KMnO4 oxidizable N (P), autoclave extractable N (A), and 2 M KCl extractable NH4(+)-N (K). Curvilinear regression analyses, relating maize N uptake to these N indexes, gave the following R2 values: NE, 0.93; NT, 0.94; TN, 0.93; P, 0.92; A, 0.95; and K, 0.92. All methods were equally sensitive on sludge treated soils, but the incubation procedure was best on untreated soil. Including second zone soil N, and expressing the results on a root-zone volume basis, improved N uptake predictions with unfertilized controls, but was unnecessary for sludge treated plots. These results indicate that chemical N availability indexes can be used to assess soil N availability on sludge treated land, provided they are calibrated to local soil-crop-climate conditions. (Lantz-PTT)
W86-05386

PREDICTION OF AVAILABLE ZINC IN SEWAGE SLUDGE-AMENDED SOILS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
B. D. Rappaport, D. C. Martens, T. W. Simpson, and R. B. Reneau, Jr.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 133-136, April-June 1986. 3 tab, 31 ref.

Descriptors: *Zinc, *Nutrient availability, *Sludge, *Wastewater farming, Virginia, Corn plants, Diethylenetriaminepentaacetic acid, Regression analysis, Soil chemistry, Land disposal, Statistical analysis, Soil amendment.

A routine soil test would be helpful for the management of agricultural soils amended with sewage sludge high in Zn. Fourteen field sites were selected in the Coastal Plain, Piedmont, and Ridge and Valley regions of Virginia to evaluate the suitability of dilute HCl-H2SO4 and DTPA (diethylenetriaminepentaacetic acid) soil extractants for predicting Zn uptake by corn (Zea mays L.). Soil and corn tissue samples were collected from these sites where sewage sludge has been applied previously. Multiple regression analysis was used to assess the forms of soil Zn extracted by dilute HCl-H2SO4 and DTPA. The exchangeable and specifically sorbed, organically bound and noncrystalline hydroxide and oxide bound Zn fractions were tested to develop the equations. Dilute HCl-H2SO4 extracts were related to the three Zn fractions (R2 = 0.98), whereas organically bound Zn was the only Zn fraction related to DTPA-extractable Zn (r = 0.96). Earleaf Zn concentration correlated more closely with DTPA-extractable Zn (r = 0.64) than with dilute HCl-H2SO4-extractable Zn (r = 0.35). The earleaf Zn concentration was studied as a function of either DTPA- or dilute HCl-H2SO4-extractable Zn, exchangeable and specifically sorbed Zn, organically bound Zn, and noncrystalline hydroxide and oxide bound Zn. Inclusion of the above fractions in a multiple regression analysis did not improve the relationship between earleaf Zn concentration and dilute HCl-H2SO4-extractable Zn. A coefficient of multiple determination (R = 0.77) was obtained between earleaf Zn concentration and a two variable regression equation comprised of DTPA-extractable Zn and organically bound Zn. The negative regression coefficient for organically bound Zn indicated that a portion of this fraction, which was extracted by the DTPA, did not supply Zn to corn plants. (Lantz-PTT)
W86-05387

POTASSIUM LOSSES IN RUNOFF AND DRAINAGE WATERS FROM CROPPED, LARGE-SCALE LYSIMETERS,

Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-05388

MINERALIZATION OF NITROGEN IN SOILS AMENDED WITH ORGANIC WASTES,

Iowa State Univ., Ames. Dept. of Agronomy.
Y. M. Chae, and M. A. Tabatabai.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 193-198, April-June 1986. 3 fig, 7 tab, 30 ref.

Descriptors: *Nitrogen, *Mineralization, *Sludge disposal, *Soil amendments, *Organic wastes, Manure, Sludge, Leaching, Leachates, Wastewater farming, Soil types, Corn, Alfalfa, Soybeans.

This study was conducted to compare the mineralization of N in soils amended with various sewage sludges, animal manures, and plant materials. In this work, field-moist soils amended with organic waste materials at a rate of 50 mg/ha were mixed with glass beads, packed in leaching columns, leached with 5 mM CaCl2 to remove the mineral N, and incubated at 30 C. The leaching procedure was repeated every 2 weeks for 26 weeks, and the leachates were analyzed for NO3(-)-N. With the exception of alfalfa (Medicago sativa L.), mineralization of N exhibited a slow initial rate, which was indicative of a lag period, followed by a rapid increase in rate, and subsequent slow rate of N release. The total N mineralized from the organic waste materials varied considerably, depending on the type of soil and organic waste material. The total N mineralized in five unamended soils ranged from 91 mg N/kg with Lester soil, to 337 mg N/kg with Webster soil. The amounts of N mineralized in soils amended with sewage sludges and animal manures ranged from 156 to 668 mg N/kg soil and from 176 to 617 mg N/kg soil, respectively. The total N mineralized in soils amended with plant materials ranged from 0 in 3 soils amended with sawdust to 983 mg N/kg for Webster soil amended with alfalfa. Expressed as a percentage of total organic N added to soils, the N mineralized ranged from 1 to 58% for sewage sludges and from 13 to 67% for animal manures. The percentage of organic N mineralized in plant materials ranged from 3% for soybeans to 97% for alfalfa. Addition of corn residue or sawdust resulted in decreases in N mineralization ranging from 3 to 687%. Soil types have marked effects on the mineralizable N pools and first order rate constants. (Lantz-PTT)
W86-05391

WASTE-WATER INJECTION: GEOCHEMICAL AND BIOGEOCHEMICAL CLOGGING PROCESSES,

San Jose State Univ., CA.
J. A. Oberdorfer, and F. L. Peterson.
Ground Water GRWAAP, Vol. 23, No. 6, p 753-761, November-December 1985. 6 fig, 18 ref.

Descriptors: *Injectin wells, *Well hydraulics, *Clogging, Municipal wastewater, Bacteria, Denitrification, Underground waste disposal, Nitrogen, Organic compounds, Hawaii.

Examination of near-well clogging processes at two experimental injection sites in Hawaii (Waimanalo and PaalaaKai wastewater treatment plants, Oahu) showed that filtration of suspended solids is not a long-term cause of clogging. Particulate filtration is probably a short-term cause of clogging at the start-up of injection, the injection organics are biodegraded once the microbial biomass becomes established. The injection head gradient determined from monitoring wells shows that most of the initial head loss is immediately adjacent to the well, but that after several weeks it shifts to a region > 0.5 to 1 m from the well. Denitrifying bacteria become sufficiently numerous to produce significant amounts of nitrogen gas, which in turn produces a gas-bound zone about 0.5 to 1 m from the well. With continued injection, the nitrogen gas-bound zone slowly extends farther out into the injection stratum. Dissolutin of the carbonate aquifer (carbonate sand, coral and recemented reef rubble) also occurs, but its effects are partially masked by gas binding. (Author's abstract)
W86-05402

ALKYLATE SLUDGE REUSE POTENTIAL,

Fluor Technology, Inc., Irvine, CA.
J. E. Cotter.
Environmental Progress, Vol. 4, No. 3, p 165-167, 4 fig, 2 tab, 3 ref.

Descriptors: *Sludge disposal, *Chemical sludge, *Sludge utilization.

In alkylation units of oil refineries, the primary waste stream is produced as a bottom draw from the acid regenerator. The waste stream is a sludge made of acid soluble oils (ASO), and water, tars, and traces of other components. A detailed discussion of the pros and cons of alternative reuse possibilities is given. The quantities of ASO and polymer that are generated, per unit of production, vary considerably from one alkylate sludge are given. One is to use ASO and polymer wastes as fuel. Another approach is to take advantage of hydrocarbon content by reintroducing the waste in the refinery product stream. The various options include reuse as a refinery fuel, recycle to refinery fuels, incineration without heat recovery, neutralization and disposal, and disposal without treatment. The technical, environmental and cost considerations of each options are discussed. It is concluded that the cost of pretreatment will pay out in a few years, by avoiding the damage to the alkylation equipment that would otherwise occur. (Master-PTT)
W86-05406

5F. Water Treatment and Quality Alteration

CONTROLLING TASTE AND ODOR WITH CHLORINE DIOXIDE,

Galveston County Water Authority, TX. Surface Water Treatment Plant.
G. L. Myers, and A. L. Thompson.
Southwest and Texas Water Works Journal, Vol. 67, No. 12, p 4-6, 10.

Descriptors: *Taste, *Odor control, *Chlorine dioxide, *Algicide, Galveston, Texas, Ozone, Potassium permanganate, Chlorine, Activated carbon, Powdered carbon, Granular carbon, Trihalomethane, Ammonia, Chlorite, Disinfectant, Oxidant, Chlorination, Water treatment facilities, Hydrogen ion concentration.

The Galveston (Texas) County Water Authority has tried several water treatment methods to provide satisfactory disinfection while avoiding the trihalomethane and ammonia problems associated with free chlorination and chloramination, respectively. Chlorine dioxide was selected as the most likely to meet these requirements, but initial attempts at its employment produced unsatisfactory results. Later, after studies of methods of chlorine dioxide generation and chlorine dioxide and chlorite residual measurements, new equipment was selected and another attempt to use this disinfectant was made. Chlorine dioxide has proven to be an effective, reliable method of preoxidation. It has been a highly effective algicide and taste and odor reducing agent. Its disinfection ability is not changed or diminished by changes in pH. These factors as well as the ability of the proper chlorine dioxide generator to produce high purity chlorine dioxide and chlorine dioxide having a longer-lasting residual than chlorine, suggest this substance as an excellent post-disinfectant as well as an excellent pre-oxidant. (Rochester-PTT)
W86-04733

WATER IS THE KEY TO MUNICIPAL GROWTH,

Scepter Mfg. Co. Ltd., Scarsborough (Ontario).
For primary bibliographic entry see Field 6D.
W86-04734

USING A FILTER TO REMOVE GIARDIA CYSTS,

Oregon State Parks and Recreation Branch, Salem.

J. E. Hollingsworth, R. E. Holt, and W. Hults.
Public Works, Vol. 117, No. 3, p 74-75, March 1986.

Descriptors: *Giardia cysts, *Filtration, *Spring water, *Oregon, Turbidity, Small-scale systems, Water treatment.

Water from a natural spring at the Van Duzer Forest Corridor State Wayside, Lincoln County, Oregon, is filtered by using a 12-in diameter plate and frame industrial style filter. In addition to removing Giardia cysts, the 1 micrometer filtration removed small animal and miscellaneous detritus. The treatment equipment uses 30 discs, and all contact parts are stainless steel. It has performed successfully for 6 yr with a vigorous maintenance program. Filter media are changed whenever turbidity (checked daily) reaches 1.0 NTU. The process of changing filters and cleaning the equipment and other media available for this type of filter are described. The authors suggest that this type of filtration would be very useful in other parks, small water districts, and municipalities, and other places where high-quality but relatively inexpensive water is required. (Rochester-PTT)
W86-04735

RIVER DEE SCHEME AND INTAKE PROTECTION SYSTEMS,

North West Water Authority, Warrington (England).
J. N. Rushbrooke, and F. Beaumont.
Institution of Water Engineers and Scientists, Journal, Vol. 40, No. 2, p 173-192, April 1986. 7 fig, 7 ref.

Descriptors: *River Dee, *Taste, *Monitoring, *Communications, *Intake protection, United Kingdom, Pollutants.

Improvements that have been made in the River Dee (United Kingdom) systems since a 1984 pollution incident involving chlorophenolic taste are described. The historical background of taste complaints, the River Dee working group, including the monitoring task group, communications task group, and communications, monitoring and training procedures, and intake protection stations (Mobile intake protection station, Huntington intake protection station, and permanent intake protection systems) are described. The systems developed since the 1984 phenol incident have ensured that no contaminated water has been delivered to the consumer. The installation and commissioning of the automatic and remote monitoring equipment, the provision of additional analytical facilities, the improvements to communications, and cooperative efforts proved successful in dealing with pollution incidents in early 1985. (Rochester-PTT)
W86-04752

CROSS SOLENT WATERMAIN,

Southern Water Authority, St. Leonards (England).
F. N. Midmer.
Institution of Water Engineers and Scientists, Journal, Vol. 40, No. 2, p 193-200, April 1986. 3 fig, 10 ref.

Descriptors: *Water mains, *Isle of Wight, *Peak demand, Seasonal variation, Cost analysis, United Kingdom, Cross Solent Watermain, Construction, Feasibility studies.

The Solent crossing watermain was intended to relieve a problem of water shortages on the Isle of Wight, United Kingdom. The project included studies of feasibility, design characteristics, construction, cost, performance, and upgrading. The original Cross Solent supply was completed in 1980, with a capacity of 10 million liter/day, and at a cost of 2,530,000 pounds Sterling, 12.5% above the original project estimate of November 1978. For two years the line was used for base supply of 5 million liter/day in winter and peak supply of 10 million liter/day in summer. In 1982/1983 an additional 100,000 pounds Sterling was expended for pumping equipment to allow temporary increases of flow up to 15 million liter/day to meet peak demands. (Rochester-PTT)
W86-04753

INFORMATIONAL/EDUCATIONAL APPROACHES TO PUBLIC ATTITUDES ON POTABLE REUSE OF WASTEWATER,

Denver Research Inst., CO.
For primary bibliographic entry see Field 5D.
W86-04827

DRINKING WATER COST EQUATIONS,

Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
P. Dorsey, and R. M. Clark.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-181826, Price codes: A09 in paper, A01 in microfiche. Report EPA-600/2-82-055, December 1982. 147 p, 6 fig, 14 tab, 8 ref, 2 append.

Descriptors: *Drinking water, *Cost analysis, *Economic evaluation, *Water treatment, Economic aspects, Statistical analysis.

This report presents capital, and operating and maintenance cost equations for 99 water treatment unit processes. The equations, derived from a cost data base developed from the Drinking Water Research Division can be used to provide preliminary cost estimates from individual unit processes or for entire trains. Methodology used for deriving the equations, an explanation as to how the equations were developed, equation testing, possible uses, and examples of their application are presented in this report. A computer program has been developed to encourage use of these equations. (Author's abstract)
W86-04942

USES OF OZONE IN WATER TREATMENT – A REVIEW,

Water Research Centre, Stevenage (England).
R. A. Hyde, and T. F. Zabel.
Effluent and Water Treatment Journal, Vol. 26, No. 3/4, p 121-125, March/April 1986. 1 tab, 4 fig, 10 ref.

Descriptors: *Water treatment, *Ozone, *Potable water, Disinfection, Taste, Color, Organics, Iron, Manganese, Turbidity, Algae.

The uses of ozone in water treatment are reviewed. In general an ozone plant consists of a gas preparation plant, an ozone generator, an ozone-water contacting stage and an ozone off-gas destruction device. The gas required for the production of ozone must have a very low humidity because moisture in the feed gas reduces the amount of ozone produced per unit power input and increases maintenance costs. The gas should also be oil free. An ozone generator element consists of two electrodes separated by an air space and a glass dielectric layer. An efficient cooling system must be provided to minimize decomposition of the ozone, to achieve maximum efficiency to the ozonizer and to prevent damage to the dielectric. For the ozone to be effective it must be dissolved in the water and sufficient contact time (5 to 10 min) must be allowed for the ozone to react. Ozone is a powerful oxidant and it can be applied for many different treatment problems: disinfection, taste and odor control, color removal, organic removal, iron and manganese removal, algal removal, and turbidity removal. To avoid problems in distribution it is important that the ozone is applied at the correct stage in the treatment process. The benefits and costs of ozone must be compared with those of alternative oxidants or processes. (Peters-PTT)
W86-04955

WATER AND WASTEWATER TIME TO AUTOMATE,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
For primary bibliographic entry see Field 5G.
W86-04958

REACTIVITY OF NITROGENOUS AND OTHER ORGANIC COMPOUNDS WITH AQUEOUS CHLORINE,

Environmental Protection Agency, Cincinnati, OH. Microbiological Treatment Branch.
E. L. Katz.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 5, p 715-722, May 1986. 1 tab, 21 ref.

Descriptors: *Chlorine, *Organic compounds, *Water treatment, Amino acids, Phenoxy acid, Pyridine, Amides, Amines, Phenols, Aliphatic hydrocarbons, Aromatic compounds, Pesticides, Chlorinated hydrocarbons.

A protocol is proposed for the testing and systematic classification of organic compounds (phenolics, chlorinated hydrocarbons/pesticides, amides, quinolines, imides, pyrimidines, aliphatics, indoles, sugars, amines, pyrrole compounds, amino acids, polynuclear aromatics, pyridines) as to their reactivity to chlorine. The ratios and concentrations are such that could be expected to occur in water treatment. By use of the generalizations formulated, some predictions as to reactions of organics in the chlorination process can be derived. In 90% of the cases studied, there were no, or only slight, effects of pH on Cl concentrations in the establishment of reactivity categories. Amino acids, phenolics, organic sulfur compounds, pyrroles, prolines and indoles were very reactive. Xanthines varied depending upon other functional groupings in the structure. Other compounds tested showed little or no reactivity in these tests. An important thrust of this study is that the compounds tested can serve as models for treatability problems that may confront utilities. (Peters-PTT)
W86-04960

SHORTAGE OF WATER FLUORIDATION CHEMICALS DEVELOPING,

D. Webber.
Chemical and Engineering News CENEAR, Vol. 64, No. 7, p 20-21, February 17, 1986. 1 fig.

Descriptors: *Fluoridation, *Municipal water, *Water treatment, *Chemical shortage, Hydrofluosilicic acid, Sodium silicofluoride, Sodium fluoride, Tooth decay, Phosphoric acid, Fertilizer, Farm crisis, Economics, Policy making.

Municipal programs to treat tooth decay through fluoridation of water are suffering due to a shortage of fluoridation chemicals. This problem has developed as a consequence of the farm crisis, because the three major fluoridation compounds, hydrofluosilicic acid (HFSA), sodium silicofluoride, and sodium fluoride, are made largely as byproducts of phosphoric acid production for fertilizer. Because of excess fertilizer inventories, production has been essentially halted. Total capacity is more than adequate to supply all other HFSA needed in the United States, both for municipal water systems and the aluminum industry, the other major consumer. The problem is not total supply but periodic gaps in production coupled with a lack of storage capacity. In addition to causing problems for communities already fluoridating their water, the periodic shortages sometimes give communities where fluoridation is a controversial issue an excuse to drop fluoridation entirely. (Rochester-PTT)
W86-04976

ESTIMATING RISK TO HUMAN HEALTH,

Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5B.
W86-04977

VIRUSES IN DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH.
G. Bitton, S. R. Farrah, C. L. Montague, and E. W. Akin.
Environmental Science and Technology ESTHAG, Vol. 20, No. 3, p 216-222, March 1986. 84 ref. EPA Contract Agreement 68-03-3196.

Descriptors: *Viruses, *Drinking water, *Standards, *Water treatment, Water softening, Charged filters, Microorganisms, Coagulation, Sand filters, Epidemiology, Aluminum salts, Iron salts, Cationic polyelectrolytes, Chemical flocculation, Lime, Soda ash, Cost analysis.

Available literature on the monitoring in drinking water is reviewed and detection methods indicators, the effects of water treatment processes on virus removal, and the epidemiological significance of viruses in drinking water are discussed. Viruses in drinking water are rare in developed countries where water is treated adequately, but are found in unchlorinated water that is consumed without treatment. To detect viruses, relatively large amounts of water (100 liters or more) need to be concentrated. The most commonly used procedure is based on the adsorption of viruses to negatively charged filters (Balston, Cox, or Filterite) or to positively charged filters (Zeta+ and Virosorb 1-MDS). There have been numerous debates concerning the usefulness of certain microorganisms as indicators of viral presence. The presence of surrogates often indicates the presence of viruses, but their absence does not ensure the absence of viruses. Coagulation with aluminum and iron salts, if properly conducted, can achieve >99% removal of viruses. The efficiency of the coagulation-sedimentation processes can be improved by the addition of coagulant aids such as cationic polyelectrolytes. Slow sand filtration is more effective than rapid sand filtration. The efficiency of rapid sand filtration can be improved when filtration is preceded by chemical flocculation. In water-softening plants, the lime-soda ash process achieves better than 99.9% virus removal. It is too soon to establish standards for viruses in drinking water, and the cost involved in implementing such standards would override any potential benefits. (Rochester-PTT)
W86-04978

ADSORPTION OF ORGANIC POLLUTANTS ON MONTMORILLONITE TREATED WITH AMINES,

Iowa State Univ., Ames. Dept. of Civil Engineering.
T. A. Wolfe, T. Demirel, and E. R. Baumann.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 68-76, January 1986. 4 fig, 5 tab, 24 ref.

Descriptors: *Clays, *Adsorbents, *Organic compounds, *Montmorillonite, *Bentonite, *Sedimentation basins, *Priority pollutants, *Water treatment, *Wastewater treatment, X-ray diffraction, Thermal analysis, Thermogravimetric analysis, Infrared spectroscopy, Scanning electron microscopy, Adsorption isotherms.

X-ray diffraction analysis, differential thermal and thermogravimetric analyses, infrared spectroscopy, and scanning electron microscopy were used to determine the initial interactions between montmorillonite and the three alkylammonium salts. Adsorption isotherms were performed with these alkylammonium montmorillonites and aqueous solutions of 11 organic pollutants representing various chemical classes of priority pollutants. Four major categories of procedures were performed: (1) separation of the sodium montmorillonite clay fraction from Wyoming bentonite by centrifugation; (2) exchanged of the sodium ions in montmorillonite with hydrochloride salts of three amines; (3) x-ray diffraction studies of the interactions between aqueous mixtures of the organic pollutants and alkylammonium bentonites over a wide concentration range; and (4) determination of adsorption isotherms for the organic pollutants. It is suggested that, in practice, alkylammonium clays could be added to a sedimentation basin, kept in suspension for a period sufficient to permit adsorption to occur, and then settle from solution. Propylammonium montmorillonite was the best adsorbent, at low organic concentrations, whereas dodecylammonium bentonite was able to intercalate the pollutants the best at higher organic concentrations. There seems to be promise for the use of clays (especially smectites) as adsorbents in water and wastewater treatment. (Rochester-PTT)
W86-05022

EFFECTS OF NON-IDEAL COMPETITION ON MULTI-COMPONENT ADSORPTION EQUILIBRIA,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
D. R. Yonge, and T. M. Keinath.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 77-81, January 1986. 3 fig, 5 tab, 25 ref.

Descriptors: *Adsorption isotherms, *Adsorption equilibria, *Activated carbon, *Water treatment, *Wastewater treatment, Mathematical models, Phenols, O-cresol, Feundlich equation, Static bottle test procedure.

Single-solute adsorption isotherms were developed using the static bottle test procedure for the following sorbates: phenol, 2-ethylphenol, o-cresol, o-methoxyphenol, and 4-isopropylphenol. To obtain information on non-ideal competition for adsorption sites, solutions containing pairs of sorbates with equilibrated with granular activated carbon in continuous-flow columns. The simultaneous sorbate addition data indicate that significant improvements in model predictability result from the addition of a competition factor to the simplified ideal adsorbed solution model. A term associated with the low solubility (eta sub 1) of a sorbate pair was not significant. Conversely, the term associated with the higher solubility sorbate (eta sub 2) resulted in a significant improvement in data description. This was accomplished by decreasing the value of K (Freundlich equation constant) associated with this sorbate and thereby decreasing its predicted degree of competitiveness. Competition factor values corresponded reasonably well with a solubility parameter for this as well as other data, making the model reasonably predictive. (Rochester-PTT)
W86-05023

MONITORING SEBAGO LAKE WATER QUALITY BELOW THE THERMOCLINE,

Portland Water District, ME.
R. P. Grady, and P. G. Boissonneault.
Journal of the New England Water Works Association, Vol. 100, No. 1, p 44-67, March 1986. 12 fig, 1 tab.

Descriptors: *Thermocline, *Sebago Lake, *Maine, *Water quality management, *Algae, *Aesthetics, *Diatoms, Intake depth, Temperature, Turbidity, Bacteria, Drinking water, Cost analysis, Hydrogen ion concentration, Physical properties, Biological properties.

A four-season study has shown that water taken from a point 85 ft deep in Sebago Lake, Maine, differs in many ways from water taken from a point 25 ft deep. These differences were primarily related to physical and biological factors, including temperature, turbidity, pH, algae counts, bacterial counts, and silting index. Chemical differences were important only in relationship to the physical and biological changes they effect. The differences measured indicated that the deep water is more desirable as a drinking water source and is likely to remain so for a long time. Aesthetic problems that have occurred with the present shallow-water source are unlikely to occur with the use of deep water. The severe aesthetic problems resulting from diatom agglomeration have never occurred when algae count numbers are at the levels found in deep water. Changing the depth of the intake appears to be desirable, and would have the same value even if more extensive treatment were required in the future. At present, this action permits a significant upgrading of water quality at a fraction of the capital cost of treatment processes, while avoiding any operating cost and incurring a very minor maintenance cost. (Rochester-PTT)
W86-05027

BIODEGRADABILITY AND GAC ADSORBABILITY OF MICROPOLLUTANTS BY PREOZONATION,

Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
I. Somiya, H. Yamada, E. Nozawa, and M. Mohri.
Ozone, Vol. 8, No. 1, p 11-26, 1986. 1 tab, 15 fig.

Descriptors: *Water treatment, *Biodegradation, *Ozone, *Humic acids, *Activated carbon, Micropollutants, Equilibrium concentration, Filters, Activated sludge.

The biodegradability and GAC adsorbability of two ozonated humic acids are discussed based on the data obtained by two kinds of experiments. The biological activated carbon (BAC) performance and the characteristics of removal mechanisms on BAC were analyzed. In batch test, the biodegradability of humic acid was improved remarkably by preozonation, but the equilibrium adsorption constant k, at equilibrium concentration c sub e = 1.0 mg/liter was not effectively improved. Some organics which are hard to adsorb on granulated activated carbon (GAC) seem to be produced. The decomposition rates of ozonated humic acid were measured by respirometers. The rate constant for microbes inoculated on GAC are in the same order as those of activated sludge. When microbes can utilize both adsorbed and soluble substrates simultaneously, the oxygen consumption is raised at the beginning of the reaction time by a few times the rate constants calculated from the data on each substrate. In continuous tests on BAC and GAC filters, the breakthrough time was distinctly prolonged on the BAC filter compared to the GAC filter, and also by preozonation. The adsorbability of ozonated humic acid on GAC is expressed by the overall transfer coefficient k sub L a, which is improved by preozonation. The value of k sub L a on BAC is estimated to be twice or three times that on GAC with respect to the sample at the same ozonation intensity. (Peters-PTT)
W86-05040

OZONIZATION OF HUMIC ACIDS. MEDIUM TERM TOXICITY TOWARDS DAPHNIA MAGNA,

Lille-2 Univ. (France). Unit of Pharmacy.
For primary bibliographic entry see Field 5C.
W86-05041

NEW YORK CITY'S OZONE DEMONSTRATION PLANT DESIGN,

Hazen and Sawyer, New York.
A. J. Varas.
Ozone, Vol 8, No. 1, p 49-62, 1986. 6 fig, 1 ref.

Descriptors: *Ozone, *New York, *Water treatment, Jerome Park Reservoir, Water quality, Turbidity, Iron, Manganese, Ozonation, Filtration.

Design and construction specifications of a 3 mgd (12,187 cu m/day) demonstration plant to treat water by ozonation followed by diatomaceous earth (DE) filtration at New York City's Jerome Park Reservoir are described. Population growth and changes in land use on the Croton watershed have contributed to a deterioration of the quality of Croton water. As a result, New York City and State health agencies have agreed upon the need for a water treatment plant for this, the oldest New York City supply. The primary treatment objectives are to maintain a treated water quality of turbidity below 0.2 NTU, color below 3 color units, and iron and manganese below 0.3 mg/liter. Three process trains will be employed, each operating at a maximum of 1 mgd (3,786 cu m/day), to test various modifications of the ozone/DE process. The demonstration plant is scheduled to operate approximately one year, beginning in April 1986, to provide data for a full-scale plant to be constructed later in the decade. The average ozone requirements will be approximately 2,000 lbs/day (900 kg/day) with a probable installed capacity of 4,000 lbs/day (1,800 kg/day). (Peters-PTT)
W86-05042

BROMOFORM FORMATION IN OZONATED GROUNDWATER CONTAINING BROMIDE AND HUMIC SUBSTANCES,

Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, G. L. Amy, C. A. Moore, and R. G. Zika.
Ozone, Vol. 8, No. 1, p 63-76, 1986. 1 tab, 6 fig, 7 ref.

Descriptors: *Water treatment, *Groundwater, *Humic acids, *Ozone, Bromoform, Bromide, Water treatment, Biscayne aquifer, Hydrogen ion concentrations, Halogens.

The effects of organic carbon concentration, bromide ion concentration, pH, and solar irradiation on the formation of bromoform in ozonated waters derived from four unique samples taken from different regions of the Biscayne Aquifer are presented. This groundwater system serves as the principal source of drinking water in south Florida, and contains high levels of aquatic humic substances (DOC 5 to 20 mg/liter) and moderate levels of bromide ion (150-250 micrograms/liter). Increases in bromide ion concentrations resulted in increases in bromoform formation. In 3 of the 4 samples, bromoform formation decreased as the pH level increased from 5 to 9. The fourth sample exhibited an opposite trend, bromoform concentration increased with increasing 03 concentration over an ozone dosage range of 3.4 to 6.7 mg/liter. Ozonated samples placed in sunlight immediately after ozone addition showed a decrease in the formation of bromoform, presumably due to the photodecomposition of HOBr/OBr(3). This research has important implications for water treatment practice. The ozonation of waters containing bromide ion and humic substances can lead to the formation of trihalomethanes in the form of bromoform. Although it is unlikely that the current EPA maximum contaminant level of 100 microgram/liter will be exceeded, bromoform levels of 10 to 20 microgram/liter may be formed under some water treatment conditions. (Peters-PTT)
W86-05043

OZONATION AT THE 900 CFS LOS ANGELES WATER PURIFICATION PLANT,

Camp, Dresser and McKee, Inc., Boston, MA.
P. W. Prendiville.
Ozone, Vol. 8, No. 1, p 77-93, 1986. 10 fig, 6 ref.

Descriptors: *Water treatment, *Ozone, *Los Angeles, California, Safe Drinking Water Act, Turbidity, Owens River, Aqueducts, Trihalomethanes, Microflocculation, Ozonation, Chlorination.

In 1979, the California Safe Drinking Water Act established a new turbidity limit of 0.5 turbidity unit for drinking waters. The Los Angeles Department of Water and Power (LADWP) began a series of studies to determine the most effective and economical method of bringing Owens River Aqueduct water into compliance with the new standards. The LADWP selected the joint venture of Brown and Caldwell and Camp Dresser & McKee in 1980 to conduct additional pilot plant tests, design the filtration plant, and provide consulting services during construction and initial operation of the plant. To meet the new standard at the Owens River Aqueduct plant, a process involving preozonation and direct filtration was tested and selected. In addition to providing water which meets the required turbidity standard, the ozone process reduces trihalomethane levels by about 50%, allows filtration rates of 15 gpm/sq ft, reduces coagulation requirements, increases the removal of organics, thus reducing final chlorination requirements, reduces sludge quantities and subsequent sludge disposal costs, is a more effective bactericide and viricide than chlorine, and provides the most cost-effective reduction of levels of taste, odor, and color. The new Los Angeles water treatment plant is expected to be on-line in 1986. (Peters-PTT)
W86-05044

DISINFECTION FOR POTABLE REUSE,

Denver Water Dept., CO.
S. E. Rogers, and W. C. Lauer.
Journal of the Water Pollution Control Federation JWPFA, Vol. 58, No. 3, p 193-197, March 1986. 6 fig, 1 tab, 28 ref.

Descriptors: *Disinfection, *Water reuse, *Potable water, Denver, Multiple barrier design, Wastewater treatment, Public health, Municipal wastewater, Bioindicators, Enteroviruses, Lime, Ozone, Reversible osmosis, Chlorination, Drinking water.

A demonstration plant operated by the Denver, Colorado Water Department has produced water of lower bacterial count than potable water from first-use mountain run-off, demonstrating a large safety factor for public health protection in the direct reuse of secondary municipal wastewater. A t-test indicated that 6-month mean values were different at p=0.05 for both total coliforms and heterotrophic plate count. The plant uses a multiple barrier design to ensure that no single process is wholly responsible for the removal of any single contaminant. The treatment train consists of 12 major steps involving 21 interrelated unit processes including lime treatment, ozone, reverse osmosis, and chlorine dioxide disinfection. Bacterial indicator and coliphage levels were significantly lower in reuse product water than in Denver drinking water. Future studies will include the analysis of additional pathogenic organisms and enteric viruses. Projections show that, in the future, treatment of wastewater effluent to potable quality will become economically competitive with the development of new supplies. (Doria-PTT)
W86-05048

BLAST FURNACE RECYCLE WATER QUALITY AND REACTIONS OF LEAD AND ZINC,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. G. Luthy, E. R. Sable, and F. C. McMichael.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 250-260, March 1986. 9 fig, 6 tab, 46 ref. EPA Grant No. R809628.

Descriptors: *Recycling, *Wastewater treatment, *Water analysis, *Water quality control, *Zinc, *Lead, Industrial water, Equilibrium, *Water reuse, Chemical analysis, Model studies, Carbon dioxide, Chemical reactions, Solids.

The purpose of this investigation was to characterize blast furnace gas (BFG) recycle scrubber water to enhance the chemical knowledge of these systems. The work was directed toward understanding the water quality and equilibrium conditions in the recycle system, including lead and zinc solid-liquid partitioning and adsorption on suspended solids. Chemical modeling showed that CO2 chemistry in the recycle water fluctuates between that for a closed system in the scrubber and that for an open system in the cooling tower, and approaches equilibrium with atmospheric CO2 to a greater extent than equilibrium with CO2 in the BFG. This seemed to be a result of sparging and spraying, as well as the larger residence time associated with process units open to the atmosphere versus that for units closed to the atmosphere. Two chemical equilibrium modeling approaches were used to evaluate recycle water chemical speciation and degree of supersaturation with respect to various solids. Both approaches indicated that the recycle water was supersaturated with CaCO3(s), and this justified the need for an organic phosphonate antiscalant chemical treatment program. The solids in BFG recycle scrubber water were comprised of iron oxides, and lead and zinc were associated with the solid surface. Under acidic conditions lead and zinc were desorbed from the solid surface to approximately 50 and 230 mg/L, respectively, at 50 g/L solids. Metal desorption-adsorption studies with lead and zinc and solids at these same concentrations, showed characteristic pH-adsorption edges for these metals. The results showed that chemical modeling approaches can be used to describe some important chemical properties of these systems, which can lead to better operation for recycle and application of water treatment chemicals and to improved control of regulated constituents. (Lantz-PTT)
W86-05056

APPLICATION OF OZONE FOR WATER TREATMENT IN THE UNITED KINGDOM CURRENT PRACTICE AND RECENT RESEARCH,

Water Research Centre, Stevenage (England).
T. F. Zabel.
Ozone Science & Engineering, Vol. 7, No. 1, p 11-30, Winter 1985. 9 fig, 5 tab, 8 ref.

Descriptors: *Ozone, *Water treatment, *United Kingdom, *Ozonation, *Potable water, Treatment plants, Filtration, Activated carbon, Pretreatment of water, Organic carbon.

Although only two water works in the UK are currently using ozone treatment, concerns regarding trace organics in potable water have stimulated research into ozonation for enhancing organics removal on slow sand filters and by granular activated carbon. The most promising application for ozone seems to be in enhancing the performance of slow sand filters treating lowland surface waters. Pre-ozonation increased total organic carbon (TOC) removal by this system from 15% to 30%, and doubled the filter run length from about 50 to more than 100 days before the maximum head loss of 1 m was reached. Pre-ozonation provided relatively little enhancement in TOC removal on granular carbon independently, whether the carbon was operated after the slow sand filters or after conventional chemical treatment. Results are improved by increased empty bed contact time of the carbon and cessation of prechlorination. (Doria-PTT)
W86-05059

INFLUENCE OF WATER PREOZONATION ON THE CONSUMPTION OF OXIDANTS,

Societe Degremont, Rueil-Malmaison (France).
L. Brener, and Y. Richard.
Ozone Science & Engineering, Vol. 7, No. 2, p 137-154, Spring, 1985. 9 fig, 6 tab, 6 ref.

Descriptors: *Ozonation, *Ozone, *Oxidants, *Water treatment, Activated carbon, Chlorination, Pretreatment of water, Halomethanes, Organoleptic properties.

Some surface waters with high color or organic contents produce undesirable chlorinated derivatives when treated with chlorine. A pilot plant was set up to determine whether a treatment line combining clarification with preozonation followed by post-ozonation and filtration through activated carbon can produce a water having the same quality as that produced by an identical treatment line whose raw water has been prechlorinated. It was found that replacement of chlorine by ozone in preoxidation treatment would produce a water having a similar quality but without any halomethanes. Preozonation treatment also produced a decrease in the chlorine demand of the waters, and installation of a preozonation treatment will not lead to any excessive consumption of ozone. (Doria-PTT)
W86-05065

AUTOMATION OF A PLANT TREATING WATER WITH OZONE,

Societe Degremont, Rueil-Malmaison (France).
R. Louboutin.
Ozone Science & Engineering, Vol. 7, No. 2, p 155-165, Spring 1985. 7 fig, 5 ref.

Descriptors: *Ozone, *Automation, *Ozonation, Water treatment, Treatment plant design.

Total automation of a treatment plant in the city of Niort demonstrated how use of advanced automation techniques makes possible the optimization of investment and operating costs. Since total redundancy as regards both the ozone production plant itself and its automatic control system was not economically feasible, the plant was designed with two non-specialized ozone production lines and one single control unit. The chemical demand in oxidizing agent of the water is ensured in the first step of the process, and the viricidal action in a second step. Reliance on a single control unit is reasonable, since it may be considered the most reliable link of the whole treatment line because of the tremendous improvements brought by computerization. At the same time, detection and correction time of a failure in the programmable logic controller is so short that the constraint of operating the plant manually remains within totally reasonable limits. (Doria-PTT)
W86-05066

BENCH TESTING OF ON-LINE TOTAL RESIDUAL CHLORINE ANALYZERS,

Canviro Consultants Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 5A.
W86-05069

WATER AND NEPAL,

For primary bibliographic entry see Field 5C.
W86-05075

WATER RESOURCE AND SUPPLY DEVELOPMENT IN BRUNEI DARUSSALAM,

Watson Hawksley Asia, Brunei Darussalam.
R. G. Cole, and Y. A. Kamarulzaman.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 5, p 381-400, October 1985. 8 fig, 8 tab, 5 ref.

Descriptors: *Developing countries, *Brunei Darussalam, Water resources, *Water supply development, Well development, Resources development, Water conveyance, Groundwater potential, Saline water intrusion.

Infrastructure and building developments are rapidly expanding in Brunei Darussalam and additional water resource and supply schemes are needed. This paper describes existing and future water demands, the various resource and supply studies undertaken, and the development of urban and rural schemes. Particular reference is made to the vertical lift gate barrage across the River Belait and the Benutan reservoir for regulation of the Tutong. During 1977-1979, water resources studies were undertaken of (1) the hydrological aspects of the Tutong and Belait, (2) saline intrusion into the estuaries, including the develop,ment of a mathematical model to predict the circumstances under which saline water would reach existing intakes, and (3) aquifer characteristics for the identification of the basins having the best potential for groundwater development. A proposed new water treatment plant and transmission system are discussed as are water supply schemes for two rural areas, Labi and Temburong. Capital costs for the projects described are tabulated and total B $375 million. (Khumbatta-PTT)
W86-05078

SIMPLE METHOD OF CHIRONOMID CONTROL AT WATER TREATMENT WORKS,

Mid Kent Water Co., Canterbury (England).
T. Flynn, and P. M. Bolas.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 5, p 414-422, October 1985. 4 fig, 5 ref.

Descriptors: *Water treatment facilities, *Midges, *Insect control, Distribution systems, Surface water, Larvae.

Infestations of public water supply mains and distribution systems by Chironomid larvae, often known as 'bloodworms', are a relatively frequent problem experienced throughout the water industry when surface water is treated. Although probably of no public health significance, the larvae give rise to numerous complaints and considerable anxiety amongst consumers and the problem period is normally from August to October when the larvae reach sizes of 1 cm or more in length. In this study an entry to the supply was found to be from eggs laid in vulnerable parts of treatment plants. Newly hatched larvae then penetrated the filters. Raw water was not the primary source of infection. Protecting the filters and sedimentation tanks with simple horticultural water sprays offers a solution which prevents over 90 per cent of potential infestation. The method has scope for insect control at other sites, such as sewage works. (Khumbatta -PTT)
W86-05079

DESIGN OF RAPID SMALL-SCALE ADSORPTION TESTS FOR A CONSTANT DIFFUSIVITY,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-05135

RELATION BETWEEN DRINKING WATER NITRATE AND TOTAL NITRATE INTAKE,

Central Public Health Lab., London (England). Communicable Disease Surveillance Centre.
For primary bibliographic entry see Field 5G.
W86-05149

IMPLICATIONS OF HEAD LOSS PATH CHOICE IN THE OPTIMIZATION OF WATER DISTRIBUTION NETWORKS,

Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, B. M. Lussier, and D. R. Morgan.
Water Resources Research WRERAO, Vol. 22, No. 5, p 819-822, May 1986. 1 fig, 3 tab, 7 ref.

Descriptors: *Head loss, *Water distribution, *Optimization, Optimum development plans, Water supply systems, Water pressure, Flow rates, Flow characteristics.

The effects of varying the paths used to ensure adequate pressure throughout a water distribution network when using iterative linear programming-gradient search techniques for least cost solution of the network are analyzed. The final flows within links in a network appear to be dependent on the degree to which the links with which they are associated are included in the equations used to define pressures throughout the network. The more often a link is included, the larger the final flow is in that link. This condition results in networks which are designed on the basis of a single loading condition having an implied 'branched' nature defined, to a large extent, by the way in which the pressure constraints are formulated. (Lantz-PTT)
W86-05229

TREATMENT EFFICIENCY OF AN IMPROVED OZONATION UNIT APPLIED TO FISH CULTURE SITUATIONS,

Biologische Anstalt Helgoland (Germany, F.R.)
H. Rosenthal and, and G. Kruner.
Ozone Science and Engineering, Vol. 7, No. 3, p 179-190, Summer, 1985. 7 fig, 1 tab, 28 ref.

Descriptors: *Ozonation, *Water reuse, *Fish farming, Efficiency, Nitrites, Ammonium, Biological oxygen demand.

In this study the oxidation rates for ammonium, nitrite, and BOD have been determined for each of these components separately or in combination, using an improved design of the contacting chamber. Two flow rates and three ozone concentrations were employed. Ammonia oxidation rates were slowest while nitrite and BOD removal was rapid. Ozone concentrations substantially influenced the oxidation rates for ammonium ion. Nitrate was oxidized equally rapidly under almost all operation conditions. Slight differences in oxidation rates were noted for both ammonia and nitrite as long as the BOD was high. (Lantz-PTT)
W86-05273

INFLUENCE OF TEMPERATURE ON BACTERIAL DEVELOPMENT IN WATERS,

Compagnie Intercommunale Bruxelloise des Eaux (Belgium).
G. Fransolet, G. Villers, and W. J. Masschelein.
Ozone Science and Engineering, Vol. 7, No. 3, p 205-227, Summer 1985. 13 fig, 7 tab, 23 ref.

Descriptors: *Bacteria, *Water treatment, *Water distribution, *Thermal effects, Ozonation, Pseudomonas, Azobacter, Bacillus, *Water pollution control, Corynebacter, Micorcoccus, Vibrionaceae, Enterobacter, Water temperature.

Microbial stability in water mains has become an increasing problem for waterworks where more surface water is used to meet distribution requirements. Even when surface water is treated appropriately, it usually contains a higher amount of organic compounds than groundwater, and during certain periods, can attain temperatures between 20 and 25 C. Furthermore, ozonation applied during treatment modifies structures of the dissolved organic materials. Six typical strains were used to determine the importance of the temperature factor on aftergrowth in five different types of water. Three criteria for the evaluation of aftergrowth are: the growth rate factor (r2), the growth yield (maximum number of germs/mL when growth stops), and the latency time. It was established that aftergrowth is related to the Pseudomonas and Azobacter families, and the species Bacillus, Corynebacter, Micrococcus, Vibrionaceae, and even Enterobacter. The temperature factor is most important in all aspects, as an increase in water temperature enhances all growth characteristics. (Main-PTT)
W86-05275

DETERMINATION OF CARBONATE TRACES IN HIGH-PURITY WATER BY MEANS OF CHROMATOGRAPHY,

Gesamthochschule Paderborn (Germany, F.R.). Fachbereich Chemie und Chemietechnik.
G. Brandt, G. Matuschek, and A. Kettrup.
Fresenius Zeitschrift Analylische Chemie, Vol. 321, No. 7, p 653-654, August 1985. 5 fig, 6 ref.

Descriptors: *Trace levels, *Carbonates, *Ion chromatography, Water quality control, Water treatment, Ion exchange, Water analysis.

The determination of bicarbonate in high-purity water applying ion-chromatography with indirect UV-detection is described. The results have been obtained using a low-capacity analytical ion-exchange column and eluents containing very pure weak organic acids. By direct injection of the sample concentration levels lower than 0.02 mg/l CO(2-)3 have been detected. (Author's abstract)
W86-05281

TREATMENT, WASTE MANAGEMENT AND COST FOR REMOVAL OF RADIOACTIVITY FROM DRINKING WATER,

Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
G. W. Reid, P. Lassovszky, and S. Hathaway.
Health Physics,Vol. 48,No. 5, p 671-694, May, 1985. 7 fig, 16 tab, 34 ref.

Descriptors: *Waste treatment, *Drinking water, *Water quality control, Radioactive waste disposal, Wastewater treatment, Reverse osmosis, Activated carbon, Adsorption, Coagulation, Electrodialysis, Chemical precipitation, Aeration, Ion exchange.

The processes used is treating drinking water for removal of radioactive contaminants and the disposal of wastes generated by the treatment processes are analyzed and discussed. The study was limited to U, Ra and Rn. Techniques discussed for the removal of radioactivity were: (1) cation exchange, (2) reverse osmosis, (3) lime softening, (4) adsorption processes, (5) DOW radium selective complexer (RSC), (6) anion exchange, (7) direct precipitation, (8) coagulation, (9) electrodialysis, (10) granualr activated carbon, and (11) aeration. The costs involved with each of the techniques are summarized along with each of the techniques are summarized along with informational needs which still remain unaddressed. (Lantz-PTT)
W86-05282

OZONE ABSORPTION WITH REACTION IN BENZESULFONIC ACID AQUEOUS SOLUTIONS,

Naples Univ. (Italy). Ist. di Chimica Industriale e Impianti Chemici.
G. Anselmi, P. G. Lignola, C. Raitano, and G. Volpicelli.
Chemical Engineering Science CESEAC, Vol. 40, No. 7, p 1033-1040, July 1985. 10 fig, 3 tab, 13 ref.

Descriptors: *Ozonation, *Chemical treatment, *Water treatment, *Benzensulfonic acid, Water treatment, Organic acids, Oxidation, Organic matter, Ultra-violet spectrophotometry.

The aim of this research, was to assess organic compound reactivity with ozone in aqueous media, and to evaluate the feasibility of oxidative degradation of traces of organic compounds in water, by

ozonized oxygen or air. Benzensulfonic acid (BSA) was chosen as representative of aryl sulfonates which constitute an important class of water pollutants owing to the widespread use of synthetic detergents. The methods of absorption with reaction, were used for the successful development of an 'ab initio' model of the oxidation of BSA aqueous solutions by ozonation. The predictive capability of the model was tested experimentally by means of an ultraviolet spectrophotometry technique. The accordance between experimental time evolution of species and that predicted by the model indirectly confirmed that the correlation for mass transfer and the kinetics were correct. (Masters-PTT)
W86-05284

TREATMENT OF AN IN-SITU OIL-SHALE RETORT WATER,

University of Wyoming Research Corp., Laramie. Western Research Inst.
D. J. Kocornik, W. F. McTernan, and S. L. Williams.
Environmental Progress, Vol. 4, No. 3, p 145-150, August 1985. 4 fig, 7 tab, 20 ref.

Descriptors: *Oil shale, *Industrial wastes, *Wastewater treatment, *Industrial wastes, Coagulation, Activated carbon, Absorbents, Green River, Sedimentation, Vernal, Utah, Pretreatment of water, Dissolved organic carbon.

The treatment of Green River formation oil shale retort water was studied in an experimental procedure whereby the effectiveness of coagulation-sedimentation and activated-carbon systems were evaluated. The specific retort water addressed here was Geokinetics-17, a product of a true in situ retort operated south of Vernal, Utah, in 1979. Seven primary coagulants - three inorganic salts and four synthetic organic polymers - and two commercially available activated carbons were used. It was concluded that coagulation-sedimentation was not an effective one-step treatment process on this water. Pretreatment by coagulation, followed by activated carbon treatment, did have an additive effect on total dissolved organic carbon removal and also increased the rate of absorption in batch systems, but did not affect the ultimate capacity of the carbon when evaluated in a batch mode. The dynamic granular carbon-untreated retort water system was rate limited by pore diffusion of the sorbate. (Masters-PTT)
W86-05285

ULTRAPURE WATER IN THE MICROELECTRONICS INDUSTRY,

Esmil Water Systems, Amsterdam (Netherlands).
H. M. Bunnik.
Effluent and Water Treatment Journal, Vol. 26, No. 1, p 23-25, January 1986. 3 fig, 3 tab.

Descriptors: *Ultrapure water, *Water treatment, *Water quality control, *Microelectronics, Filtration, Industrial water, Hamburg, West Germany, Drinking water, Sodium hypochlorite, Sand filters, Reverse osmosis, Citric acid.

Manufacturers of microelectronic devices require ultrapure water for rinsing at various stages in the fabrication process. An ultrapure water installation for 63 cu m/hr in the Hamburg factory of Valvo Roehren und Halbleiterwerke der Philips GmbH is described. The installation had to treat drinking water from the town of Hamburg. To isolate the installation from the drinking water system, three polyethylene break tanks with a content of 2 cu m each, were installed. Sodium hypochlorite was dosed to sterilize the break tank sand filters. For the prefiltration of the influent three manually operated sand filters were installed at a 28 cu m/hr capacity each. Sulfuric acid was used to neutralize the bicarbonate content of the raw water. For fine filtration, three cartridge filters were used. In addition, three high pressure pumps were added to increase the pressure to 40 bar for operation of the reverse osmosis units, and a flushing system was installed for cleaning. Citric acid was used for removing hardness scale, while iron hydroxide deposits were removed by oxalic acid, and bacterial fouling was prevented by routine sanitization using sodium hypochlorite. After the reverse osmosis unit (RO), a carbon dioxide degasser was installed on a horizontal permeate storage tank. Seven transfer pumps were installed in total and four horizontal storage tanks were made available for pure water. The operation of the installation was made fully automatic. In conclusion, the requirements for cleaner water are becoming more stringent and therefore RO units will be further improved in the future. (Master-PTT).)
W86-05288

LACK OF ASSOCIATION BETWEEN FLUORIDATION OF WATER AND CANCER,

M.D. Anderson Hospital and Tumor Inst., Houston, TX.
G. R. Newell, and M. V. Marshall.
Texas Medicine, Vol. 82, No. 2, p 48-50, February 1986. 2 tab, 23 ref.

Descriptors: *Fluoridation, *Cancer, Epidemiology, Water treatment, Drinking water.

Opponents to the fluoridation of drinking water supplies have claimed that fluoridation caused adverse health side effects, including cancer. There has probably been no human health issue more extensively evaluated for adverse medical outcomes with consistently negative results. No association between fluoridation of water and increased cancer death rates in consumers has been demonstrated. Fluoride at 1 ppm is not mutagenic in bacteria or human cells. No biochemical or biologic mechanism, whereby fluoride at 1 ppm causes cancer by genotoxic or epigenetic means, has been proposed. The time, effort, cost, and deprivation of preventive dental measures are incalculable. (McFarlane-PTT)
W86-05295

EVALUATION OF THE WATER SUPPLY AND SANITATION PROBLEMS IN NIGERIA,

Ibadan Univ. (Nigeria). Coll. of Medicine.
M. K. C. Sridhar, and M. A. Omishakin.
Royal Society of Health Journal, Vol. 105, No. 2, p 68-74, April 1985. 1 fig, 9 tab, 19 ref.

Descriptors: *Water supply, *Sanitation, *Nigeria, Water sources, Refuse disposal, Water associated diseases.

Water supply and sanitation problems before and after independence are analyzed and related to the prevalence of ten water associated diseases in different States in Nigeria. A few States showed maximum prevalence of these diseases. Rural migration, poor finances, Governmental apathy and strong cultural backgrounds in different ethnic groups have contributed to insufficient progress toward the goals of the water supply and sanitation decade. Community involvement, through health education and Government's involvement with the community at different stages of planning and implementation seem to yield the desired results. (Lantz-PTT)
W86-05300

CONTACT FLOCCULATION-FILTRATION OF LOW-TURBIDITY, HIGHLY COLOURED ACID MOORLAND WATER,

Sheffield City Polytechnic (England). Dept. of Civil Engineering.
B. A. Quaye, and N. P. Isaias.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 4, p 325-340, August 1985. 8 fig, 2 tab, 8 ref.

Descriptors: *Water treatment, *Flocculation, *Filtration, *Turbidity, *Color, *Acid water, *Moorland, Metal cations, Yorkshire, Suspended Solids, Iron, Manganese, Aluminum, Filter bed, Pilot scale, Potassium Permanganate, pH.

A contact flocculation-filtration process using a dual-media laboratory-scale apparatus, and a pilot-scale filter plant incorporating a steeply inclined settling tubes module as a flocculator, has confirmed that single-stage high-rate filtration of low turbidity, highly colored acid moorland water, can be an effective and economical alternative to conventional water treatment. A very high quality water, with low turbidity and very low levels of iron (0.05mg/l), manganese (0.03mg/l), aluminum (0.08mg/l) and color, was achieved at a filtration velocity of 15 m/hr which is treble the conventional filtration velocity. (McFarlane-PTT)
W86-05303

DISTRICT METERING,

Sunderland and South Shields Water Co. (England).
For primary bibliographic entry see Field 7B.
W86-05316

ECONOMIC APPRAISAL OF ACTIVE AND PASSIVE METHODS OF LEAKAGE CONTROL,

Mid Kent Water Co., Canterbury (England).
For primary bibliographic entry see Field 6C.
W86-05317

SOME DEVELOPMENTS IN PRESSURE REDUCTION,

Bristol Waterworks Co. (England).
For primary bibliographic entry see Field 8C.
W86-05318

SELECTING EFFECTIVE SOFTWARE FOR WATER AND WASTEWATER TREATMENT FACILITIES,

Engineering-Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 5D.
W86-05319

METHYL BROMIDE IN SURFACE DRINKING WATERS,

Azienda Comunale Elettricita ed Acque, Rome (Italy).
For primary bibliographic entry see Field 5A.
W86-05331

CHLORINE DIOXIDE REACTIVITY WITH PROTEINS,

University of South Florida, Tampa. Coll. of Public Health.
C. I. Noss, F. S. Hauchman, and V. P. Olivier.
Water Research, Vol. 20, No. 3, p 351-356, March 1986. 6 fig, 2 tab, 21 ref. EPA Contract R806074010.

Descriptors: *Disinfection, *Chlorine, *Viruses, Proteins, *Chlorine dioxide, *Water treatment, Amino acids, Escherichia coli, Disinfections.

Studies were conducted to evaluate chlorine dioxide reactivity with proteins and the role of these reactions in the inactivation of the bacterial virus f2 with chlorine dioxide. The effect of chlorine dioxide on the ability of f2 to specifically attach to its host Escherichia coli K13 was compared to the inactivation of virus during the initial seconds of contact time. At pH 7.2 and 5 degrees, the virus was rapidly inactivated with 0.6 mg/liter of chlorine dioxide. The loss of protein specific attachment function nearly paralleled intact virus inactivation with 1.2 log units of attachment inhibition occurring within 30 sec. The inactivation of virus and the inhibition of specific attachment both increased with increasing pH and disinfectant concentration. Inactivation of f2 was attributed to the reaction of chlorine dioxide with discrete chemical moieties in the viral protein. Cysteine, tyrosine and tryptophan reacted with chlorine dioxide within a time frame that could affect viral inactivation. In denatured f2 capsid protein monomers, these amino acids were almost totally degraded within 2 min by chlorine dioxide. Even though the degradation of tyrosine residues occurred at a much slower rate of virus inactivation, the protein component of f2 virus appeared to be the site of the lethal lesion produced by chlorine dioxide. These tyrosine reactions with chlorine dioxide appeared to alter the virus such that specific attachment was inhibited. (Geiger-PTT)
W86-05340

CHLORINE DIOXIDE REACTIVITY WITH NUCLEIC ACIDS,

North Carolina Univ. at Chapel Hill. School of Public Health.
F. S. Hauchman, C. I. Noss, and V. P. Olivieri.
Water Research, Vol. 20, No. 3, p 357-361, March 1986. 6 fig, 23 ref.

Descriptors: *Chlorine dioxide, *Nucleic acids, *Viruses, *Disinfection, *Water treatment, Disinfectants, Chlorine, Hydrogen ion concentration.

Studies were conducted with the bacterial virus f2 to determine the reactivity of chlorine dioxide with viral nucleic acid, and to evaluate the role of these reactions in the inactivation of virus with chlorine dioxide. The effect of chlorine dioxide on naked infectious RNA was compared to the inactivation of intact virus and to infectious f2 RNA extracted from virus which was treated with chlorine dioxide. At pH 7.2 and 5 degrees, greater than 4 log units of virus inactivation were observed within 2 min of contact time. Almost no inactivation of infectious RNA extracted from chlorine dioxide treated virus was observed. Treatment of naked infectious RNA with chlorine dioxide yielded less than 1 log unit of inactivation after 5 min of contact time. The rate of inactivation of both f2 virus and infectious RNA by chlorine dioxide increased with increasing pH. Inactivation of f2 infectious RNA was attributed to chlorine dioxide reactions with nucleotides. The reaction of chlorine dioxide within yeast RNA was uniquely associated with guanosine monophosphate (GMP). The reaction between chlorine dioxide and GMP may account for inactivation of naked f1 RNA. However, this reaction does not explain the inactivation of intact f2 virus, as the RNA within the treated virion remains infectious despite several log units of virus inactivation. (Author's abstract)
W86-05341

ALGAE REMOVAL BY FINE SAND/SILT FILTRATION,

Louisiana Dept. of Transportation and Development, Baton Rouge.
B. Naghavi, and R. F. Malone.
Water Research, Vol. 20, No. 3, p 377-383, March 1986. 6 fig, 2 tab, 21 ref.

Descriptors: *Wastewater treatment, *Filtration, *Sand filters, *Algal control, *Separation techniques, Silt, Nuisance algae, Clogging.

A laboratory scale study was undertaken to determine the potential of a method of filtering algae from water using fine sand/silt as the filter media. Five median sand sizes (0.064-0.335 mm) and four bed depths (3.175-12.700 mm) were examined in constant head experiments with the algae Scenedesmus quadricauda. A total of 46 experiments were conducted with continuous measurements of filtration rate, head loss and effluent quality. All media with median sand sizes at or below 0.200 mm gave consistently high algae removal rates. The average removal was 97.27% (based on fluorescence) with a low average initial head loss across the filter media of 7.3 cm (median grain size diameter of 0.200 mm with the bed depth of 3.175 mm). Initial filtration rates obtained in the experimental apparatus were as high as 226 cu m/sq m/day (3.84 gpm/sq ft), comparable to conventional sand units. Run times were short due to surface clogging of the media. No chemical addition was required to obtain high removal levels. (Author's abstract)
W86-05344

ALTERNATIVE ALUMINIUM FLOCCULANTS CONTROLLING MICROPOLLUTANTS,

Laporte Inorganics, Cheshire (England).
A. M. Simpson, W. Hatton, and A. Murray.
Effluent and Water Treatment Journal, Vol. 26, No. 1, p 9-15, January 1986. 1 fig, 7 tab, 22 ref.

Descriptors: *Pollutants, *Chlorination, *Water treatment, *Wastewater treatment, *Flocculation, *Dispersants, *Organic matter, *Micropollutants, *Aluminum, *Aluminum Sulfate, Chlorine, Polyaluminum Chloride Lapofloc, Lapofloc 2000, Trihalomethane.

Methods trying to minimize trihalomethane (THM) formation in dringing water are considered. One possible solution for the reductin of THMs resulting from chlorination is the prior removal of precursor organic acids. The advantages of flocculation prior to chlorination, the effect of flocculation on the removal of organic contaminants, and the effect of flocculation on the levels of heavy metals present in drinking water were investigated. Aluminum sulfate, Polyaluminum chloride Lapofloc (Lapofloc PAC) and Lapofloc 2000, were used as flocculants on water samples taken from three watersheds in England. Flocculatns were tested at their optimum doses for each raw water determined by their floc growth characteristics. In all cases Lapfloc PAC had the fastest growth, and as such was optimized at an overall lower dose than the other flocculants. Post-chlorination was advantageous in reducing the levels of THMs by means of aluminum flocculants removing humic and fulvic acids as measured by color removal to reduce the level of THM precursors. Aluminum sulfate produced the best overall color removal. The metal results were inconclusive. (Master-PTT)
W86-05404

ORGANIC MICROPOLLUTANTS AND THE PROTECTION OF WATER SUPPLIES,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5B.
W86-05405

OCCURENCE OF RADIOACTIVITY IN PUBLIC WATER SUPPLIES IN THE UNITED STATES,

Environmental Protection Agency, Washington, DC. Office of Drinking Water.
For primary bibliographic entry see Field 5B.
W86-05407

5G. Water Quality Control

POWER FROM MINE COOLING WATER,

Foster-Miller, Inc., Waltham, MA.
For primary bibliographic entry see Field 8C.
W86-04703

DELINEATING ZONES OF CONTRIBUTION FOR PUBLIC SUPPLY WELLS TO PROTECT GROUND WATER IN NEW ENGLAND,

IEP, Inc., Barnstable, MA.
S. W. Horsley, and T. C. Cambareri.
Journal of the New England Water Works Association, Vol. 100, No. 1, p 19-43, March 1986. 15 fig, 11 ref.

Descriptors: *Zones of contribution, *Groundwater pollution, *Groundwater recharge, *Land use, *New England, Cape Code, Buried river valleys, Nitrate nitrogen, Multifamily dwellings, Herbicides, Regulations, Tertiary wastewater treatment, Glacial drift, Sand, Gravel, Clay.

This paper describes the procedures used to delineate zones of contribution to public water supply wells in two major geologic settings occurring in New England, the 'cape and islands' and the 'buried river valley', and discusses measures employed to protect water quality in those identified zones. The Cape and Islands region is comprised of sands, silts, clay, and gravel, whereas the buried river valleys contain thick deposits of stratified glacial drift enclosed in bedrock walls. Various schemes have been advanced for protecting groundwater within the zones of contribution defined by the methods described here. These include: prohibiting certain land uses, such as junkyards, landfills, and road salt stockpiles, from existing within the zone; upgrading residential zoning to large lots to limit the amount of nitrate-nitrogen entering the aquifer; requiring tertiary treatment for multifamily dwellings with nitrate-nitrogen loadings exceeding 24 lb/40,000 sq ft; passing regulations against herbicides within zones of contribution; and acquiring key parcels of land within zones of contribution so that sufficient clean recharge is available to dilute contaminated water from other land within the contribution zone. (Rochester-PTT)
W86-04705

DETERGENT PHOSPHATE BANS AND EUTROPHICATION,

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
G. F. Lee, and R. A. Jones.
Environmental Science and Technology ESTHAG, Vol. 20, No. 4, p 330-331, April 1986. 1 fig, 1 tab, 8 ref.

Descriptors: *Water pollution control, *Detergents, *Phosphates, *Phosphorus removal, Eutrophication, Wastewater disposal, Domestic wastes.

The controversy over the value of detergent phosphate bans in improving water quality is discussed in relation to a recently-developed general relationship that can be used to evaluate the potential benefits of such a ban. The relationship is based on the finding that a reduction of approximately 20% in the P load to a water body must be achieved to yield a discernible effect on water quality. This 20% value is independent of the trophic state. It was developed from the P load-chlorophyll relationship developed in the Vollenweider-Organization for Economic Cooperation and Development eutrophication studies. Although detergent phosphate bans generally will not result in an overall improvement in water quality, there may be some situations in which eutrophication-related water quality would be improved by a ban. Such rare situations would be characterized by a high percentage of the water entering the water body being derived from domestic wastewaters and a substantial percentage of the phosphorus in the domestic wastewaters being derived from detergents. (Rochester-PTT)
W86-04719

POSSIBILITY OF MELIORATION AND AGRICULTURAL USE OF LIMAN AND MARINE SEDIMENTS,

Odessa Agricultural Inst. (USSR).
N. A. Kreyda, N. K. Lyadova, and T. Y. Arzumanyan.
Soviet Soil Science, Vol. 17, No. 5, p 66-71, September-October 1985. 4 tab. Translated from Pochvovedeniye, No. 7, p 75-80, 1985.

Descriptors: *Marine sediments, *Soil development, *Soil chemistry, Saline soils, Barley, Sunflower, Sorghum, Alfalfa, Sweet clover, Manure, Sodium ion, Shell detritus, Hydrogen ion concentration, Oxidation-reduction potential, Adsorbed cations.

Data on the changes in physicochemical properties (Eh, pH, adsorbed cations) and chemical composition (water-soluble salts and nutrients) of reclaimed soils on marine sediments, were used for cultivation experiments with barley, sorghum, alfalfa, sweet clover, and sunflower. It is concluded that, as a result of oxidation of the marine sediments, sodium ion activity decreased, the sediments became desolonetzified (spontaneous melioration due to shell detritus), and the pH decreased to neutral, but the supply of highly soluble salts did not decrease significantly due to the 'dry' winter of 1982-83, when the experiments were conducted. All the nutrients increased in the treatment to which manure was applied, and it was here that growth and development of all the crops was best. Barley and sunflower are recommended as pioneer crops. They should be planted on manured (80 metric tons/ha) marine sediments that have been dried to 40 cm, i.e., in the second year after transfer to dry land. (Rochester-PTT)
W86-04729

DRINKING WATER BILL SAILS THROUGH CONGRESS,

L. Ember.
Chemical and Engineering News CENEAR, Vol 64, No. 22, p 20, June 1986.

Descriptors: *Civil law, *Legislation, *Drinking water standards, Wellhead protection areas, Environmental protection, Public water systems, Pollutants, Groundwater protection, Well regulations, Regulations.

The 99th Congress passed a bill that strengthens the Safe Drinking Water Act. The conference bill passed the House May 13 by a vote of 382 to 21 and the Senate May 21 by a vote of 94 to 0. The bill authorizes vast increases in spending for drinking water programs through 1991. Groundwater protection is the major new thrust of revisions to the Drinking Water Act. In addition to issuing 83 new standards within three years, EPA is to assure through oversight and enforcement that states monitor their public water systems for contamination, including contamination by pollutants that are not regulated by EPA. States are to establish wellhead protection areas around public drinking water system wells. The bill authorizes spending of about $164 million per year from 1987 through 1991 to pay for the expanded drinking water programs. The bill has the support of the governors' association, environmental groups, and water supplier associations. (Peters-PTT)
W86-04766

FRESHWATER BIOLOGICAL MONITORING.

International Association on Water Pollution Research and Control, London (England).
For primary bibliographic entry see Field 5A.
W86-04767

BIOLOGICAL SURVEILLANCE IN WELSH RIVERS FOR WATER QUALITY AND CONSERVATION ASSESSMENT,

Welsh Water Authority, Gwent. Nash Area Lab.
For primary bibliographic entry see Field 5A.
W86-04770

MONITORING WATER QUANTITY AND WATER QUALITY IN AN URBAN BASIN,

For primary bibliographic entry see Field 7B.
W86-04807

REMEDIAL ACTION AT WASTE DISPOSAL SITES (REVISED): HANDBOOK.

Science Applications, Inc., McLean, VA.
For primary bibliographic entry see Field 5D.
W86-04820

METHODS TO ESTIMATE AQUATIC HABITAT VARIABLES.

Colorado Cooperative Fishery Research Unit, Fort Collins.
1984. 318 p, 55 fig, 23 tab, 93 ref, 8 append. Project No. DPTS-35-9.

Descriptors: *Aquatic environments, *Aquatic habitats, *Habitats, *Environment, Aquatic life, Aquatic plants, Aquatic weeds, Rivers, Stream fisheries, Streambeds.

Guidance for assessing the quality of aquatic habitats by measuring physico-chemical features is provided. Methodologies are provided for the following parameters: habitat area, cover, depth, discharge, dissolved oxygen, elevation, growing season, light, pH, pools, reservoir variables, salinity, streambank charcteristics, substrate, temperature, total dissolved solids, turbidity, velocity, and water-level fluctuation. The features, or variables, for which measurement methods are described, are those required by the Habitat Suitability Index models published by the United States Fish and Wildlife Service. (Halterman - PTT)
W86-04822

ELECTROPLATING INDUSTRY.

Centec Corp., Reston, VA.
For primary bibliographic entry see Field 5D.
W86-04823

LAKE RESTORATION: A FIVE-YEAR EVALUATION OF THE MIRROR AND SHADOW LAKE PROJECT WAUPACA, WISCONSIN,

Wisconsin Dept. of Natural Resources, Madison.
P. J. Garrison, and D. R. Knauer.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB83-176578, Price codes: A09 in paper, A01 in microfiche. Report EPA-600/3-83-010, March 1983. 100 p, 53 fig, 14 tab, 99 ref. Contract No. R804687-01.

Descriptors: *Lake restoration, *Eutrophication, *Evaluation, *Aluminum phosphate, Phosphorus, Storm sewers, Rehabitation, Diversion structures, Nitrogen, Algae, Mirror Lake, Shadow Lake, Wisconsin.

Mirror and Shadow Lakes, small seepage lakes in central Wisconsin, had experienced cultural eutrophication as a result of storm water drainage. Storm sewers were diverted from the lakes in 1976 and in 1978 aluminum sulfate was applied to enhance the recovery rate by reducing internal phosphorus loading from the sediments. Mirror Lake was artificially circulated to prevent low winter oxygen concentrations and increase spring oxygen concentrations. Storm sewer diversion reduced external phosphorus loading from 58-65 percent for both lakes while the aluminum sulfate application reduced inlake phosphorus concentrations from 90 mg/cu m and 55 mg/cm m in Mirror and Shadow Lakes respectively to 20-25 mg/cu m. Diversion of the storm sewers resulted in a decrease in epilimnetic phosphorus and nitrogen concentrations. Increased algal productivity and biovolume as a result of urban drainage after storm events were eliminated following storm sewer diversion. With the greatly reduced sediment phosphorus release following the alum treatment there was a decrease in spring algal community size and a shift from a community dominated by Oscillatoria agardhii var. to a more diverse community. Annual primary production was reduced 38 percent in Mirror Lake with the depth profiles shifting to those representative of mesotrophic lakes. Phosphorus and nitrogen sedimentation rates were reduced 55 percent and 28 percent respectively resulting in a decrease in the amount of these nutrients being recycled. The zooplankton community numerical size was reduced as the algal production declined. (Author's abstract)
W86-04939

OPPORTUNITIES FOR IMPROVING THE COST-EFFECTIVENESS OF ACID RAIN CONTROL STRATEGIES,

Argonne National Lab., IL. Energy and Environmental Systems Div.
D. G. Streets.
Environmental Progress, Vol. 5, No. 2, p 82-87, May 1986. 1 tab, 7 fig, 22 ref.

Descriptors: *Cost analysis, *Acid rain, *Legislation, Sikorsky-Waxman bill, Udall-Cheney bill, Sulfur, Adirondacks, Smokies, Coal mines, Public policy, Cost-benefit analysis.

None of the congressional bills proposed to control acid deposition can be considered a cost effective approach. Ways to improve spatial, temporal, and regulatory efficiency in choosing which emission sources to control are examined. Two kinds of cost-effective control strategy can be distinguished. Cost-optimized or least-cost seeks to reduce emissions wherever it is cheapest to do so. Sources are controlled in order of increasing marginal cost, until a desired level of emissions is reached. A second kind of cost-effective strategy, termed deposition-optimized or targeted, seeks to reduce emissions so as to reduce deposition at a particular receptor site at minimum cost. Sources are controlled on the basis of lowest cost and greatest contribution to deposition at the receptor site, until a desired deposition goal is reached. Both of these strategies can be distinguished from the legislative proposals, most of which may be termed emission-optimized strategies, in the sense that they seek to reduce emissions wherever emissions are greatest. No strategy is clearly the best from every standpoint. Those bills, such as Sikorski-Waxman, that attempt to preserve coal markets are very expensive. The cost-effective strategies, such as the Udall-Cheney bill, cause large disruptions in the coal industry. The deposition-optimized strategies are much cheaper but offer less widespread environmental protection. A workable strategy might be built around a targeted approach to control, limiting the reduction in emissions to a several-state region in the industrial Midwest and the Northeast. (Peters-PTT)
W86-04946

STEAM-REGENERATED ACTIVATED CARBON: AN EMISSION-FREE, COST-EFFECTIVE GROUND WATER TREATMENT PROCESS,

IT Corp., Knoxville, TN.
C. S. Parmele, R. D. Allan, and M. Mehran.
Environmental Progress, Vol. 5, No. 2, p 135-139, May 1986. 2 tab, 4 fig, 5 ref.

Descriptors: *Groundwater pollution,*Groundwater treatment, *Activated carbon, Carbon adsorption, Halogens, Aromatic compounds, Organics, Steam regeneration technology, Air stripping, Cost analysis, Ultraviolet radiation, Air pollution.

There is no universally applicable ground water treatment technology, but there are many site specific factors that influence the selection of the optimum ground water treatment process. Air stripping is frequently selected over carbon adsorption with virgin carbon for the removal of halogenated and aromatic solvents from contaminated ground water because it is the cheaper process when the volatilized organics can be emitted. However, increasing concern over the impact of the organics vented from an air stripping process has created a situation where ground water treatment costs will be significantly higher unless a cost-effective, emission-free treatment process can be developed. Steam regeneration technology is described and treatment costs are compared with those of several other treatment technologies. When the ground water flow required to clean up a site will be >100 gpm (6.3 L/s) for several years (which is frequently the case), a process using steam-regenerated activated carbon is an emission-free, cost-effective ground water treatment technology that should be considered. (Peters-PTT)
W86-04950

WATER AND WASTEWATER TIME TO AUTOMATE,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
D. F. Bishop, and W. Schuk.
Civil Engineering (ASCE), Vol. 56, No. 1, p 56-58, January 1986. 2 tab.

Descriptors: *Automation, *Wastewater treatment, *Water treatment, Monitoring, Control, Ohio River Sanitation Commission, Metro Seattle, Washington, Maintenance, Computers.

Water and wastewater engineers have been slow to adopt a full-circle systems approach to automated monitoring and control. Such a technical tactic for controlling water and wastewater distribution and collection would be efficient. Automated control technology is applied to some degree for managing gross contaminants and flows in most process applications and in water collection or distribution systems. A key deficiency in the centralized management of water treatment is the lack of a real-time link between raw water supply quality and treatment plant operation. Early warning systems such as those used by the Ohio River Sanitation Commission are monitoring massive toxic spills, these responses are manually activated and offer only limited protection. Complete automation of wastewater and water treatment networks would have far reaching implications for water quality control. Metro Seattle, Washington is working on an integrated network for treatment process control, lab automation and maintenance management. Other data transmission plans, such as the U.S. Geological Survey's satellite system, help bring integration of water quality control networks full circle. (Peters-PTT)
W86-04958

PHOTODEGRADATION OF THE HERBICIDE GLYPHOSATE IN WATER,

Norwegian Plant Protection Inst., Aas.
For primary bibliographic entry see Field 5D.
W86-04961

SANITARY LANDFILL LEACHATE RECYCLE,

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W86-04971

VIRUSES IN DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5F.
W86-04978

RAPID DETERMINATION OF CHEMICAL OXYGEN DEMAND IN WASTE WATERS AND EFFLUENTS BY FLOW INJECTION ANALYSIS,

Loughborough Univ. of Technology (England). Dept. of Chemistry.
J. M. H. Appleton, and J. F. Tyson.
Analytica Chimica Acta, Vol. 179, p 269-278, January 31, 1986. 2 tab, 6 fig, 7 ref.

Descriptors: *Chemical oxygen demand, *Effluents, *Water analysis, *Industrial wastewater, *Flow injection analysis, Peristaltic pump, Chemical wastewater, Brewery wastewater, Gas-works effluent, Cattle, Dye industry wastes.

In a proposed method for automated determination of chemical oxygen demand (COD) a reagent stream, containing potassium dichromate and sulfuric acid, is merged with a distilled water carrier into which samples are injected. After merging and while the stream flows through a suitable reactor, the sample is oxidized and Cr(VI) species in the reagent are reduced to CR(III). The absorbance of chromate is monitored at 445 nanometers. Reagent consumption is indicated by a transient negative departure from the steady-state absorption. Response is shown as the magnitude delta V of this negative peak. The results obtained with a processing time of 3 minutes are comparable with those given by the standard method for a wide range of effluent types (e.g., dye waste, brewery waste, cattle market waste). Agreement was achieved between the results for various standard materials. Mercury (II) is added to the sample to prevent chloride interference. Silver (I) catalyst can be incorporated into the reagent. A limitation to performance is caused by the maximum cycle time of 198 s of the analyzer. (Peters-PTT)
W86-04992

CONTROLLING TOXICITY: AN INTEGRATED STRATEGY,

K. B. Carter.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 6-11, January 1986.

Descriptors: *Environmental Protection Agency, *Surface water, *Groundwater, *Water pollution control, *Management planning, *Toxicity, *Monitoring, *Enforcement, Surrogate parameters, Effluents, Chemical-specific monitoring, State jurisdiction, Pollutant identification.

The problem of controlling toxic contamination in surface water and groundwater is discussed in relation to the recently published Environmental Protection Agency technical support document. This publication presents recommendations to regulatory authorities that cover every step in the process, from screening to compliance monitoring. Concepts in this document and toxicity-based pollution control in general are discussed under the following headings: whole-effluent monitoring, chemical-specific monitoring, limiting toxicity, exposure assessment, effluent screening, overall approach, and state responsibility. Central to a successful national program for control of toxic pollution of the nation's waters is an integration of approaches. A very important element in the EPA program is to consider toxicity itself as a constituent to be removed. Such surrogate parameters have been used before in environmental engineering, for example, in bioassay and the use of biochemical oxygen demand. This demonstrates that it is not necessary to know the identity of every toxic component of an effluent in order to mount a program to control it. (Rochester-PTT)
W86-05013

ORGANIC CONTAMINATION: WHISTLING PAST THE GRAVEYARD,

W. J. Weber, Jr.
Journal of the Water Pollution Control Federation, Vol. 58, No 1, p 12-17, January 1986. 2 tab.

Descriptors: *Water pollution control, *Water pollution sources, *Toxins, *Hazardous materials, *Policy making, *Public participation, *Organics, *Surface water, *Groundwater, Public policy, Liability, Risk assessment, Imports, Drinking water quality, Cost analysis.

Organic contamination issues embrace concerns ranging from management of cleanup disposal sites, through surface and groundwater pollution, to drinking water contamination. Weaknesses in the state of technical knowledge of toxic contamination and approaches for hazardous wastes are considered in the following areas: knowledge of the character and magnitude of hazardous waste issues and problems; the concept that problems of toxic and hazardous substances are geographically restricted to someone else's locality; the belief that land contaminant disposal provides adequate long-term solutions to toxic and hazardous waste management problems; making excuses for inaction on drinking water health risks on the grounds that the risks are small compared to those associated with smoking, driving, drinking, and other environmental health risks; knowledge of quantitative assessment of human and environmental risks of toxic and hazardous substances and about cost:benefit analysis; public information to influence decisions and policies; abandoning the responsibility for arbitration and resolution of conflicts to courts of law; the problem of strict national pollution control regulations versus imports from countries without such restrictions; excessive liabilities for participation in remedial programs and actions involving toxins and hazardous substances; inadequacy of current federal and state programs; and the need to improve drinking water quality and the costs of this effort. (Rochester-PTT)
W86-05014

DESIGN AND PERFORMANCE OF A GROUNDWATER TREATMENT SYSTEM FOR TOXIC ORGANIC REMOVAL,

CH2M Hill, Inc., Gainesville, FL. Hazardous Waste and Industrial Processes Div.
G. T. MacIntyre, N. N. Hatch, Jr, S. R. Gelman, and T. J. Peschman.
Journal of the Water Pollution Control Federation, Vol. 58, No. 1, p 41-46, January 1986. 8 fig, 4 tab, 6 ref.

Descriptors: *Toxins, *Organic compounds, *Groundwater, *On-site disposal, *Phosphate mining, *Solid waste, *Sludge, *Wastewater treatment, Florida, Grease, Oil, Septic waste, Scheduling, Wastewater facilities.

Successful design, construction, and operation of temporary treatment system is described. The facility was built at the Sydney Mine Waste Disposal site in Hillsborough County, Florida, where phosphate mining conducted during the 1930s and 1950s was followed in the 1970s by disposal of permitted solid waste and sludge disposal from grease trap, septic, and oil waste. Groundwater containment and recovery, treatment system design, construction, and performance, and on-site effluent disposal are described. The groundwater recovery, treatment, and disposal system has consistently and successfully removed toxic organics from the contaminated groundwater to below detectable limits. Time constraints were met in the project, permitting scheduled start-up of other remedial activities on schedule. (Rochester-PTT)
W86-05018

REAERATION RATE ESTIMATION USING THE LAG IN DISSOLVED OXYGEN CONCENTRATION,

Louisiana State Univ., Baton Rouge. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2E.
W86-05060

GROUNDWATER PROTECTION STARTS BELOW THE SURFACE,

A. Snow.
American City & County, Vol. 100, No. 9, p 62, 64, 66, 68, 70, September 1985.

Descriptors: *Groundwater pollution, *Underground storage tanks, *Water pollution control, Water pollution, Legislation, Contamination, Volatile organic compounds, Drinking water.

Contamination of U.S. drinking water by chemical seepage into groundwater reservoirs may affect more than 117 million Americans. Groundwater contamination has been found in every state; more than 200 substances have been detected nationwide, and 29% of groundwater drinking water supplies to large cities contain volatile organic chemicals. Leaking underground storage tanks and pipe systems are chief contamination sources. Individual companies may face liability costs of millions of dollars. Prevention measures may include secondary containment, fiberglass storage tanks, and liner and/or double wall protection. The federal government has passed numerous statutes which can be applied to groundwater protection; however, states also are working to formulate, pass, implement, and enforce new laws and regulations to detect and clean up current groundwater contamination, and to prevent future occurrences. (Doria-PTT)
W86-05063

INFLUENCE OF AN ARTIFICIAL HYDRAULIC REGIME ON WATER QUALITY IN THE TIDAL RIVER LAGAN, NORTHERN IRELAND,

Department of Economic Development, Belfast (Northern Ireland). Industrial Science Div.
J. A. Wilson
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 5, p 423-436, October 1985. 10 fig, 4 ref.

Descriptors: *River Lagan, *Weirs, *Oxygen deficit, *Stratified flow, *Estuaries, Water quality, Hydraulic models, Surface water, Dissolved oxygen, Nitrates, Recreation, Flood control, Belfast, Northern Ireland.

This paper summarizes the reasons for oxygen-deficiency in the subsurface layer of the stratified flows created by the McConnell Weir. The stratified flow of the fresh water precludes the absorption of atmospheric oxygen - usually the predominant source of oxygen in surface waters. The stratified flow of the freshwater excludes supplies of dissolved oxygen and nitrates present in the freshwater inflows. The McConnell Weir acts as a barrier to the net non-tidal landward flow associated with the subsurface layers of naturally stratified estuaries. This permits pollutants to be retained for long periods in the reach. Removal of the McConnell Weir would result in a dramatic improvement in the quality of the waters in the Lagan, during the summer months. However, the consequences with respect to the appearance of the river, and existing recreational use, preclude such action. The remedial measure being adopted at present is restoration of the sluicing facilities. The feasibility of a proposed water level control structure is being studied. (Khumbatta-PTT)
W86-05080

CHEMISTRY, MICROBIOLOGY, AND MODELING OF CHLORINATION FOR ACTIVATED SLUDGE BULKING CONTROL,

California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-05083

RELATION BETWEEN DRINKING WATER NITRATE AND TOTAL NITRATE INTAKE,

Central Public Health Lab., London (England). Communicable Disease Surveillance Centre.
C. p. J. Caygill, B. Bartholomew, and M. J. Hill.
Aqua AQUAAA, No. 2, p 94-97, 1986. 3 fig, 2 tab, 17 ref.

Descriptors: *Drinking water, *Nitrates, *Human consumption, Gastric cancer, Water pollution effects, Water quality, Potable water, Urine, Chemical analysis.

Actual measured nitrate intakes are necessary for a proper evaluation of reports linking gastric cancer to nitrate exposure from drinking water and other sources. Recent improvements in methodology permit urinary nitrate to be assayed accurately. Nitrate balance studies using these methods indicated that 60-70% of an oral challenge dose of nitrate was excreted in the urine within 24 hr. Thus the 24 hr urinary nitrate output can be used to calculate the total nitrate intake. This method was used to measure daily nitrate intake of 476 adults drinking water of differing nitrate concentration and the percentage contribution by their water to this intake. It was found that water was the major contributor to nitrate intake only when its nitrate concentration exceeded 50 mg/l. (Lantz-PTT)
W86-05149

REPORT OF TASK COMMITTEE ON WATER QUALITY PROBLEMS RESULTING FROM INCREASING IRRIGATION EFFICIENCY.

American Society of Civil Engineers, New York. Irrigation and Drainage Div.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 191-198, September 1985. 15 ref.

Descriptors: *Water quality control, *Irrigation efficiency, *Information exchange, Salinity, Nitrogen, Irrigation practices, Leaching, Nitrates, Chemical reactions, Pesticides, Path of pollutants, Erosion control, Legal aspects, Irrigation effects.

This paper summarizes and integrates results presented in papers requested by the Task Committee on Water Quality Problems Resulting from Increasing Irrigation Efficiency, addressing the perceived effects of increasing irrigation efficiencies on water quality. These papers deal primarily with salinity and nitrogen relationships, and also analyze other ramifications of increasing irrigation efficiency. Increasing on-farm efficiency usually connotes providing water to meet crop needs with minimal deep percolation and surface runoff. Topics examined include leaching requirements, chemical reactions on the root zone, potential hazards and benefits of reduced leaching, nitrate leaching, basin-wide implications of increasing efficiencies, and effects on groundwater quality. Effects on erosion and the movement of pesticides are also considered. Physical changes to improve irrigation efficiency cannot be considered independently of the associated economic, social, legal, and institutional restraints. It is concluded that from a water quality viewpoint there is no reason to avoid increasing irrigation efficiency, but any such project should be analyzed thoroughly in advance to determine whether local circumstances warrant the improvements. (Lantz-PTT)
W86-05231

PLASTIC LINING ON RIVERTON UNIT, WYOMING,

For primary bibliographic entry see Field 8G.
W86-05240

OZONE ABSORPTION WITH REACTION IN BENZESULFONIC ACID AQUEOUS SOLUTIONS,

Naples Univ. (Italy). Ist. di Chimica Industriale e Impianti Chemici.
For primary bibliographic entry see Field 5F.
W86-05284

NEW APPROACH TO IN-SITU TREATMENT OF CONTAMINATED GROUNDWATERS,

Underground Resource Management, Inc., Austin, TX.
D. C. McMurtry, and R. O. Elton.
Environmental Progress, Vol. 4, No. 3, p 168-170, August 1985. 2 fig.

Descriptors: *Groundwater, *Water treatment, In Situ tests, *Water pollution control, Waste disposal, Wastewater.

The problem of groundwater contamination resulting from industrial waste storage, treatment and disposal practice, and from accidental spills, was considered with an in-situ approach. The conceptual design of the in situ treatment facility involved three phases: physico-chemical treatment, hydraulic design, and geotechnical design. Three case studies based on different designs were considered: 1) a petrochemical manufacturing plant, located along a small river, 2) an accident involving the spill of a tank truck loaded with acid waste, 3) and a hazardous waste landfill. It was concluded that in situ treatment of contaminated groundwaters using passive control and treatment techniques may prove to be an important method for remedial action. This technology would be limited to sites where the migration of contaminants is shallow and essentially horizontal. Further research is needed to develop methodology for the design of the barrier wall/treatment zone hydraulic controls, and for the geotechnical considerations during construction. At this time, numerical modeling was found to be the most appropriate approach in most real world applications for the hydraulic control design. (Masters-PTT)
W86-05286

MERSEY ESTUARY POLLUTION ALLEVIATION SCHEME,

North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5D.
W86-05304

MULTI-LAYER SAMPLER FOR THE STUDY OF DETAILED HYDROCHEMICAL PROFILES IN GROUNDWATER,

Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
D. Ronen, M. Magaritz, and I. Levy.
Water Research, Vol. 20, No. 3 p 311-315, March 1986. 5 fig, 11 ref.

Descriptors: *Groundwater pollution, *Water quality, *Water sampling, Chemical properties, Wells, Aquifers, Deep wells, Test wells, Monitoring, Water analysis, Saline water, Israel.

A modular multi-layer sampler was developed and utilized for sampling undisturbed groundwater chemical profiles. Sampling at 3 cm depth intervals is based on the dialysis-cell method and has no depth limitations. The sampler may be used for water quality monitoring and research, both in existing or specially drilled screened wells. The sampler was tested in a research well drilled in the deep, sandy and phreatic Coastal Plain aquifer of Israel. Excellent sampling reproducibility was obtained from different dialysis cells located in the same solutions for different equilibration times. The sampler was also capable of measuring both large and small salinity gradients at 3 cm intervals. The sampler is inexpensive and easy to operate and demonstrates good potential for monitoring bodies of contaminated groundwater. A floating version of the sampler is presently being developed to move inside the well according to variations in the water table. (Geiger-PTT)
W86-05336

ESTUARINE, COASTAL AND OCEAN POLLUTION: EEC POLICY AND RESEARCH,

Commission of the European Communities, Brussels (Belgium). Directorate General for Research, Science and Education.
P. Bourdeau, and H. Barth.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 1-14, 1986. 3 tab.

Descriptors: *Estuaries, *Water pollution control, *Research priorities, *Policy making, Coastal zone management, Coastal waters, Oil pollution, Water pollution sources, Path of pollutants.

This paper presents an overview of the policy and research of the European Community concerning estuarine, coastal and marine pollution. The structure and implementation of the European Community marine environmental policy, intended to combat the various types of pollution of the sea, and to protect the European waterways and the marine environment are described. Particular reference is made to actions dealing with oil pollution and other harmful chemical substances released into the sea. The environmental research program, aimed at providing scientific support to the environmental policy of the European Community, addresses short-, mid- and long-term problems, dealing mostly with pollution: its sources, detection, fate, pathways, environmental and genetic effects. Abatement and prevention of pollution by oil, wastes, fertilizers, heavy metals and other environmental chemicals are also discussed. It is also increasingly concerned with improving the understanding of the functioning of estuarine, coastal and marine ecosystems. The future orientations of the Community's marine environmental policy and research will stress the preventive aspects of environmental protection. (Lantz-PTT)
W86-05352

STRATEGY FOR DESIGN OF MARINE POLLUTION MONITORING STUDIES,

SEAMOcean, Inc., Wheaton, MD.
D. A. Segar, and E. Stamman.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 15-26, 1986. 13 ref.

Descriptors: *Marine pollution, *Monitoring, *Water pollution, Research design, Water pollution control, Management planning, Statistical methods.

Most historical marine pollution monitoring has proven useless in a management context. A strategy for the development of effective marine pollution monitoring programs is outlined. This strategy is based on the following steps: (1) systematic evaluation of the management information needs, (2) identification of the hypothetical impacts associated with those management concerns, and (3) investigation of the feasibility of monitoring those effects such that the existence, or absence, of a specified level of effects can be established in a statistically-valid manner. There are two fundamentally different types of monitoring programs: site-specific and regional, which differ markedly in scope and approach when designed through the application of this strategy. The strategy requires development of null hypotheses which address management concerns and are amenable to scientific testing. In order for the program to be successful, the null hypotheses selected for inclusion in a marine pollution monitoring program must address levels of effect which are predefined to be environmentally significant. The definition of environmentally significant effect levels is a difficult process which must be primarily the responsibility of the managerial community. (Lantz-PTT)
W86-05353

ANALYTICAL QUALITY CONTROL (AQC) FOR MONITORING TRACE METALS IN THE COASTAL AND ESTUARINE ENVIRONMENT,

Water Research Centre, Marlow (England).
M. J. Gardner, D. T. E. Hunt, and G. Topping.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 35-41, 1986. 1 fig, 1 tab, 18 ref.

Descriptors: *Water quality control, *Water analysis, *Trace metals, *Estuaries, Water pollution control, Monitoring, Cadmium, Mercury, Coastal waters, Saline water.

Recognizing the difficulty of quality control in laboratory monitoring programs, the (U.K.) Marine Pollution Monitoring Management Group (MPMMG) and the Water Research centre (WRc) have organized a program of Analytical Quality Control (AQC). This has the objective of ensuring that analytical results for filterable cadmium and mercury in saline waters, obtained by water indus-

try and other relevant laboratories, are of adequate accuracy and comparability for their intended uses. WRc is to coordinate a series of tests, some involving distributions of standards and samples, which the participating laboratories undertake; this series of tests, the background to the approach and some of the results obtained to date, are described here. (Lantz-PTT)
W86-05355

EFFECTIVENESS OF SAMPLING STRATEGIES FOR INTERTIDAL MONITORING,

Victoria Univ. of Manchester (England). Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W86-05358

SAFE USE OF THE ASSIMILATIVE CAPACITY OF THE MARINE ENVIRONMENT FOR WASTE DISPOSAL - IS IT FEASIBLE,

Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
J. E. Portmann, and R. Lloyd.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 233-244, 1986. 3 tab, 23 ref.

Descriptors: *Water quality control, *Assimilative capacity, *Marine environment, *Waste disposal, Path of pollutants, Water pollution control, Water pollution sources.

For centuries the sea has absorbed a variety of inputs from rivers, streams, salt marshes and the atmosphere. It is generally accepted that additional limited inputs by man are unlikely to have a significant effect on the marine environment. Various control systems have been constructed to provide a framework within which the regulation of anthropogenic inputs can be achieved. These are briefly reviewed. With care, and in the light of past experience in both freshwater and marine environments, reasonable assumptions or estimations can be applied where uncertainties exist, and safe limits can be set for discharges. Case histories are used to illustrate the contention that it is possible to assess the assimilative capacity of a marine area to receive wastes. There is a major distinction to be drawn between contamination and pollution of the marine environment. Moreover, acknowledgement of the assimilative capacity concept in the marine environment does not automatically provide dischargers with the right to utilize that capacity either in part or to the upper limit. What it does is indicate the upper limit which must not be exceeded if pollution is to be avoided, and provide an indication to the control authority of the safety margin involved in the discharge limits they set accordingly. (Lantz-PTT)
W86-05376

DEFINITION OF EFFLUENT DISCHARGE CONSENT CONDITIONS IN COMPLEX ESTUARINE ENVIRONMENTS,

Welsh Water Authority, Bridgend. Tidal Waters Unit.
R. A. Milne, P. C. Nicholas, C. Pattinson, and W. Halcrow.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 267-276, 1986. 2 fig, 12 ref.

Descriptors: *Effluent limitations, *Estuarine environment, *Water quality standards, Assimilative capacity, Coastal zone management, Loughor Estuary, Dee Estuary, Wales, Mathematical modeling, Water pollution effects, Legal aspects.

The Welsh Water Authority puts considerable emphasis upon the scientific determination of discharge consents through which it controls coastal pollution. It also pursues a policy which encourages the effective use of estuarine and coastal capacity to assimilate effluents. Conflict between environmental protection and costs-effective effluent disposal is minimized by concentrating upon the relationships between environmental quality objective (E.Q.O.), environmental quality standard (E.Q.S.) and discharge consent. Welsh Water has devoted considerable resources to the understanding and prediction of these relationships in estuaries, developing a protocol for consent setting. The protocol is described and illustrated with examples from recent work on the Loughor and Dee estuaries in Wales. Desk studies, specialized investigations and mathematical modelling techniques are integrated to identify critical processes in the dispersal, degradation and biological impact of pollutants. These are modelled to predict effluent behavior for various discharge regimes, allowing a flexible approach to the selection of a consent. (Lantz-PTT)
W86-05379

DERIVATION AND APPLICATION OF ENVIRONMENTAL QUALITY OBJECTIVES AND STANDARDS TO DISCHARGES TO THE HUMBER ESTUARY (U.K.),

Anglian Water Authority, Huntingdon (England).
D. R. Sayers.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 277-285, 1986. 1 tab, 7 ref, append.

Descriptors: *Environmental quality, *Environmental policy, *Humber Estuary, *England, Discharge capacity, Estuaries, Mixing, Titanium dioxide, Water quality control, Water pollution control, Cost analysis, Outfall.

In November 1983 a set of environmental quality objectives (EQO) and standards (EQS) was published for the Humber estuary. This paper discusses some of the reasons for choosing these particular objectives and standards. It explains that a mixing zone (within which the objectives and standards may not be met) is permitted around individual effluent outfalls, and examines various options for setting the size of that mixing zone. Mixing zone size should perhaps be defined principally by length. If this length was calculated as an agreed percentage of tidal excursion or current speed at the point of discharge then zone size would be related directly to tidal energy. Where a diffuser is fitted, however, mixing zone size may need to be calculated not solely as a length but in a way that reflects the increased importance of the width of the plume and the size of the pool of effluent that forms a slack water. The mixing zone is the area within which environmental damage will be tolerated. But the use of chemical EQSs to define environmental damage fails to relate zone size directly to the effect an effluent has on the life of the estuary. The use of a biological criterion may overcome this, but it is often only possible to relate such extreme biological effects to an individual outfall. The derivation of reliable but less extreme biological EQSs, is an area where further research may be worthwhile. Ultimately, the decision of how large a mixing zone should be, has to be taken subjectively, and is a cost benefit judgement. In the present financial climate, reducing mixing zone sizes to acceptable proportions may take a number of years. (Lantz-PTT)
W86-05380

LICENSING A MAJOR INDUSTRIAL DISCHARGE TO COASTAL WATERS: THE PRACTICAL APPLICATION OF THE EQO/EQS APPROACH,

Clyde River Purification Board, East Kilbride (Scotland).
D. W. Mackay, A. J. N. Haig, and R. Allcock.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 287-295, 1986. 1 fig, 4 tab, 17 ref.

Descriptors: *Licensing, *Industrial wastes, *Coastal waters, *Environmental quality, Scotland, Estuaries, Receiving waters, Clyde River, Irvine Bay, Legal aspects, Copper.

The Environmental Quality Objective/Environmental Quality Standard approach to controlling pollution in Britain's well mixed and highly dispersive coastal waters, has been adopted by the Government. The task of the regulatory authority in relating discharge conditions to the capacity of the receiving waters, is theoretically a logical sequence of scientific calculations. In practice, a whole range of influences are brought to bear on the decision making process. This paper describes how the Clyde River Purification Board and a major chemical manufacturing company (ICI) arrived at consent conditions for the discharge of an effluent containing copper, into the Irvine Bay, in the Firth of Clyde, an area of major importance as a fishery. The technical arguments advanced during negotiations are detailed, and the areas of major disagreement such as the definition of a mixing zone are discussed. Taken into account are the uses to which the Bay is put, and the effect of other discharges on background levels. Measures taken to ensure demonstrable compliance with the agreed consent conditions are described, as are biological monitoring methods under development which assess the long term acceptability of the discharge. (Lantz-PTT)
W86-05381

REMOVAL OF PARAQUAT, DIQUAT, AND AMITROLE FROM AQUEOUS SOLUTION BY CHEMICALLY MODIFIED PEAT,

Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
P. Mac Carthy, and K. E. Djebbar.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 103-107, April-June 1986. 1 fig, 3 tab, 24 ref.

Descriptors: *Paraquat, *Diquat, *Amitrole, *Peat, Wastewater treatment, Water pollution treatment, Pesticides, Leaching, Adsorption, Cation exchange.

The presence of organic pesticides in aquatic systems has been reported for more than 40 yr. Various methods, such as sorption by clays, activated C, or synthetic resins, have been used to remove these pesticides from water. Certain pesticides, such as the cationic species paraquat (C12H14N2Cl2; 1,1'-dimethyl-4,4'-bipyridinium dichloride), diquat (C12H12N2Br2; 6,7-dihydrodipyrido(1,2-a:2', 1'-c)pyrazinediium dibromide), and the basic species amitrole (C2H4N4; 3-amino-s-triazole), are sorbed by peat. However, the use of raw peat as a sorption medium for the removal of pesticides is hampered by the relative impermeability of peat, the leaching of organic matter from peat into the effluent, and by the disaggregation of peat at pH values greater than about 6.0. Treatment of peat with concentrated sulfuric acid at elevated temperatures yields a granular product that has an enhanced cation exchange capacity, is resistant to leaching, and is permeable to water flow. The objective of this research was to evaluate the use of this chemically-modified peat for removing paraquat, diquat, and amitrole from aqueous solution under a variety of experimental conditions. Using isotherm and column experiments, it was shown that the treated peat is very effective in removing these pesticides from aqueous solution, with a capacity of about 1 mol (+)/kg for these three pesticides. The effects of pH, ionic strength, and flow rate of the efficiency of pesticide removal were found to be relatively small. Peats from two different localities behaved similarly in these experiments. (Lantz-PTT)
W86-05383

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DISJUNCTIVE KRIGING: 1. OVERVIEW OF ESTIMATION AND CONDITIONAL PROBABILITY,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. R. Yates, and A. W. Warrick.
Water Resources Research WRERAO, Vol. 22, No. 5, p 615-621, May 1986. 2 fig, 1 tab, 19 ref.

Descriptors: *Disjunctive kriging, *Probabilistic process, *Estimating, *Statistical analysis, Mathematical studies, Analysis of variance, Management planning, Kriging.

The disjunctive kriging method described in this paper produces a nonlinear unbiased estimator with the characteristics minimum variance of errors. Disjunctive kriging is as good, or better than linear estimators in the sense of reduced krig-

ing variance and exactness of estimation. It does not suffer from the difficulties associated with computing the conditional expectation and can be thought of as its estimator. Disjunctive kriging also provides an estimate of the conditional probability that a random variable located at a point, or averaged over a block in two-dimensional space, is above some specified cutoff or tolerance level. This can be written in terms of the probability distribution or the density function. The method has important implications in aiding management decisions by providing a quantitative input (which is not readily obtained from the linear kriging estimators), based on the available data, which is the best nonlinear unbiased estimator short of the conditional expectation. A major disadvantage in using disjunctive kriging is the increased computational time. This, however, is mitigated by increased information about the estimate. (see also W86-05208)(Lantz-PTT)
W86-05207

DISJUNCTIVE KRIGING: 2. EXAMPLES,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. R. Yates, and A. W. Warrick.
Water Resources Research WRERAO, Vol. 22, No. 5, p 623-630, May 1986. 13 fig, 4 tab, 15 ref.

Descriptors: *Disjunctive kriging, *Probabilistic process, *Estimating, *Statistical analysis, Mathematical studies, Analysis of variance, Management planning, Kriging.

The disjunctive kriging (DK) method is illustrated by two examples. The first example is for the electrical conductivity (EC) which is approximately lognormally distributed. In the second example the natural logarithm of the EC is used to produce an approximately normally distributed data set. The data set was chosen because the Hermite coefficients for a normal and lognormal distribution could be determined analytically, as well as to facilitate a comparison between ordinary and disjunctive kriging. The capability of DK to be a nonlinear estimator and an estimator of the conditional probability is explored. The results indicate that DK is a better estimator than linear estimators (i.e., ordinary kriging) in the sense of reduced variance of errors and average kriging variance, even when the data are approximately normally or lognormally distributed. Also, by using DK, one can obtain an estimate of the conditional probability. (see also W86-05207) (Lantz-PTT)
W86-05208

APPROACH FOR FREQUENCY ANALYSIS OF MULTIYEAR DROUGHT DURATIONS,
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-05212

IMPLICATIONS OF HEAD LOSS PATH CHOICE IN THE OPTIMIZATION OF WATER DISTRIBUTION NETWORKS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-05229

6B. Evaluation Process

ECONOMIC LIMITS OF SMALL AND LOW-HEAD HYDRO,
Monenco Consultants Ltd., Montreal (Quebec).
J. L. Gordon, and R. C. R. Noel.
Water Power and Dam Construction, Vol. 38, No. 2, p 23-26, April 1986. 2 fig, 4 tab, 11 ref.

Descriptors: *Hydroelectric power, *Small hydro, *Low-head hydro, *Economic feasibility, Cost analysis, Economic life, Damsite.

A simple engineering methodology is presented for estimating the likely minimum cost of a small hydropower development on a new site, based on an analysis of cost data from 141 sites, along with a methodology for estimating whether these sites are likely to be sufficiently attractive to warrant detailed investigation. The method is not intended for use at sites where some of the structures have been built, such as dams. A basic premise of the method is that the project must display benefits, that over its economic life, exceed its costs. First, a simple methodology is derived for estimating the minimum cost of constructing a hydro plant at a specific site. Next, an estimate of the maximum benefits that can be expected from the site is developed. It is suggested that, under these conditions, if the costs exceed the benefits, the site is clearly uneconomic and should be rejected from further consideration. A site with apparent benefits exceeding its costs should not be considered economic, but as a site with potential deserving detailed investigation. (Rochester-PTT)
W86-04724

DEVELOPING SMALL HYDRO IN INDIA,
Teknow Consultants and Engineers Pvt. Ltd., New Delhi (India).
For primary bibliographic entry see Field 8C.
W86-04728

PROJECT APPRAISAL IN WATER RESOURCE DEVELOPMENT IN BAVARIA,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
R. F. Schmidtke.
Institution of Water Engineers and Scientists Journal, Vol. 39, No. 5, p 452-461, October 1985. 6 fig, 3 ref.

Descriptors: *Water resources development, *Bavaria, *Evaluation, Hydroelectric power, Project planning, Public participitation, Legal aspects.

The planner of water resources projects must take, as a starting point, the working hypothesis that he cannot have an overview of all the problems that are likely to occur. Planning must be done as a consultative, iterative, and interactive process. In this connection, the public plays an increasingly influential role. Normally, three reasons are given for public participation: (1) It provides more information for planners and other govenment authorities, and thus improves the quality of planning and decision making; (2) It can also provide as sense of (public) satisfaction by creating a feeling of consensus and it creates a better atmosphere for plan acceptance. Large-scale or complex projects in particular, can induce distrust in lay persons because they do not understand all the issues: this should be avoided at all costs. Irrational fears must be brought into the open, in order to distinguish them from the legitimate problems. In addition, the social evolution in recent years has increased the desire for more participation in all areas; and (3) It may contribute to safeguarding the public's legal rights. It is not a question of a lack of research activity that restricts the implementation of new techniques. It is a problem of training the planners in the use of such techniques. (Lantz-PTT)
W86-05306

ROLES ALONG THE RIVERS,
For primary bibliographic entry see Field 6E.
W86-05327

SIGNIFICANCE OF ENVIRONMENTAL IMPACTS: AN EXPLORARION OF THE CONCEPT,
Dalhousie Univ., Halifax (Nova Scotia). Inst. for Resource and Environmental Studies.
For primary bibliographic entry see Field 6G.
W86-05410

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

SUMMER DISCOUNT METHODS IN SANITARY SEWER RATE STRUCTURES,
Lexington Dept. of Public Works, KY.
R. D. Wiseman.
Public Works, Vol. 117, No. 5, p 63-64, 96, 98, May 1986.

Descriptors: *Sewer systems, *Rate structures, *User charges, Summer discount methods, Lexington, Water metering, Water use, Kentucky.

Sewer authorities have devised many ways to handle discounting residential seasonal water use. These include: flat 10 percent spring summer discount; use of winter meter read year round; swimming pool only deductions; fall winter average for use in spring summer; use of 90 percent of water meter read year round; a flat rate based on meter size year round; use of the previous year low quarter meter read for the entire current year; two rate structures including a winter rate and a summer rate; hybrid systems whereby high months and low months are averaged; special application to an appeals board; maximum residential bill based on a set maximum number of gallons; and special meter read. Those communities that are reviewing their user fee rate structures are advised to take several steps if the demand for a sprinkling exemption is present. These include a seasonal and monthly analysis of water flows and an isolation of those factors that may give rise to monthly or seasonal variations. In Lexington, KY billing is on actual water consumption during fall and winter for residential customers with the spring and summer quarters being a winter average calculated usage. For commercial customers, billing is on actual water usage year round unless a customer installs a sewer or water meter and a special application is required for this. For apartment complexes, billing is on 97 percent of actual usage year round. (Peters-PTT)
W86-04684

TIGHT MONEY HAMPERS CLEVELAND SEWER JOBS,
J. Kosowatz.
Engineering News Record, Vol. 216, No. 20, p 56-57, May 15, 1986.

Descriptors: *Ohio, *Financing, *Interceptor sewers, *Environmental Protection Agency, *Tunnels, *Aerial crossing, Valleys, Pipelines, Sewage rate, Construction, Court order.

Financing difficulties and funding challenges are associated with the Northeastern Ohio Regional Sewer District. Although lacking funds, the utility is being forced by court order to continue constructing the 329 million dollar program to build two large sewer interceptors: the 18-mile Southwest interceptor and the 28-mile Heights/Hilltop interceptor, which are intended to relieve aging, overburdened collectors that constantly back up and overflow into waterways in Cleveland and 43 surrounding communities. A cap on funding by the Environmental Protection Agency may force increases in sewer charges in the Cleveland area to pay for this and other projects. Construction has been proceeding on schedule, including tunneling through both hard and soft rock and traversing the Cuyahoga River valley with a 1,150-ft aerial crossing to carry nineteen 9.5-ft-diameter steel pipe segments. (Rochester-PTT)
W86-04754

DRINKING WATER COST EQUATIONS,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W86-04942

WATER DEMAND ESTIMATION UNDER BLOCK RATE PRICING: A SIMULTANEOUS EQUATION APPROACH,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D.
W86-05243

ECONOMIC APPRAISAL OF ACTIVE AND PASSIVE METHODS OF LEAKAGE CONTROL,
Mid Kent Water Co., Canterbury (England).
M. T. Setford.

Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 6, p 494-500, December 1985. 3 fig, 4 tabs.

Descriptors: *Leakage, *Water main, *Water distribution, *Cost analysis, Economic aspects, Water treatment, Comparison studies.

A series of tests was set up in each of the Mid Kent Water Company's three divisions to compare active and passive methods of leakage control and to determine the economic effectiveness of testing waste districts. Each division adopted a different frequency for monitoring leakage to include monthly, bi-monthly, and quarterly testing, with one of the test areas within each division being subjected to an active leakage control program and the other area monitored using passive leakage control only. The trends of leakage within the active and passive test areas varied considerably between the three divisions. Within Ashford division the trends of leakage were more pronounced than in the other test areas, especially in the passive areas. This was attributed to the old leakage prone mains in this division and the nature of the ground which alluvium and more likely to show bursts readily. In the Canterbury passive area, the ground is brickearth which tends to reveal leaks fairly readily, as do the Hythe Beds in the Maidstone passive test area. It was concluded that the economic viability of adopting any leakage control policy will depend upon the comparative pumping and treatment costs between different areas of supply, the potential financial benefit obtained by deferring capital expenditure on the expansion of existing distribution schemes and/or major source development, and the ability to achieve predetermined target levels of leakage in order to be able to defer capital expenditure. (Geiger-PTT)
W86-05317

OUTPUT AND INVESTMENT FRONTIERS OF UNITED STATES IRRIGATED AGRICULTURE,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
R. B. Long.
Water Resources Bulletin, Vol. 21, No. 4, p 553-564, August 1985. 16 fig, 3 tab, 2 ref.

Descriptors: *Water allocation, *Irrigation water, *Cost analysis, *Land use, *Economic aspects, Investment, Agriculture, Irrigation, Evaluations, Benefits.

Economic models sometimes indicate that irrigation water is misallocated in agriculture, especially when it appears that the marginal value product is higher in other uses (such as for hydropower). Historically, trends tend to contradict this reasoning, especially since irrigation has grown from 20 million acres in 1940 to over 50 million acres in 1980. Sixteen relationships were examined to show the economic benefits of irrigated agriculture. The relationships covered such factors as dryland vs. irrigated agriculture, cash receipts and land use, real estate investment and land use, and machinery and livestock investments. The sixteen relationships examined tended to confirm that irrigated land was related to new output and investment in seven of eight relationships, while dryland use was positively related to new output or investment in only two of eight relationships. As agriculture becomes more and more intensive (in terms of inputs), irrigation is part of that long term trend. Major economic variables, such as output and investments in agriculture, appear to be more highly correlated with irrigated land than with dryland agriculture. From these findings, it is concluded that water is not misallocated when used for crop production. (Geiger-PTT)
W86-05326

6D. Water Demand

WATER IS THE KEY TO MUNICIPAL GROWTH,
Scepter Mfg. Co. Ltd., Scarsborough (Ontario).
T. E. Walsh.
Public Works, Vol. 117, No. 3, p 82-83, March 1986.

Descriptors: *Water shortage, *Polyvinyl chloride pipe, *Plastic pipes, *Economic growth, *Pueblo, Colorado.

The response of the Pueblo (Colorado) Board of Water Works to an impending shortage of water that might stifle industrial growth is described. Two major corporations had expressed interest in developing major facilities in Pueblo, but both were concerned about possible water shortages affecting industrial processes and fire protection. Polyvinyl chloride (PVC) pipe (16 in diameter) was chosen to provide a supplementary water line parallel to an existing one. The installation was ahead of schedule due to good weather, timely pipe deliveries, high productivity, and full-time inspection. The pipe was successfully tested at 165 lb/sq in; bacteria tests showed no contamination problems. (Rochester-PTT)
W86-04734

METHOD FOR USING COMPUTERIZED CUSTOMER INFORMATION IN WATER DISTRIBUTION NETWORK MODELS,
Newcastle and Gateshead Water Co., Newcastle-upon-Tyne (England).
For primary bibliographic entry see Field 7B.
W86-04749

FLOODS IN BRITAIN'S BASEMENT; INDUSTRY'S DEMAND FOR WATER IS PLUMMETING. AS A RESULT, RISING GROUND WATER THREATENS TUNNELS AND DEEP FOUNDATIONS IN MANY CITIES,
For primary bibliographic entry see Field 4C.
W86-04969

WATER RESOURCE AND SUPPLY DEVELOPMENT IN BRUNEI DARUSSALAM,
Watson Hawksley Asia, Brunei Darussalam.
For primary bibliographic entry see Field 5F.
W86-05078

PRIMARY INFLUENCE FACTORS ON DOMESTIC WATER DEMAND IN EUROPE,
Gelsenwasser A.G., Gelsenkirchen (Germany, F.R.).
H. Gundermann.
Aqua AQUAAA, No. 2, p 81-85, 1986. 7 fig.

Descriptors: *Water demand, *Domestic water, *Water demand, *Europe, *Available water, Water users, Human population, Rainfall, Population density, Water management, Water supply, Water use efficiency.

Many factors influence the quantity and structure of domestic water demand. However, in spite of national and regional differences concerning domestic water supply, there are generally valid influence factors in Europe. The public and practicians call for evident and definite reasons concerning the trend of water demand. It is not possible to comment on more than 100 influence factors which, in any case, will differ from country to country and from undertaking to undertaking. It is, however, necessary in daily work, to choose those statistical primary factors which are in direct relationship with the water demand. From past experiences and special scientific research, the following influence factors may be regarded as general determinants: 1) Number of inhabitants, population trend; 2) Number and equipment at properties; 3) Weather and rainfall; 4) Settlement structure (supply density, towns and countryside); and, 5) Consumer habits (general principles of conduct, water conscioueness, water saving attitudes). The dominating factor is undoubtedly the number of inhabitants. Other factors, e.g. size of income, education of the head of household, water quality or even overall economy factors or living standards, can be disregarded as they are usually expressed in separate index figures. (Lantz-PTT)
W86-05147

IRRIGATION WATER REQUIREMENTS FOR SENEGAL RIVER BASIN,
Army Engineer District, New York.
G. L. Hargreaves, G. H. Hargreaves, and J. P. Riley.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 265-275, September 1985. 3 tab, 12 ref, append.

Descriptors: *Irrigation practices, *Water requirements, *Senegal River, River basins, Africa, Economic impact, Agricultural engineering, Crop production, Water demand, Rainfall, Farm management, Mauritania, Mali.

The Senegal River is a major natural resource in West Africa where the principal economic resources are agricultural. A proposed irrigation project will provide a significant increase in crop production and will exert a large influence on the economics of Senegal, Mauritania, and Mali. The magnitude of benefits from the project will depend upon the allocation, scheduling and managing of that portion of the water to be used for irrigating agricultural crops. A procedure is recommended for estimating crop water requirements that only requires the measurement of maximum and minimum temperatures. This procedure although calibrated for the Senegal River Basin using climatic data from four representative locations appears to be generally applicable for other areas without calibration. The importance of rainfall in supplying part of crop water requirements is described. Mean, actual dependable and effective precipitation values are compared for one location. Block farming or the planting of a single crop to manageable areas should be made mandatory. (Lantz-PTT)
W86-05238

DAILY WATER USE IN NINE CITIES,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W86-05241

APPLICATION OF FUNCTIONAL ANALYSIS TO OPTIMIZATION OF A VARIABLE HEAD MULTIRESERVOIR POWER SYSTEM FOR LONG-TERM REGULATION,
Ain Shams Univ., Cairo (Egypt). Faculty of Engineering.
For primary bibliographic entry see Field 8C.
W86-05242

WATER DEMAND ESTIMATION UNDER BLOCK RATE PRICING: A SIMULTANEOUS EQUATION APPROACH,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
D. L. Chicoine, S. C. Deller, and G. Ramamurthy.
Water Resources Research WRERAO, Vol. 22, No. 6, p 859-863, June 1986. 1 tab, 30 ref.

Descriptors: *Water demand, *Estimating, *Pricing, *Simultaneous equations, Mathematical analysis, Statistical analysis, Potable water, Estimating equations, Rural areas.

A model of demand for potable water is developed and estimated simultaneously with observations on rural water district customers. The estimation technique incorporates the error structure in an attempt to provide more efficient estimates and eliminate potential ordinary least squares bias in single equation models of demand for goods sold through block rate pricing systems because of possible price endogeneity. The model also tests alternative specifications for price variables. The simultaneous equation model estimates from three-stage-least squares were slightly more efficient than those available using two-stage-least square estimates. The findings are not generally supportive of the Taylor-Nordin specification of consumer demand for block rate priced potable water. The similarity between three-stage-least squares and single equation ordinary least squares estimates provides some validation for the use of simpler single equation demand models of potable water, when water is sold under block rate pricing schedules. (Lantz-PTT)
W86-05243

BETTER ACCOUNTING FOR UNACCOUNTED FOR WATER,

Wessex Water Authority, Poole (England).
For primary bibliographic entry see Field 3D.
W86-05315

6E. Water Law and Institutions

DRINKING WATER BILL SAILS THROUGH CONGRESS,

For primary bibliographic entry see Field 5G.
W86-04766

OPPORTUNITIES FOR IMPROVING THE COST-EFFECTIVENESS OF ACID RAIN CONTROL STRATEGIES,

Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5G.
W86-04946

PUBLIC RELATIONS PLOYS HAVE TRANSFORMED REGULATORY ISSUE INTO CONSUMER CONCERN,

R. L. Stanfield.
National Journal, Vol. 18, No. 4, p 213-215, January 25, 1986.

Descriptors: *Legislation, *Hydroelectric Plants, *Public Relations, Permits, Legal Aspects, Edison Electric Institute.

Privately owned electric utilities are seeking renewal of expiring federal hydroelectric licenses to permit use of the nation's falling waters to generate electricity. Frustrated by years of congressional disinterest, lobbyists hired public relations consultants. To date, the PR firm's direct mail tactics have produced positive results--citizens write congressmen, newspapers print editorials, and it seems likely that Congress will pass the Electric Consumers Protection Act (ECPA; S 426, HR 44) to practically guarantee reissuance of licenses to privately owned concerns, thereby striking down preexisting prejudice towards those publicly owned. Supporters of municipal control claim that the Committee for ECPA is only a front for Edison Electric Institute and other companies and organizations pushing the legislation. The power struggle continues; each side accuses the other of spending millions of dollars for promotion of its goals, with the cost therefor borne by consumers. (Doria-PTT)
W86-05058

ROLES ALONG THE RIVERS,

J. A. Kusler.
Environment, Vol. 27, No. 7, p 18-20, 37-44, September 1985. 29 ref.

Descriptors: *Management planning, *River basins, *Water law, *Federal jurisdiction, *Local governments, Riparian Land, Riparian waters, Rivers, River basin development, Resources management, Project planning.

An overview of federal, state, and local policies for river management in the United States is given. Since 1968, three major federal programs have been adopted that provide partial control over river corridor lands (channel and adjacent floodplains, wetlands, riparian habitats, and other related areas). The National Flood Insurance Program made federally subsidized flood insurance available for existing structures in communities that establish minimum regulatory standards for elevation or for floodproofing of new construction. Section 404 of the Water Pollution Control Amendments of 1972 and the Clean Water Act of 1977 require that any individual must get a permit from the U.S. Army Corps of Engineers in order to discharge any fill or dredge materials into the nation's waters. The Wild and Scenic River Program protects designated waterways from federal water projects. State river management programs include floodplain management programs, shoreland zoning programs, wetland regulatory programs, scenic, wild, or recreational river programs, special management areas programs, and regulation of dams, in-stream uses, and water appropriations. Local governments differ in their river-corridor management approaches according to size, location, and funding. Some examples of rural and urban programs are illustrated. To strengthen state programs for river-corridor management, the administration and congress should re-examine their role in enhancing state roles, improve training and subsidy for management projects, and adopt a state and local river-corridor management act. (Geiger-PTT)
W86-05327

ECOLOGICALLY DERIVED GUIDELINES FOR MANAGING TWO NEW ZEALAND LAKES,

Otago Univ., Dunedin (New Zealand). Dept. of Botany.
A. F. Mark, and P. N. Johnson.
Environmental Management, Vol. 9, No. 4, p 355-364, July 1985. 7 fig, 1 tab, 16 ref.

Descriptors: *Standards, *Hydroelectric plants, *Ecological effects, *Lake shores, Legislation, Vegetation, New Zealand, Lake Manapouri, Lake Te Anau, Glacial lakes, Operating policies.

The details and ecological basis of the legislation governing the use of Lakes Manapouri and Te Anau, in Fiordland National Park, New Zealand, by and overseas aluminum smelting consortium for electricity generation, are summarized. The lake levels were not raised as orginally proposed. Rather, government sought guidelines to optimize hydroelectric potential while maintaining ecological stability of the glaciated lakeshores. Guidelines were derived by relating the vegetation zonation to the natural lake-level fluctuations recorded daily for 37 years. A high operating range in the upper third of the lakes' natural ranges, based on flood tolerances of the woody shoreline species, restricts both duration and frequency. A low operating range (ca. lower third) safeguards stability of shoreline sediments by limiting drawn-down rates, duration and frequency. The main operating range (ca. middle third) has few limitations. These guidelines, which allow utilization of 93% of the water resource, have now been verified by instances of flooding and draw-down rates that exceeded the natural rates recorded earlier. The guidelines were officially accepted by the government in 1977 as a basis for managing the valuable multiple resources of these two lakes and their environs, and they were formalized in legislation in 1981. (Peters-PTT)
W86-05399

6F. Nonstructural Alternatives

FLOOD FREQUENCY ANALYSIS WITH HISTORICAL AND PALEOFLOOD INFORMATION,

Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2E.
W86-05225

6G. Ecologic Impact Of Water Development

PAPAGO WATER SUPPLY PROJECT: CLASS III ARCHAEOLOGICAL SURVEY FOR SCHUK TOAK AND SAN XAVIER DISTRICTS; RESEARCH DESIGN,

Franzoy-Corey Engineering Co., Tempe, AZ.
A. Dart, W. H. Doelle, and T. R. McGuire.
Institute for American Research, Technical Report No. 85-6, 1985. 44 p, 1 fig, 1 tab, 49 ref, 3 append.

Descriptors: *Archaeology, *Arizona, *Water resources development, *Resources development, Water allocation, Resources allocation, Available water, Water use, Water delivery, Water demand, Water conveyance.

Part of the planning process for the Papago Water Supply Project, Arizona, a Class III cultural resource survey included: location and environmental conditions of the project area, problem domains, site definition and classification, archaeological field methods, ethnohistoric research methods, and project structure. An Archaeological Resources Protection Ordinance waspresented. The geomorphology of the Schuk Toak area is described and presented in map form. (Halterman - PTT)
W86-04817

EFFECTS OF WATER DEVELOPMENT ON THE HYDROLOGY AND MORPHOLOGY OF PLATTE RIVER CHANNELS, SOUTH-CENTRAL NEBRASKA,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W86-04897

MORPHOLOGICAL INVESTIGATIONS ON THE LOWER SALZACH RIVER DOWNSTREAM OF SALZBURG,

Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 2J.
W86-04918

ECOLOGICAL IMPACTS OF THE CONSTRUCTION OF DAMS IN AN ESTUARY,

Rijkswaterstaat-Deltadienst, Middelburg (Netherlands). Hoofdafdeling Milieu en Inrichting.
J. Leentvaar, and S. M. Nijboer.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 181-191, 1986. 7 fig, 2 tab, 7 ref.

Descriptors: *Ecological effects, *Dams, *Estuaries, *Construction methods, Water resources development, Tidal hydraulics, Tides, Tidal effects, Biomass, Benthic environment.

The ecological impacts of alternative methods of constructing dams in an estuary are discussed. The main options available were: (1) using concrete blocks and rubble, and (2) using only sand. The advantages of using sand are that it is available locally and cheaper than concrete blocks and rubble. However, the application of sand in a tidal basin requires low current velocities. During the final closing period of a dam, these velocities can be reduced by using a storm-surge barrier (to be built in the mouth of the Eastern Scheldt estuary) in one of two ways: either reducing the tidal amplitude, or reducing the tidal frequency. Tidal reduction influences the vertical amplitude and current velocities, thereby decreasing the intertidal area, and in turn, the biomass and production of microphytobenthos and macrozoobenthos. A reduction of the horizontal tide leads to a reduction of the exchange of water between the North Sea and the estuary, decreasing current velocities. These phenomena affect the concentration of suspended and dissolved material. In particular, salt concentrations decrease with possible stratification. This paper describes the effects of these closing procedures on natural ecosystems and fisheries more fully. (Lantz-PTT)
W86-05371

SIGNIFICANCE OF ENVIRONMENTAL IMPACTS: AN EXPLORARION OF THE CONCEPT,

Dalhousie Univ., Halifax (Nova Scotia). Inst. for Resource and Environmental Studies.
P. N. Duinker, and G. E. Beanlands.
Environmental Management, Vol. 10, No. 1, p 1-10, January 1986. 1 tab, 37 ref.

Descriptors: *Environmental input statement, *Project planning, Social impact, Ecological effects, Canada.

Use of the term impact significance over the past 15 years in Environmental impact assessment (EIA) documentation is reviewed. Some recent attempts at elucidating the concept are summarized. Four perspectives on impact significance that emerged from a series of workshops on the ecological basis for EIA are as follows: (a) statistical (related to problems of isolated project-induced changes from natural variation), (b) ecological (re-

lated to the importance of project-induced changes from a purely ecological perspective), (c) szocial (related to the acceptability of project-induced changes in important environmental attributes), and (d) project (related to whether project-induced changes will indeed influence project decision making). The following synthesis is proposed: Any exercise in judging the impact should thoroughly consider (a) The importance of the environmental attribute in question to project decision makers, (b) the distribution of change in time and space, (c) the magnitude of change, and (d) the reliability with which change has been predicted or measured. (Peters-PTT)
W86-05410

7. RESOURCES DATA

7A. Network Design

METHOD FOR USING COMPUTERIZED CUSTOMER INFORMATION IN WATER DISTRIBUTION NETWORK MODELS,
Newcastle and Gateshead Water Co., Newcastle-upon-Tyne (England).
For primary bibliographic entry see Field 7B.
W86-04749

DETERMINATION OF A MEASURING NETWORK ALONG RIVERS,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
P. Klote van der, H. Niet de, and A. G. Posthumus.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 305-319, 8 fig, 5 tab, 3 ref.

Descriptors: *Networks, *Water level, *Flow velocity, *Flow measurements, *Flow pattern, *Algorithms, Mathematical models, Mathematical studies, Rivers, Filters, Models, Hydrometry.

During the last decade much attention has been given to the question of optimizing data networks, probably due to the trade-off between required quality and cost. For the situation of a measurement system along a river one of the objectives of the network is that water levels and velocities can be interpolated within a desired accuracy from the available data. If this situation is obtained, a further question is to consider the possibility of dropping one or more measurement stations along the river. In this paper the last question is answered for the river IJssel in the Netherlands using a Kalman filter algorithm. A preliminary step in using this algorithm is the determination of the model for the flow pattern in the river. With knowledge of this model and the given fact of available data in measuring stations along the river IJssel, calculations have been performed to show the effect of neglecting existing information in one or more points. By means of these calculations and a criterion on wanted accuracy some idea can be given on the value of the measured information. (See also W86-04785) (Author's abstract)
W86-04811

ADVANCED HYDROLOGIC INSTRUMENTATION ACTIVITIES WITHIN THE WATER RESOURCES DIVISION OF THE US GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-04815

DATA REQUIREMENTS FOR SEDIMENT, EROSION AND TRANSPORT SIMULATION,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
G. Fleming, and S. Fattorelli.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 321-327, 2 fig, 1 tab, 5 ref.

Descriptors: *Sediment transport, *Erosion, *Computer models, *Model studies, Deposition, Sediment deposition, Universal Soil Loss Equation, Strathcycle sediment model.

The computer simulation of sediment, erosion, transport, and deposition processes has developed considerably, but limited discussion has taken place on the data requirements for the various models available. This paper starts with a review of the techniques available for assessing sediment processes. The main theme of the paper is the intercomparison of data requirements for each assessment technique. This comparison explores the relevance of the output obtained from the assessment. For example, the accuracy of the input data to the Universal Soil Loss Equation and the relevance of the output to the real problem of soil loss tolerance assessment, is compared to the accuracy of the input to the Strathclyde sediment model and the relevance of its output to the same problem. Several methods are considered and recommendations made of future data needs. (See also W86-04843) (Author's abstract)
W86-04876

SPATIAL AND TEMPORAL VARIATIONS IN EROSION MEASUREMENTS,
Alberta Univ., Edmonton Dept. of Geography.
I. A. Campbell.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 447-456, 4 fig, 3 tab, 24 ref.

Descriptors: *Erosion, Spatial variation, Temporal variation, Red Deer River, Alberta, Badlands, Soil erosion, Soil loss, Canada.

In 1969 nine erosion study sites were installed in the Red Deer River badlands of Alberta, Canada. A decade of data collection and 4500 point measurements show mean erosion rates of the order of 4.00 mm/year. This is considerably in excess of the estimated geological norm for this region (0.021-0.04 mm/year). Computer-simulated time lapse analyses of the data reveal short term sporadic pulses of erosional activity marked by distinct thresholds. These are separated by longer periods of relative inactivity. The 10-year study shows that prolonged periods of very detailed field measurement are required for the collection of reliable data since, even in geologically rapidly changing environments, such as badlands, relatively little change occurs for most of the time. Moreover, processes that appear erratic or sporadic in the short-term may be part of a steady trend over a longer time span. The results suggest the creation of a remarkably consistent pattern of change over a wide range of slopes and lithologies. (See also W86-04843) (Author's abstract)
W86-04887

ESTABLISHMENT OF EXPERIMENTAL PLOTS FOR STUDYING RUNOFF AND SOIL LOSS IN THE ROLLING LOESS REGIONS OF CHINA,
Yellow River Conservancy Commission, Zhengzhou (China). Inst. of Hydraulic Research.
For primary bibliographic entry see Field 2J.
W86-04889

STRATEGY FOR DESIGN OF MARINE POLLUTION MONITORING STUDIES,
SEAMOcean, Inc., Wheaton, MD.
For primary bibliographic entry see Field 5G.
W86-05353

DEVELOPMENT, TESTING AND INTERCALIBRATION OF REFERENCE METHODS FOR POLLUTION STUDIES IN COASTAL AND ESTUARINE WATERS,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5C.
W86-05354

ANALYTICAL QUALITY CONTROL (AQC) FOR MONITORING TRACE METALS IN THE COASTAL AND ESTUARINE ENVIRONMENT,
Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5G.
W86-05355

STANDARDIZATION OF WATER QUALITY INFORMATION IN A TIDAL RIVER,
Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-05356

7B. Data Acquisition

RELATION BETWEEN L-BAND SOIL EMITTANCE AND SOIL WATER CONTENT,
Agricultural Univ., Wageningen (Netherlands).
L. Stroosnijder, R. J. Lascano, C. H. M. van Bavel, and R. W. Newton.
Remote Sensing of Environment RSEEA7, Vol. 19, No. 2, p 117-125, April 1986. 2 tab, 2 fig, 18 ref.

Descriptors: *Remote sensing, *Soil water, *Moisture content, *Radiometry, Soil texture, Soil emittance, Dielectric constant, Volumetric moisture content.

An experimental relation between soil emittance (E) at L-band and soil surface moisture content (M) is compared with a theoretical one. In order to convert emittance values, as derived from remote sensing, into water content values it does not seem necessary to determine the E-M relation experimentally for all soil types. An estimate of the clay percentage of the soil within 10 percent should suffice to calculate the volumetric moisture content of the top 0-2 cm with 0.02 cu m per cu m accuracy. If the estimated values of M are used in a hydrological model, in which the soil hydraulic properties also have to be known or estimated, the requirement of knowing the clay fraction within 10 percent is not restrictive. The soil dielectric constant is a function of both soil moisture content and of soil texture. (Peters-PTT)
W86-04688

SATELLITE THERMAL OBSERVATION OF OIL SLICKS ON THE PERSIAN GULF,
Japan Marine Science and Technology Center, Yokosuka.
I. Asanuma, K. Muneyama, Y. Sasaki, J. Lisaka, and Y. Yasuda.
Remote Sensing of Environment RSEEA7, Vol. 19, No. 2, p 171-186, April 1986. 3 tab, 3 fig, 17 ref.

Descriptors: *Remote sensing, *Oil slicks, *Satellite technology, *Radiometry, *Persian Gulf, Seawaters, Thermal channel, Thermal inertia, Sea surface temperature, Diurnal variation.

The images of the Advanced Very High Resolution Radiometer (AVHRR) carried on the NOAA-7 were collected from the end of March 1983 to the beginning of July 1983 for the detection of oil slicks on the Persian Gulf. The visible channels showed the possibility of detecting smog from the Nowruz oil fields. The thermal channel showed the distribution of sea surface temperature obtained after the atmospheric correction using the empirical equation by two thermal channels. The apparent thermal inertia, computed from the difference of sea surface temperature between the daytime and the nighttime, showed the possibility of oil slick detection, where it was difficult to detect oil slicks from the temperature difference between oil slicks and sea water in one observation. The apparent thermal inertia was computed on several points which may correspond to the same target among continuous observations. As a result, oil slicks showed a small apparent thermal inertia and sea water showed a large one. This means that oil slicks have smaller resistance to thermal change than sea water. Sea surface temperature used for computing the apparent thermal inertia was obtained through an atmospheric correction with an empirical equation which uses an energy difference between two thermal channels of the AVHRR.

Although there was an ambiguity on the selection of the same object on a water body, the computed apparent thermal inertia showed the possibility of oil slick detection from sea water. (Peters-PTT)
W86-04689

METHOD FOR USING COMPUTERIZED CUSTOMER INFORMATION IN WATER DISTRIBUTION NETWORK MODELS,

Newcastle and Gateshead Water Co., Newcastle-upon-Tyne (England).
D. G. Shore.
Institute of Water Engineers and Scientists, Journal, Vol. 40, No. 2, p 131-138, April 1986. 1 fig, append.

Descriptors: *Networks, *Computer models, *Metered consumption, *Water company, *England, Watnet simulation program, Computer programs, Urban areas, Rural areas.

The Watnet Simulation Program was developed by the Newcastle and Gateshead Water Company (United Kingdom), for determining and maintaining base load information used in the network analysis of water distribution systems. The method utilizes customer records to assess the number of unmetered connections and annual metered consumption within load areas defined by network models. The postal code of each customer is used as the geographical reference between network models and the customer data base. In an urban area examined, the number of open connections within the area was found to be within 1% of that determined by traditional physical counting of houses. In a rural area, the computerized system produced a lower number of unmetered connections than a physical count. An appendix lists the computer programs developed by the water company, including their language, purpose, input, output, and operation. (Rochester-PTT)
W86-04749

ADVANCES IN HYDROMETRY.

Institute of Hydrology, Wallingford (England).
Available from the IAHS, 2000 Florida Ave., NW, Washington, DC. 20009, Price: $30.00. IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. Edited by J.A. Cole. 359 p.

Descriptors: *Hydrometry, *Hydrometers, *Tracers, *Discharge measurement, *Networks, Gages, Flowmeters, Flow velocity, Mathematical models, Satellite technology, Bubble gages.

This symposium was organized by the International Association of Hydrological Sciences' International Commission on Surface Water and sponsored by the World Meteorological Organization (WMO). WMO is concerned with the establishment of hydrometric networks and the collection and application of hydrometric data, in particular in relation to its Hydrological Operation Multipurpose Sub-program (HOMS). The symposium presents 32 papers covering the following six topics: discharge measurement by the current metering and by gauging structures, discharge measurement by the moving boat and related techniques, float and tracer techniques, discharge measurement by ultrasonic and electromagnetic techniques, hydrometry in the electronic age, and regional hydrometry. (See also W86-04786 thru W86-04815) (Geiger - PTT)
W86-04785

HYDROMETRIC CABLEWAYS IN THE YANGTZE VALLEY,

Yangtze Valley Planning Office, Wuhan (China).
C. Youlie, and Z. Guozhen.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 7-17, 7 fig, 2 tab, 3 ref.

Descriptors: *Stream discharge, *Discharge measurement, *Stream gages, *Flashy streams, *Hydrometric cableways, Flow discharge, Hydrometry, Sediment discharge, Remote sensing, Measuring instruments, Yangtze Valley.

The hydrometric cableway is the principal measuring device in the Yangtze Valley for the gaging of discharge in deep, swiftly flowing, and violently fluctuating streams. This paper describes technical problems which have to be studied and resolved when the cableway is used. Topics covered are the layout of the cable, principles and methods of depth measurement using a sounding weight, methods for eliminating the effects of cable vibration, signal transmission and remote operation for velocity, depth, and sediment measurements. Correction for oblique angle of suspension of the cable takes into consideration the droop of the main cable, the rise of the hanging point, and the variation of curve length. Use of the powered winch and silicon controlled speed regulator eliminates cable oscillation and increases accuracy of positioning and measuring. In order to apply the ultrasonic sounding method to cableways, some problems need to be recognized. The insulated wire used for conducting sound impulses suffers extraneous influences of water flowing past it. The echo sounder can be used for both measuring water depth of verticals and positioning observation points. It is also difficult to position observation points in shallow streams. To solve the above problems, water body and steel cable are used as the conducting circuit. (See also W86-04785) (Geiger - PTT)
W86-04786

FLOW MEASUREMENT IN OPEN AND CLOSED CONDUITS OF GRAVITATIONAL URBAN STORM SEWER NETWORKS,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
A. Borzsonyi.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-20, 1982, Exeter, England. p 19-23, 2 fig, 2 ref.

Descriptors: *Unsteady flow, *Storm sewers, *Flow measurement, *Flowmeters, *Telemetry, Sewers, Sewer systems, Flow rates, Flow discharge, Conduits, Hydrometers, Hydrometry, Hydrometric equipement.

The analytical investigation of unsteady flow phenomena in gravitational urban sewer networks is essential for the proper dimensioning, hydraulic analysis and operation of the network. Regular records of measurement data form the basis of such investigations. The construction and functions of a computer-based automatic data collection system installed along a selected section of the storm sewer network at Pecs in South-Hungary are described. The system involves the telemetry of water levels, pressure heads and flow rates at specific points of the network, as well as of precipitation at six points in the basin. A structure of special design involving lateral constriction has been developed for the measurement of levels, heads and flow rates, which is equally suited to measurement in open and closed conduits. Provision had to be made for passing sediments and solid pollutants as well. The technique and evaluation of flow measurement in open and closed conduits are described. The data are computer-processed on the basis of calibrated rating curves. (See also W86-04785) (Author's abstract)
W86-04787

CURRENT METER CALIBRATION - INDIVIDUAL RATING VERSUS GROUP RATING,

Department of the Environment, Reading (England). Water Data Unit.
R. W. Herschy.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-20, 1982, Exeter, England. p 25-36, 3 tab, 10 ref, 3 append.

Descriptors: *Water metering, *Cost analysis, *Calibrations, *Water costs, Gages, Performance evaluation, Comparison studies, Error analysis, Hydrometric equipment.

The cost of the individual rating of current meters is expensive and is likely to increase substantially in the future. Both International and British standards make provision for current meters to be used with either an individual rating or a group rating. Previous work in this field by Lambie, Smoot, Carter, and Grindley are summarized. Joint conclusions confirm that the use of an individual rating for each meter, changing every time the meter is rated, cannot be justified, and the use of a rating derived from the mean of a fairly large group of ratings of different meters of the same type is preferred. Strict control of manufacturer's tolerances would be an essential requirement for the implementation of a group rating. The adoption of a group rating need not reduce the accuracy or current meter gagings; the cost saving of a group rating however is significant. (See also W86-04785) (Geiger - PTT)
W86-04788

UP-DATING OF DISCHARGE RATING CURVES BY MEANS OF MATHEMATICAL MODELS,

Institut fuer Wasserwirtschaft, Berlin (German D.R.).
A. Becker, M. Melcher, and G. Kose.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 37-48, 4 fig, 8 ref.

Descriptors: *Mathematical models, *Discharge measurement, *Flow discharge, *Streamflow forecasting, *Mathematical studies, Models, Flow measurement, Discharge hydrographs, Gages, Streamflow, Rivers, Running waters, Routing.

A centralized computerized streamflow forecasting system was developed for the River Elbe and for the downstream reaches of its main tributaries in the GDR to provide daily streamflow forecasts for up to 23 gaging stations. An appropriate combination of precise flow measurements at selected well-established river gaging stations with flow computations along the river by means of mathematical models (streamflow routing techniques) aided in monitoring and up-dating discharge rating curves at all gaging stations along the river. It also allowed for extrapolation of results of precise flow measurements performed at one or a few selected stations, under critical flood conditions, to neighboring stations, and helped to avoid water balance discrepancies along the river. (See also W86-04785) (Geiger - PTT)
W86-04789

METHOD FOR UNIFORMIZING THE STAGE-DISCHARGE RELATIONS OF STABLE RIVER BEDS AND ITS APPLICATION,

Yangtze Valley Planning Office, Wuhan (China).
G. Weiya, L. Xueqi, and T. Peiwen.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 49-61, 1 fig, 4 tab.

Descriptors: *Discharge hydrographs, *Discharge measurement, *River beds, *Mathematical models, *Uniformity coefficient, Hydrometry, Gaging stations, Gaging, Regression analysis, Mathematical studies, Automation, Data processing, Computers, Stage-discharge relations, Stages.

A parabolic optimum mathematical model for uniformizing the stage-discharge relations of stable river beds is presented and applied to methods of automatic processing and simplification of data collection at gaging stations. A hyperbolic simulation model and a multivariate linear stepwise regression optimum model for performing the same functions are also described. The objects of uniformizing the complex rating curves for stable river beds are those of giving a clear conception, of providing a simple appropriate adjusting method, and of taking this method as a basis for solving the principle problems concerned in automatic processing. Uniformization provides a basis for reducing the number of measurements and makes continuous-record stations obsolete, or changes them into

record stations where data at yearly intervals are collected. Uniformization makes it possible to improve the measurement of discharge and allows gaging stations to be visited only periodically in sequence. It also privdes a new way of simplifying the complex loop rating for hydrological design and forecasting. (See also W86-04785) (Geiger - PTT)
W86-04790

EQUATIONS FOR ESTIMATING DISCHARGE IN STEEP CHANNELS WITH COARSE BED MATERIAL,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W86-04791

MULTILAYER WIDTH-INTEGRATED VELOCITY MEASUREMENT METHOD,

Fujian Provinicial Hydrometric Station, Fuzhou (China).
C. Rihua.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 75-85, 3 fig, 2 tab.

Descriptors: *Flow velocity, *Flow measurement, *Hydrometry, *Mathematical studies, Flow profiles, Flow characteristics, Mathematical models, Flowmeters, Gages, Running waters, Rivers.

The multilayer width-integrated velocity measurement method (MVIVMM) is an innovation in current meter design. The cross section of the river is divided into 4 or 5 layers: the meter (which is suspended from a cable) is drawn across each layer at a constant rate while it makes continuous with-integrated velocity measurements. This contrasts with the standard method in which velocities are determined at fixed points along a series of verticals. The MWIVMM has the advantage of measuring the mean velocity of each individual layer of the cross section: since the operation saves about two-thirds of the time needed for the standard method it may prove an attractive competitor, especially on rivers with rapidly changing stages. (See also W86-04785) (Author's abstract)
W86-04792

MOVING BOAT DISCHARGE MEASUREMENTS USING ACOUSTIC DOPPLER TECHNIQUES,

Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
V. R. Schneider, and R. H. Billings.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 87-92, 5 ref.

Descriptors: *Acoustics, *Flow discharge, *Flow measurement, *Boats, *Flow velocity, Hydrometry, Discharge hydrographs, Discharge measurement, Flowmeters, Rivers, Running waters.

Moving-boat techniques using conventional equipment have been tested and established. Discharge is computed on the basis of cross-section geometry, current meter readings, and flow angles relative to shrore-based targets. Recent developments in acoustic Doppler technology promise a new and potentially superior approach. The acoustic system uses a single transducer array to probe the water column beneath a moving boat and processes echoes from the water mass and bottom into sectional area and velocity measurements. Total discharge across a straight line between the starting and ending points of the boat travel is computed by integration. Feasibility tests are being conducted in the Mississippi River near Baton Rouge, Louisiana. Discharge measurements will be independently made with current meter, conventional moving boat, and acoustic Doppler techniques. (See also W86-04785) (Author's abstract)
W86-04793

DEVELOPMENTS IN HYDROMETRY IN INDIA,

Central Water Commission, New Delhi (India).
S. K. Haldar.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 93-100, 4 fig, 1 tab.

Descriptors: *Flood discharge, *Flood hydrographs, *Flow discharge, *India, *Indirect flood measurement, *Discharge measurement, Discharge hydrographs, Hydrometry, Flowmeters, Flow measurement, Flood profiles, Flow velocity, Mannings equation, Chezy equation, Running waters, Manning's equation.

Measurement of high flood discharge in India is subject to many complications. The most difficult operation while observing high discharge is: the accurate positioning of the boat at the point of measurement, accurate determination of depth, and placing the current meter at the point of measurement in the vertical. A high-powered motor launch has been provided at almost all the important measurement sites. Fish weights are used whenever it is possible to measure the depth by suspension cable and weights. Correction factors are used to compensate for drift of the boat. Discharge measurements by the moving-boat method are conducted at some of the important sites during flood periods and experience has shown that this method is both quick and reliable. When the river is in high flood and it is extremely difficult to enter the river either with the held of motor launch or cable-way, the velocity is measured with the help of floats. Indirect peak discharge estimation is usually carried out by the slope-area method. In India, Manning's equation is used for estimation of discharge on account of its simplicity. (See also W86-04785) (Geiger - PTT)
W86-04794

DESIGN AND STUDY OF THE INSTRUMENTATION REQUIRED FOR THE MEASUREMENT OF DISCHARGE BY THE MOVING BOAT METHOD,

Water Conservancy Hydroelectric Power Scientific Research Inst., Beijing (China).
W. Hongli.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 101-108, 3 fig, 1 ref, 1 append.

Descriptors: *Discharge measurement, *Flow discharge, *Flow measurement, *Flow velocity, *Flowmeters, Discharge hydrographs, Hydrometry, Design criteria, Gages.

The instruments and equipment developed for the measurement of discharge by the moving boat method are described and compared with those in ISO-4369; future development is also discussed. The basic equipment consists of a propeller-type current meter with a photo-electric velocity sensor which generates 24 pulse signals for a turn, an angle indicator with a magnetic synchronous inductor, and an improved echo sounder. The remaining instrumentation is automatic, and includes simultaneous operation and synchronous recording. (See also W86-004785) (Author's abstract)
W86-04795

FLOOD FLOW GAUGING WITH TRITIUM IN SOUTHERN AFRICA,

Ministry of Water Development, Salisbury (Zimbabwe). Hydrological Branch.
P. Wurzel, and P. R. B. Ward.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 119-128, 3 fig, 2 tab, 11 ref.

Descriptors: *Tritium, *Radioactive tracers, *Flood hydrographs, *Rivers, *Flood profiles, Hydrometry, Gages, Flood forecasting, Tracers, Running waters, Ward's equation.

Tritiated water has been in routine use for a number of years in Zimbabwe for measuring flood flows by the dilution method. The advantages of using the dilution method instead of current meter gagings in the kinds of ephemeral rivers, with difficult access that exist in Zimbabwe, are the availability of a liquid scintillation counter and a trained technician for carrying out the measurements, and the low cost of the tritiated water compared to other chemicals. Tritiated water ampules, housed in a small cartridge, are shot into midstream by the use of a mortar. Samples are taken at regular intervals at predetermined sampling stations. Approximate rules for forecasting tracer arrival times and tracer transit durations are useful in planning the execution of the measurements. Ward's equation is used to compute mixing distances and is found to give good approximate predictions of desirable injection point to sampling point distances. (See also W86-04785) (Geiger - PTT)
W86-04796

TRACER MEASUREMENTS IN LOWLAND RIVERS,

Vrije Univ., Brussels (Belgium). Lab. of Hydrology.
W. Bauwens, J. Bellon, and A. van der Beken.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 129-139, 5 fig, 2 tab, 12 ref.

Descriptors: *Tracers, *Dye releases, *Adsorption, *Alluvium, *Organic matter, *Rivers, Sediments, Fluvial sediments, Flow discharge, Flow velocity, Discharge measurement, Mathematical equations, Hydrometry, Running waters.

Comparative travel time measurements were carried out in a river with alluvial sediment and organic material to study the influence of adsorption of fluorescent tracers on the travel time determination. Three types of dyes were used: rhodamine B, rhodamine WT and sulpho-rhodamine B. The results show that adsorption can influence the travel time derived from the concentration curve, especially if the centroid of this curve is used. The relationship between discharge and velocity was examined. For higher discharges the velocity tends to a limit. Measured and calculated values of effective dispersion coefficients are compared. (See also W86-04785) (Geiger - PTT)
W86-04797

TWO LESS CONVENTIONAL METHODS OF FLOW-GAUGING,

Leicester Univ. (England). Dept. of Engineering.
P. H. John, F. A. Johnson, and P. Sutcliffe.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 141-152, 2 fig, 2 tab, 22 ref.

Descriptors: *Gaging, *Flow measurement, *Automation, *Flowmeters, *Flow velocity, Hydrometry, Gages, Floats, Bubble gages, Streamflow, Running waters.

The recent development of the integrating float and salt-velocity flow-gaging methods is discussed. The results of tests relating to precalibration of plastic floats and of field trials using both the single and two-float techniques are presented. It is concluded that if solid floats are used, precalibration may be employed with confidence, integrating float gagings comparing favorably with those obtained by current meter. However, in view of some problems associated with the application of this technique in natural channels, the use of air bubbles is examined. This method has considerable potential but requires some further investigation. Two new automated forms of the salt-velocity technique are described and the results of laboratory tests presented. These show that although slightly less accurate than some other salt-velocity techniques, these automated methods have the advantage of being portable and giving velocity data quickly. (See also W86-04785) (Author's abstract)
W86-04798

RISING AIR FLOAT TECHNIQUE FOR THE MEASUREMENT OF STREAM DISCHARGE,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
D. M. Sargent.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 153-164, 3 fig, 1 tab, 4 ref.

Descriptors: *Streamflow, *Flow measurement, *Gaging, *Floats, *Bubbles, Discharge measurement, Discharge, Flow discharge, Flowmeters, Automation, Gages, Flow velocity.

A simple, practical method of stream flow measurement has been developed that is based on the integrating float technique using air bubbles as rising integrating floats. The field equipment consists of a flexible rubber air supply pipe fitted with nozzles. The photographic method of data capture for subsequent analysis using a micro-computer is described. Field use and a number of field applications ranging from rivers of 20 m to 100 m width, slow moving canals, and concrete channels are considered. Current work on the method includes the possibility of automation using a television camera. Some advantages and limitations of the technique are discussed. The present method offers a real alternative to the velocity area method, particularly as it produces measurements of instantaneous discharge, and it can be used in some situations in which gaging is not possible using traditional techniques. (See also W86-04785) (Geiger - PTT)
W86-04799

INSTALLATION AND OPERATION OF A BUBBLE GAUGE NETWORK IN THE MAHAKAM RIVER BASIN, EAST KALIMANTAN, INDONESIA,

German Agency for Technical Cooperation, Frankfurt am Main (Germany, F.R.).
T. N. Woods, and E. Wachjan.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 165-172, 3 fig, 4 ref.

Descriptors: *Bubble gages, *Water level recorders, *Gages, *River basins, *Automation, Hydrometry, Hydrologic data collections, Networks, Water resources development, Hydrometric equipment, Hydraulic equipment.

A network of automatic water level recording stations has been installed in the Mahakam River Basin to provide water resources data for planning of Transmigration (Resettlement) and Area Development Programs and to monitor the environmental problems of flooding, erosion and sedimentation associated with large scale clearing of primary forests. The topography and instability of the river sections led to the selection of bubble gage recorders and the use of piled timber supports for staff gages at 13 locations. The SEBA Bubbler Gage Omega with a modified chart recorder was selected. This instrument was housed in wood and mounted on stilts on the top of the bank. The instrument casing was secured to the inside wall of the house by means of a clamp. The orifice was generally placed at a minimum depth of 0.5 m below the estimated lowest water level. In the absence of any main supply, 5 volt DC batteries were used to power the instrument at each location. The feed pressure to the instrument is controlled by a reducing valve. The thirteen stations equipped with bubble gages were manned by field observers and visited monthly by hydrological technicians. The network was administered from a project office at Kotabangun in the mid-catchment area. (See also W86-04785) (Geiger - PTT)
W86-04800

DETERMINATION OF THE ACCURACY OF WATER LEVEL OBSERVATION,

Rijkswaterstaat, The Hague (Netherlands).
J. W. Made van der.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England, p 173-184, 12 fig, 1 ref.

Descriptors: *Water level recorders, *Water level, *Multiple regression analysis, *Error analysis, *Rivers, Water level equipment, Hydrometry, Mathematical studies, Gages, Gaging, Hydrometric equipment, Statistical analysis.

The accuracy of a water level observation, expressed by its standard deviation, is influenced not only by the recording instrument itself but also by the situation and the conditions at and around the station. Some external factors affecting the results are: levelling errors; differences in level between the open water and the stilling well; influences of observation time; instrumental inaccuracies; influences of the situation of the gaging station; errors due to observation and digitizing; processing errors; and unclear definitions of the concept of true water level. The standard deviation cannot be derived from local observations only, because of the real movements of the water stage. Methods of deriving the standard deviation (inaccuracy) from neighboring stations, using simple multiple regression, are described. It appears that the standard deviation of water level observations in rivers can amount to several centimeters. (See also W86-04785) (Geiger - PTT)
W86-04801

IMPROVEMENT OF ULTRASONIC FLOWMETER IN RIVERS IN JAPAN,

National Research Center for Disaster Prevention, Sakura (Japan).
T. Kinosita.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 187-202, 12 fig, 6 ref.

Descriptors: *Flowmeters, *Flow measurement, *Ultrasonics, *Japan, *Stage-discharge relations, *Discharge measurement, Hydrometry, Flow, Rivers, Tidal rivers, Networks, Hydrologic data collections, Hydrometric equipment.

Ultrasonic flowmeters have already been successfully implemented in rivers in Japan. There is good agreement between the traditional method using current meters and the ultrasonic method. Direct continuous measurement is often necessitated in areas of high water, on tidal rivers, and at outflow from a lake. Improvements have been made concerning cable crossings, interference caused by temperature extremes, interference caused by noise, and ultrasonic velocity changes. Hydraulic characteristics of river flow based on continuously measured discharge are discussed, and these characteristics are useful in providing guidelines for hydrometric network systems. (See also W86-04785) (Geiger - PTT)
W86-04802

EXPERIENCES GAINED DURING THE HYDRAULIC INVESTIGATIONS ON THE COOLING WATER SYSTEM OF A THERMAL POWER STATION,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 8C.
W86-04803

MEASUREMENT OF OPEN CHANNEL FLOW BY THE ELECTROMAGNETIC GAUGE,

Department of the Environment, Reading (England). Water Data Unit.
R. W. Herschy, and J. D. Newman.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 215-227, 10 fig, 1 tab, 4 ref.

Descriptors: *Gages, *Flowmeters, *Flow measurement, *Electromagnetic waves, *Channel flow, Channels, Hydrometry, Gaging, Automation, Flow discharge, Discharge measurement, Flow, Performance evaluation, Sewers, Culverts, Hydraulic equipment.

Since 1975, significant improvements have been made to the electromagnetic gage for measuring flows in open channels. These improvements have been mainly in the instrumentation. The principle of operation of the gage and the main criteria for site selection for an electromagnetic gaging station are described. The site calibration of an electromagnetic gage requires the establishment of the relation of discharge as found by current meter, or other means, to the variables for electrode voltage, depth of flow, and coil current. The coil of the gage may be installed in covered U-section ducts, or pipes. The electromagnetic gage may be used in gaging flow in sewers and culverts. In this application a prefabricated pipe of glass reinforced plastic is lowered into a manhole or access shaft and coupled to the pipeline. Performance tests of the gage on rectangular channels show the method to be reliable with an uncertainty of the order of 2%. The instrumentation of the process is based on a microprocessor bus-bar system which gives a high degree of flexibility in providing output options. A software and hardware sub-routines so that where software extensions are needed additional modules may be plugged in. (See also W86-04785) (Geiger - PTT)
W86-04804

HYDROMETRIC DATA CAPTURE USING INTELLIGENT SOLID STATE LOGGING SYSTEMS,

Severn-Trent Water Authority, Birmingham (England).
S. T. Walker.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 229-237.

Descriptors: *Hydrometry, *Computers, *Gages, *Monitoring, *Hydrologic data collections, Gaging, Ultrasonics, Electromagnetic waves, Rain gages, Remote control, Data acquisition, Automation, Hydrometric equipment.

From small beginnings with relatively simple rainfall event recorders, the use of solid state logging technology has expanded steadily within the Severn-Trent Water Authority hydrometric service. Ultrasonic and electromagnetic river flow measuring systems now record on intelligent microprocessor driven devices, instead of on the traditional punched paper tape. Further variants with increased versatility have been developed and are undergoing field trials. These include devices with built-in facility to monitor continuously, but record data only when predetermined threshold values are exceeded, or indeed, to record only significant changes in the state of a variable. The concept of the 'electronic notepad' has been introduced successfully into current meter gaging and shows promise for use in other hydrometric fields. In all cases, great attention has been paid to the human engineering' of the devices, and satisfying success has been achieved in making them easily usable by staff previously experienced only with traditional hydrometric equipment. (See also W86-04785) (Author's abstract)
W86-04805

FLOW MEASUREMENT AT SEWAGE TREATMENT PLANTS,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Mayer.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 241-245, 3 fig.

Descriptors: *Flow measurement, *Flowmeters, *Wastewater facilities, *Canals, *Flow rates, Flow discharge, Flow, Process control, Hydrometry, Hydrometric equipment.

Flow rates in open canals are measured almost exclusively by devices registering the headwater

level of shooting flow created by a constriction. At sewage treatment plants the sensing devices situated along the measuring constriction are susceptible to clogging, corrosion and to becoming inoperative, owing to the chemical, bacterial, or radiation effects of the substances present in the water. These difficulties were overcome by a measuring tube continuously flushed with fresh water. This is a substantially perforated tube in which the flushing water flows toward the sewage. The surface of the flushing fresh water in the tube rises - as in communicating vessels - to the same height as the surface of the sewage to be measured. In this way a fresh-water measuring station is achieved in the sewage. A teflon-coated sensing device is installed at the measuring station. The transmitted are transformed by micro-processors and a calculator into digital and graphical printouts indicating the actual flow rate, and the total volume up to the time of measurement. (See also W86-04785) (Author's abstract)
W86-04806

MONITORING WATER QUANTITY AND WATER QUALITY IN AN URBAN BASIN,

F. H. M. Ven van de.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IASH, July 19-30, 1982, Exeter, England. p 247-256, 6 fig, 3 ref.

Descriptors: *Water quality, *Water supply, *Urban drainage, *Catchment areas, *Monitoring, Hydrometry, Flow measurement, Computers, Automation, Hydrologic data collections, Flowmeters, Sampling, Hydrometric equipment, Water quality control, Water quality management, Canals.

A new urban drainage basin has been equipped in Lelystad for monitoring of both water quality and water quantity. Measurements of flow and the water quality parameters are performed continuously at the outfall of the stormwater drain and at three points in the receiving water body - a canal. A sampler is also installed at the outfall. The monitoring equipment is connected to a computer-controlled data logging system by a common carrier interface. On-line data reduction is performed by the logger, while the sampler takes either grab samples or collected samples. The quantitative variables are measured simultaneously with two instruments for a higher degree of reliability and accuracy. The qualitative monitors are regularly recalibrated and are kept under a strict preventive maintenance schedule. (See also W86-04785) (Author's abstract)
W86-04807

HADDINGTON FLOOD WARNING SYSTEM,

Institute of Hydrology, Wallingford (England).
G. P. Brunsdon, and R. J. Sargent.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 257-272, 5 fig.

Descriptors: *Flood forecasting, *Models, *Rainfall-runoff relationships, *Automation, *Flow measurement, Flood hydrographs, Flood plain management, Hydrologic data collections, Monitoring, Hydrometry, Computers, Rain gages, Hydrologic models, Data acquisition.

The data acquisition system described in this paper is described for forecast floods in the Haddington region which is located 25 km east of Edinburgh in Scotland. The instrumentation is compact, simple to operate, exploits modern microprocessor technology and is fully automatic. Low cost, good reliability and minimal maintenance requirements were factors considered during design. The system collects river flow and rainfall data, computes the catchment's response using a rainfall/runoff model and automatically updates a remote monitor with flow predictions and maintenance alerts. It is thus particularly suited to flood warning schemes where 24-hr manning cannot be provided and is specifically designed to operate on steep catchments where upstream river correlation cannot give sufficient warning. (See also W86-04785) (Author's abstract)
W86-04808

SATELLITE DATA AS BASIS FOR THE ESTIMATION OF RAINFALL AND RUNOFF,

Bochum Univ. (Germany, F.R.).
L. R. Kruger, G. Strubing, and G. A. Schultz.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 273-284, 10 fig, 7 ref.

Descriptors: *Satellite technology, *Rainfall, *Runoff, *Remote sensing, *Infrared imagery, Hydrologic data collections, Hydrometry, Rainfall-runoff relations, Data acquisition, Hydrologic models, Clouds.

Remote sensing techniques are increasingly applied in order to acquire hydrological data. Particularly in developing countries (where often no hydrometric data are available) remote sensing techniques based on satellite imagery may be valuable for design or operation of water resources systems. Two techniques for the application of satellite imagery in hydrology are presented. The first shows a method for the estimation of rainfall volumes from infrared imagery of a geostationary satellite providing information of the time-dependent change of cloud surface temperature and cloud area. On the basis of these parameters a mathematical model is developed which computes rainfall volumes. This technique is not yet operational, but in principle it can be used for runoff estimation from images of a polar orbiting satellite using an indexing technique. This method allows the direct estimation of monthly runoff values from daily infrared images. The method could eventually be applied for the generation of hydrological design data. (See also W86-04785) (Author's abstract)
W86-04809

TOWARDS A SATELLITE-BASED HYDROMETRIC DATA COLLECTION SYSTEM,

Department of the Environment, Reading (England). Water Data Unit.
R. W. Herschy.
IN: Advances in Hydrometry, IAHS, July 19-30, 1982, Exeter, England. p 285-296, 3 fig, 1 tab, 4 ref.

Descriptors: *Satellite technology, *Hydrologic data collections, *Telemetry, *Hydrometry, *Meteorological data collection, Discharge measurement, Networks, Data acquisition, Remote sensing, Data transmission, Gaging, Cost analysis.

Water level and discharge data for the United Kingdom streams and rivers are at present punched on to paper tape. This system involves delay, and the equipment is due for replacement. The use of satellite telemetry is considered as an alternative. The types of Data Collecting Platforms (DCPs) available include self-timed units where the data are transmitted in buffered blocks of data at fixed intervals, DCPs which provide an immediate alert transmission when a critical data value has been reached, and interrogable DCPs where the unit receives a command message from the control center via the satellite. The United Kingdom has investigated the data collection systems offered by the geostationary satellites and the METEOSAT earth receiving station. The United Kingdom pilot study showed the DCP to be a reliable and cost effective method of transmitting hydrological data. Some on-site pre-processing before transmission could be performed simply and conveniently by the DCP microprocessor. Use of the satellite system in conjunction with the WEFAX dissemination program is considered. Exiting telemetry networks suffer from high installation and maintenance costs. The largest cost of a satellite system is the design, manufacture, launching and operation of the satellite. A satellite data collection system would appear to offer a cost effective replacement to the existing United Kingdom system of data collection. (See also W86-04785) (Geiger-PTT)
W86-04810

SPECIFIC HYDROMETRY OF KARST REGIONS,

Split Univ. (Yugoslavia). Faculty of Engineering.
For primary bibliographic entry see Field 2F.
W86-04812

DEVELOPMENTS IN HYDROMETRY IN CENTRAL AMERICA AND BRAZIL,

Projecto de Hidrologia e Climatologia da Amazonia, Belem (Brazil).
M. B. Dengo.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 335-344, 2 fig, 4 ref.

Descriptors: *Hydrometry, *Developing countries, *Hydrologic data collections, *River basins, *Telemetry, Data acquisition, Meteorological data collection, Discharge measurement, Flow discharge, Flow measurement, Flood forecasting, Networks, Hydrologic models, Tocatins River, Amazon River, Brazil, Costa Rica, Panama.

A general review of the developments in hydrometry in Central America in the 1970-1980 decade is given. Under the UNDP/WMO Central American Hydrometeorological Project, the number of meteorological and hydrological networks were increased in improved flow and flood-forecasting systems. Honduras has begun forecasting activities with a new telemetric network in the basin used for the El Cajon Hydroelectric Project. Panama and Costa Rica are also preparing telemetry stations in their networks. The Brazilian Project on Hydrology and Climatology of Amazonia (PHCA) has centered its activities along three main lines: the square-grid study to determine the minimum size of network capable of producing data of acceptable quality, and to create a physiographic-hydrometeorlogical data bank; the design, installation and oepration of a pilot telemetry network in the River Tocantins basin; and the mathematical modelling of the middle and lower Amazon River. Two techniques used by PHCA for stage-discharge relationship evaluation are discussed. For the calculation of discharge in backwater reaches, the backwater isolines method is used. A dynamic model has been implemented to represent the stage-discharge relationship in hysteresis loops. Both of these methodologies are computer-oriented and permit the automatic calculation of discharge. (See also W86-04785) (Geiger - PTT)
W86-04813

ADVANCED HYDROLOGIC INSTRUMENTATION ACTIVITIES WITHIN THE WATER RESOURCES DIVISION OF THE US GEOLOGICAL SURVEY,

Geological Survey, Reston, VA. Water Resources Div.
R. W. Paulson, R. H. Billings, and A. S. Cherdak.
IN: Advances in Hydrometry, IAHS Publication No.134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 353-359, 3 fig, 2 ref.

Descriptors: *Networks, *Hydrologic data collections, *Hydrometry, *Research priorities, *Gaging, *Monitoring, Sampling, Data acquisition, Data collection, Automation, Future planning, Data transmission, Data processing, Design criteria, Network design, Water sampling.

Primary responsibility for the USA's water data lies with the Water Resources Division of the U.S. Geological Survey. The Survey has identified a need for upgrading its water data-collection system in the field. A three-phase program is under way to define needs for field instrumentation and techniques, applicable technologies, and specific research and development plans. Two of the Survey's instrumentation projects are described, which fit into this program of upgrading technology. The first is a study of the time base of data sampling at fixed gaging stations. The second is the planning and development of a new field data acquisition system to replace the 12,000 to 15,000 mechanical punched-tape recorders now used in

the Survey network. (See also W86-04785) (Author's abstract)
W86-04815

EROSION AND SEDIMENT TRANSPORT MEASUREMENT: SYMPOSIUM.

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2J.
W86-04843

MEASUREMENT OF BED LOAD IN RIVERS,

Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 2J.
W86-04844

INCREASED BAG SIZE IMPROVES HELLEY-SMITH BED LOAD SAMPLER FOR USE IN STREAMS WITH HIGH SAND AND ORGANIC MATTER TRANSPORT,

For primary bibliographic entry see Field 2J.
W86-04845

EFFICIENCY OF BASKET TYPE BED LOAD SAMPLERS,

National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2J.
W86-04846

DEVELOPMENT OF A SAND BED LOAD SAMPLER FOR THE YANGTZE RIVER,

Yangtze River Planning Office, Hankou (China).
For primary bibliographic entry see Field 2J.
W86-04847

NUCLEAR TECHNIQUES FOR MEASURING SEDIMENT TRANSPORT IN NATURAL STREAMS, EXAMPLES FROM INSTRUMENTED BASINS,

Naples Univ. (Italy). Ist. di Geologia e Geofisica.
For primary bibliographic entry see Field 2J.
W86-04849

DEVELOPMENT OF NUCLEAR SEDIMENT CONCENTRATION GAUGES FOR USE ON THE YELLOW RIVER,

Yellow River Conservancy Commission, Zhengzhou (China). Inst. of Hydraulic Research.
For primary bibliographic entry see Field 2J.
W86-04850

LATEST ACHIEVEMENTS IN THE DEVELOPMENT OF NUCLEAR SUSPENDED SEDIMENT GAUGES,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2J.
W86-04851

CONTINUOUS MEASUREMENT OF SUSPENDED SEDIMENT IN RIVERS BY MEANS OF A DOUBLE BEAM TURBIDITY METER,

Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 2J.
W86-04852

USE OF TURBIDITY MONITORS TO ASSESS SEDIMENT YIELD IN EAST JAVA, INDONESIA,

Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 2J.
W86-04853

ANALYSIS OF A SIMPLE SUSPENDED LOAD INTEGRATING SAMPLER,

Florence Univ. (Italy). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-04854

RECENT DEVELOPMENTS IN PUMP SAMPLERS FOR THE MEASUREMENT OF SAND TRANSPORT,

Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 2J.
W86-04855

FIELD MEASUREMENTS OF SUSPENDED SEDIMENT CONCENTRATION IN THE SURF ZONE,

Polish Academy of Sciences, Gdansk. Inst. Budownictwa Wodnego.
For primary bibliographic entry see Field 2J.
W86-04856

IN SITU MEASUREMENTS OF PARTICULATE MATTER TRANSPORT IN RIVERS,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 2J.
W86-04857

SEDIMENT MEASUREMENT TECHNIQUES USED BY THE SOIL CONSERVATION SERVICE OF NEW SOUTH WALES, AUSTRALIA,

Soil Conservation Service of New South Wales, Sydney (Australia).
For primary bibliographic entry see Field 2J.
W86-04858

SEDIMENT TRANSPORT SAMPLING FOR ENVIRONMENTAL DATA COLLECTION,

Water and Power Resources Service, Denver, CO.
E. L. Pemberton.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 159-167, 3 fig, 2 tab, 10 ref.

Descriptors: *Sediment transport, *Sampling, *Environmental effects, *Rivers, Suspended sediments, San Juan River, New Mexico, Trinity River, California, Smith's Fork River, Utah, Niobrara River, Nebraska, Einstein sampling procedure, River beds.

Case histories of sediment sampling for environmental concerns are described. Sampling programs varied, primarily because of the bed material composition. The collected sediment data consist of suspended sediment samples and channel hydraulic parameters for use in computing total sediment transport by the modified Einstein procedure. The rivers were as follows: San Juan River, New Mexico; Trinity River, California, Smith's Fork River, Utah; and Niobrara River, Nebraska. All were shallow, less than 1 meter. Sediment sampling was done with the rod sampler or handline using the equal width interval method. For the rivers with bimodal bed material (Gravel-cobble in both the quiescent reaches and the riffles or rapids and sand-size sediments intermixed with the larger material) both types of bed material were sampled. The coarser material was sampled with a square grid photograph, shovel sample for sieve analysis, or visually. Another problem with the bimodal beds was the number of samples required for good representation; sand requiring more samples. (See also W86-04843) (Cassar - PTT)
W86-04859

SEDIMENT SAMPLING IN RIVERS AND CANALS,

Uttar Pradesh Irrigation Research Inst. Roorkee (India).
H. S. S. Singhal, G. C. Joshi, and R. S. Verma.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 169-175, 3 fig, 6 ref.

Descriptors: *Sediment transport, *Sampling, *Bed load, *Suspended sediments, *Rivers, *Canals, India, Floods.

Sampling techniques for bed and suspended load observations in rivers and canals at both low and high velocity flows were studied at Roorkee, India. Bed load measurements were done with a pressure difference bed load sampler. This instrument had very high efficiency. In rivers suspended and bed load sampling was done at five verticals. However, in canals three vertical samples were done. Suspended load measurements were done with a modified depth integrating sampler. The mean value of suspended sediment load was found from single samples at 0.5 of the river depth and 0.54 of the canal depth. Sediment loads in flood stage could not be determined using conventional equipment and methods. The following techniques were used during these periods. Surface samples were collected from bridges, assuming that the turbulence around the piers would produce a homogeneous sample. A relationship was developed between average suspended sediment concentration and surface suspended sediment concentration, which was applicable to surface samples collected during floods. A relationship was determined between total (suspended and bed) load and average suspended load during stable conditions for calculation of total load at high flows. (See also W86-04843) (Cassar - PTT)
W86-04860

STUDY OF THE VARIABILITY OF SUSPENDED SEDIMENT MEASUREMENTS,

Agricultural Research Service, Chickasha, OK.
P. B. Allen, and D. V. Petersen.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 203-211, 3 fig, 4 tab, 6 ref.

Descriptors: *Sediment transport, *Suspended sediments, *Rivers, *Sampling, Washita basin, Oklahoma, Sediment load.

A study was made of the variability of suspended sediment concentration data collected using paired equal-transit-rate samples, paired vertical and equal-transit-rate samples, and paired automatic type and equal-transit-rate samples. Data were selected from two gaging locations in the U.S. southern plains. Equal-transit-rate sample concentrations collected by experienced operators. Agreement was less at the more difficult-to-sample location that had a large channel, a truss bridge, and a large sand load. The long-term sediment load for this location was computed with the higher of each of the paired concentrations obtained by less experienced operators. This load was 30% higher than the truer load derived with the lower concentrations. Data obtained with the single-vertical sampling method and automatic pumping-type samplers can be used to determine the entire suspended sediment load, if long-term sediment yield errors up to about 10% can be tolerated. (See also W86-04843) (Author's abstract)
W86-04863

ACCURACY OF ESTIMATING BASIN DENUDATION PROCESSES FROM SUSPENDED SEDIMENT MEASUREMENTS,

Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 2J.
W86-04864

TECHNIQUES APPLIED IN DETERMINING SEDIMENT LOADS IN SOUTH AFRICAN RIVERS,

Pretoria Univ. (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-04865

MEASUREMENT OF DEBRIS FLOW AND SEDIMENT-LADEN FLOW USING A CONVEYOR-BELT FLUME IN A LABORATORY,

Kyushu Univ., Fukuoka (Japan). Dept. of Civil Engineering.
M. Hirano, and M. Iwamoto.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 225-230, 12 fig, 2 ref.

Descriptors: *Sediment transport, *Flow measurement, *Suspended sediment, Flumes, Flow Rate.

Though a bore is a nonsteady flow, it can be treated as a steady flow in a coordinate system which moves at the same speed as the bore. To make a steady bore in the laboratory, a conveyor-belt type of flume with a movable bed was constructed. By setting the belt speed to that of the bore front, a statistic debris bore was obtained. In addition, flow of a zero mean velocity was obtained by setting the belt speed to that of the mean flow velocity for a selected slope. In this way detailed observations of grain behavior over long periods were possible with improved measurement accuracy. Experiments on debris flow and sediment-laden flow were undertaken incorporating measurements of grain concentration, velocity distribution and grain trajectories. (See also W86-04843) (Author's abstract)
W86-04866

SOME PROBLEMS RELATED TO SEDIMENT TRANSPORT MEASUREMENT IN STEEP MOUNTAIN STREAMS,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2J.
W86-04867

INTEGRATED DEBRIS FLOW OBSERVATIONS,

Kyoto Univ. (Japan). Disaster Prevention Research Inst.
For primary bibliographic entry see Field 2J.
W86-04868

NEW METHODS OF MEASUREMENT OF SLOW PARTICULATE PROCESSES ON HILLSIDE SLOPES,

London School of Economics and Political Science (England). Dept. of Geography.
W. E. H. Culling.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 267-274, 1 fig, 17 ref.

Descriptors: *Sediment transport, *Soil mechanics, *Soil creep, *Slopes, Particulate matter, Mathematical studies.

Two methods for measuring soil creep on hillsides are proposed. The first relies on a steady-state solution to the diffusion equation for the region bounded internally by a circular cylinder. This method has some theoretical and practical difficulties, but it offers the advantage of a single, completely destructive observation that can be carried out in the laboratory. The second estimates the velocity of particles by counting. (See also W86-04843) (Cassar - PTT)
W86-04870

SEDIMENT MEASUREMENT IN THE YELLOW RIVER,

Yellow River Conservancy Commission, Zhengzhou (China).
For primary bibliographic entry see Field 2J.
W86-04871

MEASUREMENT OF SEDIMENT YIELD AND TRANSPORT IN MOUNTAIN TORRENTS IN JAPAN,

Public Works Research Inst., Tsukuba (Japan).
For primary bibliographic entry see Field 2J.
W86-04872

MEASUREMENT OF SUSPENDED SEDIMENT AND BED LOAD IN SAND BED CHANNELS AND THE ASSOCIATED PROBLEMS,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W86-04873

SIGNIFICANCE, MEASUREMENT, AND ANALYSIS OF SEDIMENT DISCHARGES OF FLASHY STREAMS,

Irrigation and Power Research Station, Amritsar (India).
For primary bibliographic entry see Field 2J.
W86-04874

UPLAND EROSION: EVALUATION AND MEASUREMENT,

Istituto Sperimentale per lo Studio e la Difesa del Suolo, Florence (Italy).
For primary bibliographic entry see Field 2J.
W86-04877

INSTRUMENTATION FOR STUDIES OF THE EROSIVE POWER OF RAINFALL,

National Coll. of Agricultural Engineering, Silsoe (England).
N. W. Hudson.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 383-390, 1 fig, 31 ref.

Descriptors: *Erosion, *Measuring instruments, *Rainfall impact, Splash erosion, Soil erosion.

There is a need for both a worldwide study of the erosivity of rainfall, and also for detailed localized studies. Previous studies, which are reviewed, have used different techniques, and this complicates the comparison of results. The alternatives are (a) direct measurements of erosion, which are only effective for splash erosion; (b) computations from measurements of raindrop size, which is established but laborious technique even with modern scanners and signal analyzers; (c) direct measurement of rainfall properties such as impact stress, momentum, or energy. It is suggested that this last method is most appropriate because of developments in pressure transducers and microprocessors. The proposed route to standardization is first a comparative study of pressure transducers and acoustic or piezoelectric sensors, followed by development of an instrument suitable for cheap mass production, which could then be adopted and used by an international network. (See also W86-04843) (Author's abstract)
W86-04881

SOIL EROSION UNDER SIMULATED RAINFALL IN THE FIELD AND LABORATORY: VARIABILITY OF EROSION UNDER CONTROLLED CONDITIONS,

Scarborough Coll., Westhill (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W86-04882

LABORATORY AND FIELD TESTING OF A PROGRAMMABLE PLOT-SIZED RAINFALL SIMULATOR,

Purdue Univ., Lafayette, IN. Agricultural Experiment Station.
For primary bibliographic entry see Field 2J.
W86-04883

OUTDOOR PORTABLE RAINFALL EROSION LABORATORY,

Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
C. A. Onstad, J. K. Radke, and R. A. Young.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 415-422, 6 fig, 8 ref.

Descriptors: *Erosion, *Measuring instruments, *Rainfall simulators, Simulated rainfall, Infiltration, Sediment concentration, Runoff, Soil surfaces, Microrelief profilimeter.

A trailer-mounted rainfall simulator for infiltration and erosion research has been built and tested. Rainfall is applied continuously through a series of drop forming needles. The simulator allows for a wide range of intensities, from near zero to approximately 200 mm/hour. In conjunction with the simulator, an automatic microrelief profilimeter is used to measure soil surface characteristics. This instrument automatically scans points on a 1 cm by 5 cm grid spacing to measure soil surface elevations with a vertical resolution of 1 mm over a 25 cm range. Also, associated with the laboratory is a density measuring apparatus which continuously records sediment concentrations in runoff water. (See also W86-04843) (Author's abstract)
W86-04884

PORTABLE RILL METER FOR FIELD MEASUREMENT OF SOIL LOSS,

Agricultural Research Service, Pullman, WA.
D. K. McCool, M. G. Dossett, and S. J. Yecha.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 479-484, 1 fig, 1 tab, 3 ref.

Descriptors: *Erosion, *Measuring instruments, *Soil loss, Soil erosion, Rill erosion, Rill meters, Runoff, Runoff plot.

A portable rill meter for measuring soil erosion is described. It has a working width of 1.829 m, uses long stainless steel pins, and has a maximum depth range of 410 mm. A 35 mm single lens reflex camera with a 28 mm wide-angle lens is used to record data. A grid background serves as reference or as a means for digitization. These instruments can be used after events in relatively inaccessible locations such as high elevation surface mine spoil banks and revegetated sites in remote areas. They can measure erosion on rangeland trails carrying heavy off road recreational vehicle traffic, on cropland to supplement runoff plot data, and on runoff collection plots to quantify rill and inter-rill erosion. The lightweight second version of the meter weighs 25 kg without the camera. (See also W86-04843) (Cassar-PTT)
W86-04890

FIELD MEASUREMENTS OF RATES OF BANK EROSION AND BANK MATERIAL STRENGTH,

Akademiya Nauk SSSR, Moscow. Soviet Geophysical Committee.
C. R. Thorne.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 503-512, 2 fig, 17 ref.

Descriptors: *Erosion, *Soil mechanics, *Field measurements, Stream banks, River banks, Soil properties, Shear strength, Tensile strength, Remote sensing, Sonar, Flumes, Aerial photography, Photograph, Maps.

Methods of monitoring rates and locations of bank erosion are reviewed. On-site measurements require a detailed map of the channel and bank lines. This can be done by plane tabling or the compass and tape technique. Spatial and temporal variations are obtained using erosion pins. On large rivers side-scan sonar can locate bank failures underwater. Remote sensing techniques involve aerial photography and historical maps. Measurements of bank material strength involve erodibility (studied in flumes), shear strength (measured with the bore-hole shear tester), and tensile strength (measured by the modified compression tester). (See also W86-04843) (Cassar - PTT)
W86-04893

LAND EROSION, RESEARCH EQUIPMENT, FORECASTING METHODS AND PROSPECTS FOR THEIR IMPROVEMENT,

Gruzinskii Nauchno-Issledovatel'skii Inst. Gidrotekhniki i Melioratsii, Tiflis (USSR).
For primary bibliographic entry see Field 2J.
W86-04895

TRACKING SALTY SOIL, SAVING FRESH WATER,

For primary bibliographic entry see Field 3C.
W86-04982

MONITORING WELL SCREEN INFLUENCES ON DIRECT FLOWMETER MEASUREMENTS,

K-V Associates, Inc., Falmouth, MA.
W. B. Kerfoot, and V. A. Massard.
Ground Water Monitoring Review, Vol. 5, No. 4, p 74-77, Fall 1985. 4 fig, 3 tab, 3 ref.

Descriptors: *Instrumentation, *Flowmeters, *Flow measurement, *Well screens, *Monitoring, *Groundwater movement, *Test wells, Directional determinations, Flow resistance.

A simple procedure is described to test an unknown well screen to determine its influence on measurement of direction and rate of groundwater flow. The investigations concern well screens constructed of smooth-interior, slotted or wrapped polyvinylchloride monitoring wells compatible with ground water flowmeters employing gravity bead packers where glass beads are used in a netbag to maintain porous flow conditions between the screened area and are used to transmit the heat pulse. A variety of commercial smooth-interior slotted and wrapped well screens were found satisfactory for sensitive measurements. Increasing the frequency of slots and the number of slot rows allows accuracies of directional determination of + or - 4 degrees. Using external packing material to keep silt out and maintaining a 0.02-inch slot width allows more than a six-fold increase in sensitivity to flow by lessening resistance to flow. The simple procedure employed for testing resistance to flow and accuracy of direction can be used on any unknown well screen to verify its suitability for measurements. (Rochester-PTT)
W86-05026

TWO-WAVELENGTH (0.86 CM AND 3.2 CM) RADAR OBSERVATION OF MICROPHYSICAL PROCESS IN STRATIFORM PRECIPITATION PART I. ATTENUATION OF RADAR WAVE DUE TO PRECIPITATION PARTICLES AND CORRECTION METHOD,

Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2B.
W86-05091

TWO-WAVELENGTH (0.86 CM AND 3.2 CM) RADAR OBSERVATION OF MICROPHYSICAL PROCESS IN STRATIFORM PRECIPITATION PART II. STUDY ON SIZE DISTRIBUTION CHANGE OF PRECIPITATION PARTICLES,

Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2B.
W86-05092

ACHIEVING IMPROVED FREQUENCY RESPONSE OF THE RAIN STRUCTURE FROM SPACEBORNE RADAR ALTIMETERS BY EMPLOYING DECONVOLUTION METHODS,

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
For primary bibliographic entry see Field 2B.
W86-05098

ACCURACY OF RAINFALL ESTIMATES BY RADAR, PART II: COMPARISON WITH RAINGAUGE NETWORK,

British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
For primary bibliographic entry see Field 2B.
W86-05110

ACCURACY IN RAINFALL ESTIMATES BY RADAR, PART III: APPLICATION FOR SHORT-TERM FLOOD FORECASTING,

British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
For primary bibliographic entry see Field 2B.
W86-05111

COMPATIBILITY OF CARBON UPTAKE RATES CALCULATED FROM STABLE AND RADIOACTIVE ISOTOPE DATA: IMPLICATIONS FOR THE DESIGN OF EXPERIMENTAL PROTOCOLS IN AQUATIC PRIMARY PRODUCTIVITY,

Centre de Recherche en Ecologie Marine et Aquaculture, Nieul sur Mer (France).
For primary bibliographic entry see Field 2H.
W86-05174

DIFFERENTIAL BARE FIELD DRAINAGE PROPERTIES FROM AIRBORNE MICROWAVE OBSERVATIONS,

Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
For primary bibliographic entry see Field 2G.
W86-05245

SOIL WATER EXTRACTOR THAT MINIMIZES CO2 DEGASSING AND PH ERRORS,

For primary bibliographic entry see Field 2G.
W86-05246

DISTRICT METERING,

Sunderland and South Shields Water Co. (England).
R. A. Pepper.
Journal of the Institute of Water Engineers and Scientists, Vol. 39, No. 6, p 485-493, December 1985. 1 fig, 3 tab, 5 ref.

Descriptors: *Water metering, *Telemetry, *Networks, *Data collections, Water use, Water districts, Computers, Monitoring, Water distribution, Leakage.

The Mid Kent Water Company of England started a telemetry system in 1968 which has evolved into a regular weekly, computer-assisted procedure for water accounting in some 240 districts covering much of the area of supply. The network also uses manually read meters with the potential to improve the metering level in the future. The metering system identifies districts with abnormal demands, assists in planning, optimizing and extending the distribution system and is a valuable aid in leak detection. The company maintains a strong uniformed prevention of waste department that handles both waste prevention and bylaw enforcement. Weaknesses in the current computational procedures are being examined along with domestic consumption levels, new metering equipment and a replacement computer-based telemetry system. (Geiger-PTT)
W86-05316

EFFECTIVENESS OF SAMPLING STRATEGIES FOR INTERTIDAL MONITORING,

Victoria Univ. of Manchester (England). Dept. of Zoology.
S. J. Hawkins, R. G. Hartnoll, G. A. Williams, P. J. Azzopardi, and M. T. Burrows.
Water Science and Technology WSTED4, Vol. 18, Nos. 4/5, p 63-72, 1986. 5 fig, 2 tab, 21 ref.

Descriptors: *Water sampling, *Intertidal areas, *Monitoring, Water quality control, Evaluation, Estuaries, Wales, Isle of Man, Statistical analysis.

Multiple random quadrats (25 cm by 25 cm) were sampled at five sites on depositing shores in South Wales and the Isle of Man. The effect of the increased number of samples was examined in relation to the reliability of estimation of various ecological measures (number of species, total individuals, total individuals of selected species). The replication required varies with the measure involved, but generally 10-20, or even more quadrats, are needed for reliable information which can be used to detect other than very gross changes with time. In monitoring programs, it is therefore advantageous to concentrate sampling efforts on a limited number of sites with high replication, because of this considerable spatial variation. The need to define specific aims, and to design a sampling format related to these aims, is emphasized. (Lantz-PTT)
W86-05358

7C. Evaluation, Processing and Publication

AUTOMATION OF DAILY WATER DISCHARGE COMPUTATION FOR RIVERS WITH DIFFERENT REGIMES,

Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
Y. N. Ivanov.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 345-352, 19 ref.

Descriptors: *Discharge measurement, *Automation, *Rivers, *Computers, *Runoff, Flow discharge, Mathematical studies, Algorithms, Hydrologic data collections, Flood forecasting, Ice jams, Mathematical models, Data processing, USSR.

A system for processing hydrological data is proposed which allows one to automate the process of getting computerized daily water discharges, daily water stages, tables of measured water discharges and icing conditions of a water body. The system of processing consists of an automated input of initial information and its processing, the evaluation of quantity and accuracy of water discharge, and computation of parameters of water discharge curves. The selection of a method for computation of daily water discharges is made automatically by means of criteria elaborated by the author. Computation of discharge for the periods of out-of-bank flow, and during freeze-up, is realized by the methods accepted in the USSR; and for periods of river bed deformations by the method of time curves and Bolster, but with the author's corrections. Results are available in the form of tables of daily data with accuracy estimates of all the computations. The system is now under trial. (See also W86-04785) (Author's abstract)
W86-04814

RELIABILITY OF SUSPENDED SEDIMENT LOAD DATA,

Exeter Univ. (England). Dept. of Geography.
D. E. Walling, and B. W. Webb.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 177-194, 6 fig, 9 tab, 23 ref.

Descriptors: *Sediment transport, *Suspended sediment, *Sampling, Creedy River, United Kingdom, Sediment load, Mathematical studies.

Numerical indirect methods for estimating long-term suspended loads were applied to data from the River Creedy, United Kingdom, for which 7 years of continuous records were available. Serious over- and underestimation of loads was evident. Ratios of estimated/measured load for eight year-long periods and five interpolation procedures ranged from 0.17 to 3.13. (See also W86-04843) (Cassar - PTT)
W86-04861

ACCURACY AND PRECISION OF SUSPENDED SEDIMENT LOADS,

Guelph Univ. (Ontario). School of Engineering.
W. T. Dickinson.
IN: Erosion and Sediment Tranport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 195-202, 3 fig, 15 ref.

Descriptors: *Sediment transport, *Sampling, *Suspended sediment, *Rivers, Sediment load, Mathematical studies.

The effects of five computational methodologies and four sampling frequencies on the accuracy and precision of annual suspended sediment load estimates has been explored. The mean ratio of the estimated annual suspended load to the population suspended sediment load has been determined for each method and frequency as an index of accuracy. The standard deviation of the ratio has been

determined as an index of precision. Some computational methods have been found to be both precise and accurate over a range of sampling frequencies. One method appears to be reasonably precise but very inaccurate: another reasonably accurate but not precise. The results are seen to be extremely important for the selection of both sampling schemes and computational techniques for suspended sediment studies and for the evaluation of existing data sets. (See also W86-04843) (Author's abstract)
W86-04862

NATIONAL EROSION INVENTORY OF THE SOIL CONSERVATION SERVICE, US DEPARTMENT OF AGRICULTURE, 1977-1979,
Soil Conservation Service, Washington, DC.
J. N. Holeman.
IN: Erosion and Sediment Transport Measurement: Symposium, IAHS Publication No. 133, 1981. Proceedings of the Florence Symposium, June 22-26, 1981. p 315-319, 1 tab.

Descriptors: *Erosion, *Soil loss, Cropland, Range, Forests, Bank erosion, Pastures, Construction, Roads, Stream banks, Gully erosion, Erosion rates.

The Soil Conservation Service has completed the second phase of a national erosion inventory. Phase I covers erosion rates on cropland, range, forest, and pasture. Phase II covers erosion rates on stream banks, gullies, roads, and construction areas. Data collection was completed on October 1979 from 72,500 randomly selected sites on nonfederal land in all states except Alaska and including Puerto Rico. Total national erosion on nonfederal land is estimated at about 4.8 trillion mg annually, itemized as follows: cropland, 37.6%; range, 26.5% forest, 8.3%; pasture, 6.6%; stream bank, 10.6%; gullies, 5.7%; roads, 3.2%; and construction, 1.5%. Expressed at 1000 mg per year, the erosion losses for 610 million ha of nonfederal land are cropland, 1,786,676; pasture, 314,192; range, 1,263,218; forest, 396,875; stream banks, 501,763; gullies, 270,619; roads, 153,003; and construction, 72,529. Erosion data are also presented for streams, gullies, roads, and construction for each state. (See also W86-004843) (Cassar - PTT)
W86-04875

DATABASE MANAGEMENT,
Data Stream Systems, Greenville, SC.
L. G. Blackwell, and V. W. Langworthy.
Water Engineering and Management, Vol. 133, No. 3, p 23, March 1986.

Descriptors: *Database management, *Software, *Data collections, Management planning, Utilities.

Database management software for water and wastewater utilities is discussed in terms of selecting the software, software capabilities, using the data, and limitations of the software. Selection of database management software should be based on a careful assessment of each utility's needs. Important applications of data stored in the computer database files are generation of table (row and column) reports and a label format, which can be used for printing labels, addressing envelopes, and personalizing computer-generated correspondence. The user should distinguish between simple database software and more complex database management information systems. Finally, the prospective purchaser of computer hardware must know that the equipment to be purchased is compatible with the software to be used. (Rochester-PTT)
W86-05010

RAINFALL INVESTIGATIONS AT CARDINGTON AND WINCHCOMBE 1954-67,
British Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W86-05045

NEW TECHNIQUE FOR MONITORING THE WATER VAPOR IN THE ATMOSPHERE,
Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
For primary bibliographic entry see Field 2B.
W86-05097

ACCURACY OF RAINFALL ESTIMATES BY RADAR, PART I: CALIBRATION BY TELEMETERING RAINGAUGES,
British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
For primary bibliographic entry see Field 2B.
W86-05109

ACCURACY IN RAINFALL ESTIMATES BY RADAR, PART III: APPLICATION FOR SHORT-TERM FLOOD FORECASTING,
British Meteorological Office, Easthampstead (England). Operational Instrumentation Branch.
For primary bibliographic entry see Field 2B.
W86-05111

DETERMINATION OF SATURATED HYDRAULIC CONDUCTIVITY FROM SOIL PERCOLATION TEST RESULTS,
Oxford Univ. (England).
For primary bibliographic entry see Field 2G.
W86-05124

ANALYSIS OF GROUNDWATER QUALITY DATA OBTAINED FROM PRIVATE INDIVIDUAL WATER SYSTEMS IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 2F.
W86-05140

8. ENGINEERING WORKS

8A. Structures

HEAVY RAINS HASTEN BRIDGE REPLACEMENT,
H. M. Barr.
Public Works, Vol. 117, No. 5, p 56-57, May 1986.

Descriptors: *Bridge construction, *Bridge design, Precipitation, Soil properties, Flood plains, Linings, Concrete, Texas, Longview.

On March 20, 1985, a particularly heavy rain caused the supporting timbers under the King Street Bridge, Longview, TX to begin to fracture, forcing city officials to close the crossing to traffic. Within Longview is the 1,900 acre drainage basin of Wade Creek, which along its 3.6 mile course is crossed at mile 1.7 by the King Street Bridge. The major design considerations were the 100 year discharge of Wade Creek at King Street, the elevations of intersecting streets and driveways, and the soil condition. The 100 year discharge of the basin was 2,850 cfs and the flood plain elevation was approximately 2 ft above the old wooden structure. The creek was concrete lined for 30 ft on each side of the bridge. Wicks extending from the top of the ditch wall lead to weep holes near the bottom. The new bridge opened to traffic three and a half months after closure of its predecessor. The combination of precast concrete boxes, filter fabric, crushed rock base, and drainage wicks were used to provide the city an efficient design, timely construction, and a project with potential for a long life. (Peters-PTT)
W86-04683

IMPLEMENTING THE TALIHA MINI HYDRO SCHEME IN ZAIRE,
M. Gebendinger.
Water Power and Dam Construction, Vol. 38, No. 2, p 35-36, April 1986.

Descriptors: *Zaire, *Kyondo, *Taliha mini hydro, *Construction, Hydroelectric plants, Developing countries.

Planning and construction of a small hydroelectric plant at Kyondo, Zaire, were carried out by volunteer engineers and missionaries in cooperation with local villagers. Simplicity of operation, with many hand-operated features, characterized the design. Much of the construction of roadways, headrace, and powerhouse materials was done by local labor with a minimum of modern construction equipment. To date, the peak load has never exceeded 60 kW, equal to no more than 20% of the maximum rated load, but the plant has run practically 100% of the time over the last four years. The only shutdown occurred when the headrace was nearly filled with storm debris, and the locally trained operators managed the problem. (Rochester-PTT)
W86-04726

SALVAGING A WATER RESERVOIR,
Overman (W.C.) Associates, Virginia Beach, VA.
R. L. W. Kelly, W. M. Boone, and J. R. Spacek.
Public Works, Vol. 117, No. 4, p 50-51, April 1986.

Descriptors: *Storage reservoirs, *Rehabilitation, *Reservoir construction, Post-tensioned concrete, *Thoroseal, *Cost analysis, *Portsmouth, *Virginia, Leakage, Structural deterioration, Concrete spalls.

Portsmouth, Virginia's Godwin southern reservoir, a 2 million gallon facility built in 1920, but was suffering loss of capacity due to leakage and had severe structural deterioration. Rehabilitation was chosen as a much less expensive alternative to construction of a new reservoir. Under the plan, the concrete walls and floor slab would be salvaged, and the expansion joints repaired, but top slabs would be replaced. Replacement of the top slab was accomplished using a post-tensioned slab system at a cost of 305,334 dollars, and numerous spalls in the concrete walls were repaired. All concrete surfaces were treated with Thoroseal, and the earth berm around the reservoir was reseeded. Construction of a new reservoir had been estimated to cost more than 900,000 dollars. (Rochester-PTT)
W86-04739

BIG BUCKS SAVED ON SEWER REHABILITATION PROJECT,
D. R. Lovejoy, and K. J. Munz.
Public Works, Vol. 117, No. 4, p 53-54, April 1986.

Descriptors: *Sewers, *Maintenance, Bogs, Long Island, New York, Pipes, Maintenance costs, Acidic soils.

The sewer system of Freeport, Long Island, New York, was built in 1927 and included concrete pipes and asbestos cement, all of which have become leaky from the effects of acidic subterranean bogs through which they passed. Various rehabilitation alternatives were considered to correct the serious infiltration problems within the system. The Insituform process was chosen, in which a polyester felt sleeve saturated with thermosetting resins is inserted inside out into the sewer, and unrolled by the pressure from a column of water. Heat is then applied to set the resin. Two contracts for different aspects of this work totaled 6 million dollars, making it the largest Insituform installation in the United States. One half of the construction project was the lining procedure and the remainder was repair and replacement of pipes that were too badly deteriorating for lining. (Rochester-PTT)
W86-04740

DURABLE CHEMICAL GROUT SOLVES 'CASE OF THE DISAPPEARING LAKE',
R. H. Allred, and B. W. Kostyk.
Public Works, Vol. 117, No. 4, p 68-69, April 1986.

Descriptors: *Sewer infiltration, *Acrylamide grout, *Scout-seal grout, *Sinkholes, *Auburndale, *Florida, Maintenance, Roads, Water table.

Severe infiltration problems existed in Auburndale, Florida, for many years because much of the sewage piping was laid below the water table. In one part of town the area lift station operated continuously and wet season flows exceeded 1.0 million gal/day, even though the theoretical flow based on the local population was only 0.25 million

gal/day. Attempts to seal the piping with acrylamide chemical grout failed twice. Ultimately Scotch-Seal 5600 (Foam grout, formerly known as 3M Brand CR 202 Grouting Compound) was tested and installed. Scotch-Seal 5610 Gel has been used more recently in other parts of the network. This grouting system is working well, preventing infiltration, the development of sinkholes in roads, and the drainage of Little Lake Dickey into the sewage network. (Rochester-PTT)
W86-04742

GLEN CANYON DAM'S QUICK FIX,

Water and Power Resources Service, Denver, CO.
M. S. Eckley, and D. L. Hinchliff.
Civil Engineering (ASCE), Vol. 56, No. 1, p 46-48, January 1986.

Descriptors: *Colorado River, *Arizona, *Glen Canyon Dam, *Maintenance, Spillway, Open channel, Concrete arch, Dams, Tunnels, Seepage control.

When the spring runoff rampaged down the Colorado River in 1983, Glen Canyon Dam was one of its victims. The Bureau of Reclamation had only 10 months to make repairs in time for the following spring's flows. The Guy F. Atkinson Construction Company was hired on a cost reimbursable basis. Both the designer and contractor began work immediately. Neither limited access to the remote Northeastern Arizona site, water seepage, nor a confined work area kept them from meeting their deadline. Close monitoring of work progress and efficient use of resources helped. Located on the Colorado River, 15 miles upstream of Lee's Ferry, Arizona, the 710 foot high concrete arch dam has an open-channel flow-type spillway in each abutment. Each spillway consists of a 41 foot diameter concrete lined section inclined at 55 degrees, a vertical bend, some 1000 feet of near horizontal tunnel and a flip bucket at the downstream tunnel portal. Construction was speeded up by the use of multiples of specialized equipment, and by the building of a concrete plant on-site. Two 20 ft. diameter tunnels were driven through the sandstone canyon walls to repair horizontal portions of the tunnel spillway. This work was accomplished in 3 wk using a roadheader continuous mining machine. Water seepage in the tunnels was controlled by a dewatering platform at the spillway intake, French drains and ditches, and water barriers and plastic sheeting. (Peters-PTT)
W86-04957

LIFT STATION DESIGN,

GRW Engineers, Lexington, KY.
B. Montgomery.
Civil Engineering (ASCE), Vol. 56, No. 1, p 66, January 1986.

Descriptors: *Sanitary wastewater, *Computer programs, *Storm wastewater, *Wastewater treatment, Pumping, Least squares method.

A computer program was written to run on an IBM PCXT or AT and other IBM-compatible machines to aid in the design of duplex sanitary or storm sewage lift stations. The program assumes a duplex station, with the second pump used solely for backup. There are no provisions for multiple pump operation. The system head curve is calculated using the least squares method of curve-fitting through three points. The calculation of a pump curve requires the user to select one or more pump curves from a manufacturer's catalog that will produce the desired operating conditions. The system head curve and the pump curve are intersected to produce a preliminary operating point for the selected pump. Input for wet well design includes type of wet well, wet well dimensions, the invert elevation of the lowest line entering the wet well, and the minimum wastewater depth in the wet well. The program assigns a new low level wastewater surface elevation in the wet well, and then recalculates the system head curve and final operating point. The program can then create a printout that provides backup documentation for a design file, or is suitable for inclusion in reports. (Peters-PTT)
W86-04959

CONTROL OF SPILLWAY GATES DURING FLOODS,

Lewin Fryer and Partners, Richmond (England).
J. Lewin.
Water Services, Vol. 90, No. 1081, p 93-95, 98, March 1986. / fig.

Descriptors: *Spillway gates, *Floods, *Dams, Safety, Computer control, Automatic gates, Transmission lines, Gates, Reservoirs, Automation.

Methods of controlling spillway gates during floods are reviewed. The objectives of spillway gate operation include the safety of the dam (ensured by preventing the reservoir level from rising to within a few meters of the crest, maximum storage, flood routing, and bank stability. The operating rules and systems are presented for both manual methods, (local control of motorized operation, remote control of motorized operation, and computer assisted control) and automatic methods. Cascade control is generally used in conjunction with power actuation of gates, either by electric motor driven winches or by oil hydraulic cylinders. Level control by electro-mechanical control is actuated by a predetermined rise in the reservoir level above the retention level, which initiates opening of the gates in steps and in sequence. Level control by computer (feedback) control system) moves the gate to a set point after determining the desired outflow with reference to the measured inflow. The water-level-operated automatic gates are either sector gates, drum gates, or radial automatic gates. A survey of existing practice shows wide variation between operators. In nearly all cases, at least one stage of redundancy is introduced for critical equipment and in many cases, two stages are provided. Transmission links are usually duplicated. In exceptional circumstances, dedicated buried transmission lines are used. The trend toward automatic control of spillway gates is likely to continue because it eliminates 24 hr manning and reduces the requirements for trained personnel. Regular, thorough maintenance and testing is essential to maintain reliability. (Peters-PTT)
W86-04993

SCALE MODEL TESTS FOR AUSTRIA'S KUHTAI PUMPED-STORAGE PLANT,

Technische Univ., Graz (Austria). Dept. of Hydromechanics, Hydraulics and Hydrology.
For primary bibliographic entry see Field 8C.
W86-04997

CONSTRUCTION OF SPAIN'S CORTES-LA MUELA SCHEME,

Hidroelectrica Espanola, Madrid.
For primary bibliographic entry see Field 8C.
W86-05000

CHINA'S FIRST WORLD BANK-ASSISTED HYDRO SCHEME,

Ministry of Water Resources and Electric Power, Beijing (China).
For primary bibliographic entry see Field 8C.
W86-05001

WORLD'S HIGHEST DAM CONQUERS HARSH ENVIRONMENT,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
For primary bibliographic entry see Field 8D.
W86-05002

TECHNIQUES FOR SOVIET PUMPED-STORAGE PLANT CONSTRUCTION,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
For primary bibliographic entry see Field 8C.
W86-05003

LARGE CONCRETE DAM CONSTRUCTION IN THE USSR,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
L. P. Mikhailov.
Water Power and Dam Construction, Vol. 38, No. 3, p 24-28, March 1986. 5 fig, 1 tab.

Descriptors: *Dam construction, *USSR, *Concrete, Arch dams, Concrete buttress dams, Concrete, Gravity dams, Model studies, Cranes, Geology, Seismology.

Characteristics of the major concrete dams in the USSR are summarized, and problems associated with their design and construction are discussed. Most of the large, high-head concrete dams in the USSR are concrete gravity dams, with some arch dams and concrete buttress dams. A uniform system of state standards and norms is employed for construction of dams in the USSR. In addition to stress and strain calculations, seismic analyses are conducted. Geomechanical models are frequently employed. Experience in the construction of dams in severe climate conditions in the USSR has resulted in progress on techniques to ensure reliability and efficiency in such areas as concrete placement, use of cranes in construction, and placement of concrete dams on rock foundations. Areas still needing investigation are application of concrete with low cement content, development of a continuous construction procedure, eliminating pipe cooling of concrete, and decreasing the amount of cement and reinforcing steel used in dams. (Rochester-PTT)
W86-05004

TIDAL POWER ENGINEERING IN THE USSR,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
I Bernstein.
Water Power and Dam Construction, Vol. 38, No. 3, p 37-41, March 1986. 6 fig, 10 ref.

Descriptors: *Tidal powerplants, *Caissons, *USSR, *Bulb turbines, *Double-action generation, *Ecological impact, Hydraulic engineering, Feasibility studies, Tide cycles, Tide range, Peaking capacity.

Tidal power experience in the USSR and possible employment of tidal power to supply peak load in Western Europe are discussed. Experience with the 400 kW Kislaya Guba tidal powerplant is reviewed, and the characteristics of three proposed tidal power schemes are discussed as follows: Mezensk, with a tidal range of 9 m, a powerhouse with 800 x 19 MW bulb units built into a 92.9 km-long dam and including floating caissons housing generating sets with 10-m-diameter runners; Turgursk, where a total of 10 GW could be generated along with 35 km-long dam for a total annual output of 27 TWh and also using caissons for holding generating sets; and Pezhinsk, where two possible sites exist for a tidal powerplant of 87 GW capacity that could generate 200 TWh annually. The following main criteria were used in the feasibility studies of the three projects: double action (ebb and flow) arrangement and Rance type bulb turbine with the runner diameter increased to 10 m to comply with the design of the Leningrad Metal Works. The ebb and flow arrangement ensures a 25% increase in power output, and reduces the ecological impact of the project by almost completely retaining the original tide cycles and range. (Rochester-PTT)
W86-05005

UNDERGROUND WORKS AT KENYA'S KIAMBERE PROJECT,

Watermeyer, Legge, Piesold and Uhlmann, London (England).
R. D. Gill, and D. S. Lawrenson.
Water Power and Dam Construction, Vol. 38, No. 5, p 13-16, May 1986. 6 fig, 2 tab.

Descriptors: *Kenya, *Powerhouse, *Tunnels, *Pressure shafts, *Surge chambers, *Underground powerplants, *Tunnel construction, Hydroelectric plants, Powerplants.

Three different approaches to underground work in rock of excellent quality with negligible water

infiltration are compared as found in the three separate civil works contracts for the 140 MW Kiambere project, Kenya. The three projects were for underground powerhouse and associated tunnels, pressure shafts, tailrace tunnels, and surge chambers; intake and headrace tunnel; and dams, spillway, and river diversion tunnels. Geology, site investigations, design of the power system, design of the diversion tunnels, construction of tunnels, construction of shafts, and powerhouse cavern are discussed. Tunneling and shaft sinking data are provided, including excavation procedures, support system, and concrete, for each of the three portions of the excavation works. (Rochester-PTT)
W86-05006

OPTIMUM CAPACITY AND TUNNEL DIAMETER OF RUN-OF-RIVER PLANTS,

Morrison-Knudsen Engineers, Inc., San Francisco, CA.
F. Fahlbusch.
Water Power and Dam Construction, Vol. 38, No. 5, p 17-20, May 1986. 5 fig, 2 ref.

Descriptors: *Hydroelectric plants, *Tunnel design, *Hydraulic design, Mathematical models, Optimization, Powerplants.

A solution is described of the problem of optimization of the capacity of run-of-river hydro plants with tunnels. The solution is a special case to the general two-variable optimization problem; it defines an upper boundary of the optimum capacity of these plants. In addition to providing the initial value for the iterative solution procedure, it also can be used to obtain a quick order-of-magnitude estimate of the plant capacity in cases where an approximate figure is sufficient. The solution presented here is exact and avoids the lengthy and time-consuming calculations involved in numerical calculations. In addition, it provides valuable insight into the interaction of some variables and their individual and cumulative effects, thus providing useful guidance in design. Only plants with single tunnels are considered and constraints that could narrow the choice of tunnel diameter are disregarded. The solution is obtained either by iteration or step-by-step evaluation of the optimality conditions. It is shown that if the relationship between capacity and tunnel diameter is not taken into account, the plant design may be substantially at variance with the optimum. (Rochester-PTT)
W86-05007

DESIGN OF PERVIOUS PRESSURE TUNNELS,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
A. J. Schleiss.
Water Power and Dam Construction, Vol. 38, No. 5, p 21-26, May 1986. 13 fig, 1 tab, 32 ref.

Descriptors: *Tunnel design, *Rock properties, *Tunnel hydraulics, *Permeability, Hydraulic design, Seepage, Hydraulic engineering, Differential equations.

A new design procedure for pressure tunnels takes into account the seepage pressures and the influence of fracture deformation on secondary permeability in rock masses. The porous, thick-walled cylinder theory, computation of pervious tunnels, and mechanical-hydraulic coupling are analyzed, including the differential equation for radial displacement of the cylinder, deformations and stresses, influence of mechanical boundary loads, a pressure tunnel with uncracked concrete lining, reach of the seepage flow pattern, effect of cracks in lining and rock effect of rock grouting, influence of fracture deformation on secondary permeability, the thick-walled cylinder with stress-dependent permeability, and an pressure tunnel with stress-dependent permeability. Design criteria are discussed for avoiding cracks in the lining, limiting water losses, and ensuring the bearing capacity of the rock masses. (Rochester-PTT)
W86-05008

INFLUENCE OF AN ARTIFICIAL HYDRAULIC REGIME ON WATER QUALITY IN THE TIDAL RIVER LAGAN, NORTHERN IRELAND,

Department of Economic Development, Belfast (Northern Ireland). Industrial Science Div.
For primary bibliographic entry see Field 5G.
W86-05080

EFFECTS OF WATER INTERACTIONS ON ENGINEERING STRUCTURES,

Binnie and Partners, London (England).
For primary bibliographic entry see Field 8B.
W86-05276

8B. Hydraulics

HYDRAULICS OF TWO FLOWING LAYERS WITH DIFFERENT DENSITIES,

Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2E.
W86-04714

RIVER MECHANICS,

University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2J.
W86-04750

MEASUREMENT OF OPEN CHANNEL FLOW BY THE ELECTROMAGNETIC GAUGE,

Department of the Environment, Reading (England). Water Data Unit.
For primary bibliographic entry see Field 7B.
W86-04804

ENTRAINMENT DESCRIPTIONS FOR MATHEMATICAL MODELING OF PUMPED-STORAGE INFLOWS IN RESERVOIRS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. J. W. Roberts, and M. S. Dortch.
Final Report. Technical Report E-85-12, October 1985. 118 p, 14 fig, 22 ref, 3 append. Contract Nos. DACW39-81-M-2771, DACW39-82-M-3273.

Descriptors: *Entrainment, *Mathematical models, *Pumped storage, *Reservoirs, *Inflows, Jets, Simulation models, Water quality.

During hydropower generation and pumpback operations of pumped-storage projects, inflows are introduced into the reservoir system. These jetlike inflows often cause considerable entrainment of ambient water. The entrainment process can have a strong influence on the vertical distribution of reservoir water quality when pumped-storage inflow jets are discharged into a stratified reservoir. The objective of this study was to develop algorithms to describe the pumped-storage inflow entrainment process for use in reservoir water quality models. Pumped-storage inflow jets fall into two classes: strongly or weakly buoyant. The former class has been fairly extensively studied, and well-established mathematical models exist to predict their behavior. For this case, incorporation into a reservoir thermal model simply required adaptation of existing code. For the latter case, however, that of weakly buoyant jets, it was found that little information existed of either a theoretical or experimental nature. For that reason, an extensive series of experiments of a fundamental nature were performed on weakly buoyant jets into arbitrary stratification. The results were then reduced to a form suitable for inclusion into reservoir water quality simulation models. The developed algorithms were incorporated into an existing reservoir thermal simulation code, and a test application was made for Carters Lake, a Corps of Engineers pumped-storage project in Georgia. (Author's abstract)
W86-04940

LABORATORY MODELING OF A COASTAL UPWELLING,

University of Southern California, Los Angeles. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2L.
W86-04980

NATURAL FLOW VISUALIZATION IN LAKE EYRE, SOUTH AUSTRALIA,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-04981

WAVE INTERACTION WITH A RECTANGULAR TRENCH,

California Inst. of Tech., Pasadena. W.M. Keck Lab. of Hydraulics and Water Resources.
F. C. K. Ting, and F. R. Raichlen.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 3, p 454-460, May 1986. 1 tab, 6 fig, 4 ref.

Descriptors: *Waves, *Trenches, *Fluid mechanics, Kinetics, Channel improvement, Dredging.

An initial phase of an investigation of the wave-trench interaction in a constant density fluid revealed an apparent effect of the relative wavelength and the trench geometry on the reflection and transmission characteristics of the trench and on the kinetic energy of the fluid within the trench compared to that in the incident progressive wave. This frequency selectivity may be related to a resonant condition in the trench although the details of this are not clearly apparent. The velocities near the corners of the trench are intensified by the flow process. These results are of consequence in the process of aging of navigation channels duc to waves and currents where channel dredging modifies the near bottom kinematics which can then affect the channel shape. (Peters-PTT)
W86-04987

ARMOR LAYER STABILITY OF RUBBLE-MOUND BREAKWATERS,

P. A. Hedar.
Journal of Waterway, Port, Coastal and Ocean Engineering, (ASCE)/JWPED5, Vol. 112, No. 3, p 343-350, May 1986. 5 fig, 8 ref, append.

Descriptors: *Breakwaters, *Mathematical models, *Stability analysis, Rubble-mound, Wave height, Permeability, Angle of repose, Slope stability, Rocks.

Improved stability formulas for rubble-mound breakwaters calculate the required weight of the armor units in the cover layer reflect the complex phenomena, and take into account the most important parameters affecting the stability. The influence of the wave climate, the difference between the angle of repose and the slope angle, the density of the block material and the fluid, and the permeability of the underlayers are involved. The weight of the armor units under no-damage conditions is determined. The difference in the weight Q of armor units calculated from the given equation, which consider permeability of underlayers and interlocking is considerable compared with those calculated using existing equations. The block weight Q will get larger as the breaking wave height increases with increasing wave period. The required block weight under no-damage conditions varies to a high degree and to an extent that does not appear when using a previously developed formula. The most suitable gradient of the slope for the armor layer is from 1 on 2 to 1 on 3. (Peters-PTT)
W86-04988

EFFECTS OF WATER INTERACTIONS ON ENGINEERING STRUCTURES,

Binnie and Partners, London (England).
A. N. James, and K. J. Edworthy.
Hydrological Sciences, Vol. 30, No. 3, p 395-406, September, 1985. 5 fig, 25 ref.

Descriptors: *Structural engineering, *Earth-water interfaces, Dissolution, Rocks, Water analysis, Groundwater movement, Erosion.

The interactions of water with soil and rock are important to many engineering structures built to contain or transport water. These structures, built on soluble rock or soil foundations, may depend on rates of dissolution caused by water seeping through joints, fissures, or granular zones. Previous papers have defined the rates of dissolution for soluble rocks by means of a simple equation: dM/dt = K A (Cs - C) to the theta power. This relationship may be used as an aid to prediction of enlargement of joints and fissures in rocks, settlements of granular foundation strata, the deterioration of filters, risks to shallow but intensely loaded foundations, and durability of underground storage caverns in soluble rocks. Predicting the effects of dissolution of soluble rocks or soils depends, sometimes critically, upon the solution potential of the water reaching the soluble materials. Particularly at the planning stage, but also in the specification of remedial measures, consultation with hydrologists is advisable to achieve a full understanding of the groundwater flow and chemistry and of the surface/groundwater interconnections. (Main-PTT)
W86-05276

UNCONFINED GROUNDWATER FLOW CALCULATION INTO A TUNNEL,

Tahal Consulting Engineers Ltd., Tel-Aviv (Israel). Hydrology Div.
For primary bibliographic entry see Field 2F.
W86-05298

MORPHOLOGIC EFFECTS OF CHANNELIZATION: THE CASE OF THE NEEBING-MCINTYRE FLOODWAY, THUNDER BAY, ONTARIO, CANADA,

Lakehead Univ., Thunder Bay (Ontario). Dept. of Geography.
H. Rasid, B. A. M. Phillips, and M. Oosterveld.
Environmental Management, Vol. 9, No. 5, p 399-416, September, 1985. 12 fig, 6 tab, 30 ref.

Descriptors: *Channel morphology, *Neebing-McIntyre Floodway, *Floodways, Erosion, Sediment yield, Hydraulic geometry, Backwater effect, Maintenance, Canada, Energy gradient, Sediment transport.

A study was conducted to compare the post construction morphology of a channelization project with the preconstruction morphology of the channelized streams and to postulate the most immediate morphological effects of such channelization. The Neebing-McInyre floodway, in Thunder Bay, Ontario, Canada, was constructed with a relatively straight and uniform trapezoidal channel, compared with the prechannelized sinuous reaches of the Neebing and the McIntyre Rivers. The flow regime of the floodway also contrasts significantly with the prechannelized regime, because of the combination of discharges from these rivers into a new channel and the regulation of flows by a diversion structure. The maximum channel capacity of the floodway is 284 cu m/s (175-year regional flood), compared with about 40 cu m/s and 60 cu m/s, respectively, for the Neebing and McIntyre. According to regime theories, the construction of a straight and trapezoidal channel has upset the equilibrium of the stream system and therefore should lead to some accelerated erosion and sedimentation processes in the new channel immediately after construction. Erosion potential is paticularly high during higher discharge events. The overall sediment yield of the watersheds of North America, but due to the backwater effect of Lake Superior. Unless maintained by constant channel work, the floodway will tend to fill up with sediment, until a postconstructional equilibrium is reestablished. (Peters-PTT)
W86-05408

8C. Hydraulic Machinery

INNOVATIVE DESIGN OVERCOMES MULTIPLE INSTITUTIONAL BARRIERS AT HYDRO PLANT,

J. Reason.
Power, Vol. 130, No. 4, p 120-122, April 1986. 8 fig.

Descriptors: *Powerplants, *Electric power plants, Massachusetts, Lowell, Merrimack River, Fish ladders, Gravity dams, Tourism, Hydraulic turbines, *Institutional constraints, Recreation facilities.

When a new 15 MW low head hydroelectric project was first proposed in the center of Lowell, MA, the Department of Energy gave it a 20 percent chance of ever being completed because of institutional barriers. The major problems were the protection of Lowell's many historic structures along its canal system and the protection of fish in the Merrimack River. Despite these hurdles, the project was completed one month ahead of schedule and is now generating revenue for its owner, Boott Hydropower Inc. The powerhouse was designed with a low profile, set into the riverbank in an 80 ft deep excavation. The Northern Canal runs from the Pawtucket Dam 2200 ft along the side of the river before turning inland to divert water into the forebay. A small lock, built at the right-hand end of this dam permits Park Service tour boats to navigate the entire canal. At the Pawtucket dam a new fish ladder was built with lampblack-darkened concrete to blend in with the weathered stone. At the powerhouse, migrating fish are collected in an elevator, raised to a window where a Fish and Wildlife Service biologist counts them, and passed either into the canal or back to the river. The 13 foot diameter direct driven hydraulic turbines turn at 120 rpm. (Peters-PTT)
W86-04682

POWER FROM MINE COOLING WATER,

Foster-Miller, Inc., Waltham, MA.
R. N. Torbin, and E. Thimons.
Power Engineering, Vol. 90, No. 3, p 27-28, March 1986. 3 fig, 1 tab, 1 ref.

Descriptors: *Turbines, *Generators, *Energy conservation, *Hydroelectric plants, *Mines, Idaho, Cost analysis, Performance evaluation, Cooling water.

Results of a demonstration project are described in which a turbine-generator system was installed in the Lucky Friday deep mine, Mullan, Idaho, and used to recover potential energy of cooling water flow, thereby increasing efficiency of the refrigeration system as well as generating electrical power at a considerable saving. The turbine-generator employed could produce 210 kW of power at an average flow of 31.5 liter/sec with an inlet head of 840 m. In three performance tests, head and flow data were identical to predicted values, indicating that the difference between actual and predicted performance of the system was caused by lower than expected efficiency of the turbine, generator, or electrical system. However, the actual system efficiences were deemed acceptable. By the end of August 1985, the system had run 10 months without any major problems and had produced more than 1,000,000 kWh of power. This resulted in a gross savings of approximately 25,000 dollars. (Rochester-PTT)
W86-04703

SMALL HYDRO CASCADE DEVELOPMENTS IN CHINA,

Hangzhou Regional Center For Small Hydropower (China).
D. Guangquan.
Water Power and Dam Construction, Vol. 38, No. 2, p 16-20, April 1986. 6 fig.

Descriptors: *Run-of-river, *China, *Cascade hydroelectric systems, *Flow regulation, *Electric power demand, Hydroelectric power, Economics, Developing countries.

Because of seasonal variation in stream flow and daily fluctuations of load, it is difficult to balance the supply and consumption of electric power with run-of-river small hydro power (SHP) stations in China. Cascade developments involving a number of stations can help solve these problems. Planning and operation of cascade SHP developments are described including the characteristics of five differently-configured cascade schemes in China and a summary of the characteristics of the cascade schemes on the He Jiang River tributaries. Cascade developments, where one or several reservoirs regulate stream flow can make full use of both the head of the river and the regulated flow, and hence can balance supply and demand of electricity in small grids. Many SHP-developed counties in China have proceeded with cascade developments on small streams. These stations have become the backbone of the county grids, greatly improving the reliability of electricity supply and providing significant economic benefits. (Rochester-PTT)
W86-04723

ECONOMIC LIMITS OF SMALL AND LOW-HEAD HYDRO,

Monenco Consultants Ltd., Montreal (Quebec).
For primary bibliographic entry see Field 6B.
W86-04724

STANDARD DESIGN FOR SIX MINI HYDRO SITES IN INDONESIA,

Beca Worley International, Auckland (New Zealand).
P. S. Crighton, G. L. Barker, and J. M. Magyari.
Water Power and Dam Construction, Vol. 38, No. 2, p 26-30, April 1986. 7 fig, 4 tab.

Descriptors: *Design standarization, *Indonesia, *Run-of-River hydro, *Hydroelectric power, *Cost analysis, Francis turbine, North Sumatera, Hydroelectric engineering, Developing countries.

A rational approach is presented for the development of mini hydro sites using one design for multiple sites. Small sacrifices in efficiency resulting from this approach are compensated by savings in development costs, an important consideration for developing countries. This technique has been applied successfully to a project to develop six mini hydro sites in North Sumatera, Indonesia. Standard designs were prepared for the following components and fitted to each site plan: weir and river bypass culvert, diversion intake, de-sand channel, canal, penstock intake and penstock, powerhouse, generating equipment, switchgear, protection and control, and gates. A horizontal Francis turbine was selected. The total installed capacity at the six run-of-river sites was 6,000 kW; the total development cost was 12.66 million US dollars, with a per kilowatt average cost of 2,110 dollars. (Rochester-PTT)
W86-04725

IMPLEMENTING THE TALIHA MINI HYDRO SCHEME IN ZAIRE,

For primary bibliographic entry see Field 8A.
W86-04726

JONES FORK SMALL HYDRO SCHEME,

Tudor Engineering Co., San Francisco, CA.
G. Rummel, and R. Everett.
Water Power and Dam Construction, Vol. 38, No. 2, p 54-57, April 1986.

Descriptors: *Small hydro, *Jones fork, *California, *Pressure regulator valve, *Surge tank, Penstock, Tunnels, Intakes, Seismicity, Design, Planning, Environmental studies, Intakes, Hydraulic equipment, Upper American river project, Sacramento Municipal Utility District, Cost analysis.

The Jones Fork hydroelectric project of Sacramento (California) Municipality Utility District includes development, planning, preliminary design, licenses, permits, and environmental studies, exploration and survey, seimicity, intake structure, power tunnel, penstock, and powerhouse and equipment. This portion of the Upper American river project is a 182.9 m head hydroelectric project providing 10 mW of dependable capacity. The project requires a 3,048 m long penstock and tunnel to capture the head and flow between two existing reservoirs. Because the topography did not permit siting of an economical surge tank, the pressure and speed rise are controlled with a synchronous poly-jet pressure regulator valve. (Rochester-PTT)
W86-04727

DEVELOPING SMALL HYDRO IN INDIA,

Teknow Consultants and Engineers Pvt. Ltd., New Delhi (India).
D. R. Sikka.
Water Power and Dam Construction, Vol. 38, No. 2, p 59-60, April 1986.

Descriptors: *Small hydro, *Micro hydro, Mini hydro, *India, *Hydroelectric power, Electric power production, Management planning, Canal drops, Irrigation, Agriculture, Rural industries, Developing countries.

The potential role of small hydro in India and the problems delaying small hydro application are discussed. Small hydro in India consists of 83 stations producing 140 MW, with 43 stations under construction accounting for a total capacity of 120 MW, and 100 schemes under consideration with a potential 320 MW. About 230 micro/mini hydro stations have been constructed since 1897, and account for 45 MW. Serious delays occur in design, model experiments and manufacturing, and in matching civil works and coordinating with manufacturers. The total potential from small hydro projects is 6,000 MW, of which 1,000 MW is from irrigation canal crops. Micro hydro energy systems can be used in rural areas to augment the supply of energy for agriculture and rural industries. (Rochester-PTT)
W86-04728

CROSS SOLENT WATERMAIN,

Southern Water Authority, St. Leonards (England).
For primary bibliographic entry see Field 5F.
W86-04753

INSTALLATION AND OPERATION OF A BUBBLE GAUGE NETWORK IN THE MAHAKAM RIVER BASIN, EAST KALIMANTAN, INDONESIA,

German Agency for Technical Cooperation, Frankfurt am Main (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W86-04800

EXPERIENCES GAINED DURING THE HYDRAULIC INVESTIGATIONS ON THE COOLING WATER SYSTEM OF A THERMAL POWER STATION,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
J. Tas, and P. Schneemeier.
IN: Advances in Hydrometry, IAHS Publication No. 134, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 203-213, 5 fig, 1 tab.

Descriptors: *Flow measurement, *Ultrasonics, *Flowmeters, *Current meters, *Flow discharge, Hydrometry, Gages, Hydraulic equipment, Cooling water, Thermal powerplants, Discharge measurement.

Occasional flow measurements with conventional current meters are often too time- and labor-consuming to be practicable for field investigations on the water systems of large industrial and agricultural consumers. Measurements under extreme conditions departing from normal operation are especially difficult. These measurements conflict with the interests of operation, but are essential for plotting performance curves. In such cases the ultrasonic method of flow measurement can be applied to advantage and with acceptable accuracy. Under adverse conditions of installation the integrating type of ultrasonic measurement proved successful. (See also W86-04785) (Author's abstract)
W86-04803

SUBMERSIBLE PROPELLER PUMP AS AN ALTERNATIVE TO THE TUBULAR AXIAL FLOW PUMP,

Werk Bremen (Germany, F.R.). Water Pumps Div.
H. Knopp.
Water Services, Vol, 90, No. 1080, p 55-56, 59, February 1986. 9 fig.

Descriptors: *Pumps, *Drainage, *Effluents, Submersible propeller pump, Tubular axial flow pump, Hydraulic equipment, Leakage.

The combination of the classical tubular axial flow pump for drainage and the standard submersible pump for discharging effluent has resulted in the submersible propeller pump. With the reliable hydraulics of the propellar tubular axial flow pump and the proven combination of the dry running asynchronous motor with the double mechanical seal the submersible motor propeller pump is an alternative to the tubular axial flow pump. Depending on plant conditions the choice of one type or the other can only be determined by an evaluation of the technical and industrial advantages and disadvantages by the user/planner of the plant together with the pump supplier. The submersible propeller pump, type PNT, consists of three units: motor, cables with cable glands, and pump section. The sealing combination is important. Two single acting mechanical seals with rubber bellows in tandem guarantee the lowest leakage rates. The bearing with the mechanical seals is placed near the impeller which has a small shaft diameter. The leakage rate and/or the wear is dependent on the circumferential speed and thus on the diameter of the sealing surfaces and the radial bearing. Some advantages of the submersible propeller pumps include relatively low noise level, lighter weight than a comparable tubular axial flow pump, no above surface structure, easily moved, and the intake structure can be smaller than that of a tubular axial flow pump with an air cooled motor because of the well cooled motor surface of the submersible propeller pump. (Peters-PTT)
W86-04986

SEAWATER PUMPED-STORAGE SCHEME UNDER STUDY IN JAPAN,

Electric Power Development Co. Ltd., Tokyo (Japan). Construction and Engineering Dept.
T. Hashimoto.
Water Power and Dam Construction, Vol. 38, No. 2, p 9-11, February 1986. 2 fig.

Descriptors: *Pumped storage, *Artificial lakes, *Japan, *Hydroelectric plants, *Fouling, *Sealants, *Breakwaters, Okinawa, Marine organisms, Reservoir, Environmental studies, Turbidity, Wave dissipation.

Current investigations and research being conducted for a seawater pumped-storage scheme in Okinawa, Japan, are outlined. The scheme calls for generation of a maximum output of 150 MW (3 x 50 MW units) as a source of peak power supply, and includes an excavated upper pond. The problem of sea-water seepage, marine fouling, and preliminary environmental investigations are discussed. Main features of the design include: (1) choice of an excavated type of pond, so that the site could be selected to keep the waterway as short as possible and to eliminate the need for a spillway; (2) watertightness of the pond is achieved using waterproof sheets (ethylene propylene terpolymer rubber tested best) and a drainage layer behind the sheets to collect any seepage for pumping back into the pond; (3) maintaining high flow velocity in the waterway to prevent adherence of marine organisms; and (4) introduction of breakwaters and wave dissipation works to avoid turbidity in the tailrace area (and the intake while pumping). (Rochester-PTT)
W86-04995

BATH COUNTY: THE WORLD'S LARGEST PUMPED-STORAGE PLANT COMMISSIONED,

Virginia Power, Warm Springs.
R. Sullenberger.
Water Power and Dam Construction, Vol. 38, No. 2, p 12-13, February 1986. 2 fig.

Descriptors: *Pumped storage, *Virginia, *Bath county, *Hydroelectric plants, *Construction, Dam construction, Tunnel construction, Reservoir construction, Penstocks, Turbines, Peaking power, Scheduling, Powerplants.

Construction of the 1.65 billion dollar Bath County, Virginia, pumped-storage plant is reviewed. The plant began commercial operation in December 1985. It adds 2,100 MW of peaking power to a six-state service area. The main features of Bath County include the 500 x 200 x 150 ft powerhouse, two earth- and rock-filled dams containing 22 million cu yd of material, and about 12 miles of tunnels. Although the powerhouse is above ground, it will experience the greatest submergence of any structure of its type, because of a fluctuation of 60 ft in water depth of the lower reservoir. Seepage into the structure has been insignificant during the first full reservoir filling. There are six Francis-type pump-turbine generator motor units, rated at 350 MW each, and operating at a maximum head of 1,262 ft. Particular construction difficulties were encountered due to penstock rupture, in welding of spiral casings, and due to leakage of one penstock lining, which required drilling and grouting involving injection of about 90,000 bags of cement. Civil structure areas and dams were constructed ahead of schedule; during this phase a world record was set in continuous underground jumpform pumping. (Rochester-PTT)
W86-04996

SCALE MODEL TESTS FOR AUSTRIA'S KUHTAI PUMPED-STORAGE PLANT,

Technische Univ., Graz (Austria). Dept. of Hydromechanics, Hydraulics and Hydrology.
H. Simmler, and E. Kresnik.
Water Power and Dam Construction, Vol. 38, No. 2, p 14-16, February 1986. 9 fig, 6 ref.

Descriptors: *Hydroelectric plants, *Pumped storage, *Austria, *Hydraulic models, *Hydraulic engineering, Kuhtai pumped storage plant, Scale model tests, Powerhouse intake, Outlet structure, Vortices, Approach flow, Pumping, Uniform flow, Powerplants.

The history and present status of pumped-storage in Austria, and its relationship to the country's topography and hydrology are outlined, followed by a description of the results of hydraulic scale model testing for the design of the powerhouse intake and outlet structure for the Kuhtai pumped-storage scheme. Hydraulic scale model tests were conducted to ensure that two essential requirements were met, namely: (1) establishing an approach flow free of air-entraining vortices, that is, an air-free and low-vorticity flow, to the intake structure, and (2) establishing a uniform and irrotational approach flow from the draft tube. Theoretical concepts and results of the tests are described for the vortex problem (pumping mode) and flow conditions in the pressure shaft (pumping mode). It is concluded that for pump intakes, and for inlets in general, where the formation of strong vortices or even air-entraining vortices is to be avoided, a theoretical approach will rarely be reliable enough in view of the complexity of the marginal conditions that govern flow. The same applies where a smooth and uniform approach flow to the draft tube inlets is to be established. Scale model tests help to devise means of preventing efficiency losses or disturbances during operation. (Rochester-PTT)
W86-04997

CONSTRUCTION OF CZECHOSLOVAKIA'S DLOUHE STRANE PROJECT,

Hydroprojekt, Brno (Czechoslovakia).
M. Janda.
Water Power and Dam Construction, Vol. 38, No. 2, p 23-26, February 1986. 3 fig, 2 tab.

Descriptors: *Pumped storage, *Dlouhe strane, *Czechoslovakia, *Peaking capacity, Construction, Design, Tunnels, Pump-turbines, Automation, Ostrava, Moravia, Hydroelectric plants, Powerplants, Desna River.

The role of pumped-storage in Czechoslavakia is reviewed, and details of the design and construction to date of the 650 MW Dlouhe Strane project are described. Dlouhe Strane is sited in northern Moravia, where favorable geomorphologic conditions were found. The upper reservoir is at 1,350

m, and the lower one is in a deep valley of the Desna River. Two tunnels of 3,600 mm diameter will connect the hydro plant with the upper reservoir. An underground machine hall is the main structure of the scheme; the cavern is 25 m wide, 50 m high, and 87 m long. Two reversible Francis pump-turbines, each with a maximum output of 325 MW and a pumping output of 312 MW, will be used. After commissioning, the pumped-storage plant will serve not only during peaks in the daily and weekly loading schedules, but for standby in cases of losses in the distribution system. Operation of the power station will be fully automated, primarily between the pumping unit and the turbine. A major advantage of the station is its proximity to the Ostrava industrial region. (Rochester-PTT)
W86-04998

ELECTRO-MECHANICAL EQUIPMENT FOR THE KALAYAAN PUMPED-STORAGE PLANT,

Gruppo Industrie Elettromeccaniche per Impianti all'Estero, Milan (Italy).
F. di Gioia.
Water Power and Dam Construction, Vol. 38, No. 2, p 33-36, February 1986. 5 fig.

Descriptors: *Kalayaan, *Phillipines, *Pump-turbines, *Hydroelectric plants, *Pumped storage, Pumping, Electric power production, Powerplants.

Characteristics are described for the first two single-stage reversible pump-turbine units, each rated at 150 MW, recently completed at the Kalayaan pumped storage plant in the Phillipines. These include the power station, electro-mechanical equipment (upper and lower intakes, penstock, spherical valves, pump-turbines, motor-generators, and step-up transformers), electrical and electronic equipment (control room, service building, control building, and switchyard), and pump starting methods. The project takes advantage of two existing reservoirs and when the remaining units are in place it will have a rated capacity of 1,800 MW. Pump starting is accomplished by three different sequences: a pony with the runner in air (normal sequence); back-to-back (one unit only) with the runner in air, using about 4 MW power from the other unit; and back-to-back (one unit only) with the runner in water and the spherical valve closed, using about 35 MW from the other unit. The distinctive feature of the Kalaayan plant is its flexibility of operation because of its rapid connection to the network, which includes geothermal and thermoelectric stations, and because of its wide range of operational modes. (Rochester-PTT)
W86-04999

CONSTRUCTION OF SPAIN'S CORTES-LA MUELA SCHEME,

Hidroelectrica Espanola, Madrid.
N. Nevalon.
Water Power and Dam Construction, Vol. 38, No. 2, p 37-41, February 1986. 6 fig.

Descriptors: *Hydroelectric plants, *Spain, *Cortes dam, *La Muela, *Pumped storage, *El Naranjero dam, *Reservoirs, Geology, Nuclear powerplants, Cost analysis, Intakes, Conduits, Tunnels, Powerplants.

The Cortes-La Muela project, currently under construction, will provide 870 MW of peak power for East Spain, while complementing, with 540 MW of pumping capacity, the operation of a nearby nuclear plant. The main project features two dams, two powerplants, and an artificial reservoir. The two powerplants are linked hydraulically through the reservoir created by Cortes dam, and electrically connected by a single switchyard that allows the direct coupling of the units for back-to-back start-up. Cortes II is a conventional hydroelectric plant the downstream reservoir of which, El Naranjero, is used for flow regulation, whereas La Muela is a pure pumped-storage plant. The total cost of the project will be about 750 million dollars, including interest during construction and price escalation. Commissioning of the Cortes II machinery is scheduled for mid-1988, whereas the units at La Muela will begin operation in the first half of 1989. Exploration work, geology, Cortes dam and reservoir, Cortes II powerhouse, El naranjero dam and reservoir, La Muela upper reservoir, water intakes and conduits, powerhouse and transformer caverns, and project status are described. (Rochester-PTT)
W86-05000

CHINA'S FIRST WORLD BANK-ASSISTED HYDRO SCHEME,

Ministry of Water Resources and Electric Power, Beijing (China).
C. Xuemin.
Water Power and Dam Construction, Vol. 38, No. 2, p 41-44, February 1986. 2 fig.

Descriptors: *Hydroelectric plants, *China, *Lubuge hydropower project, *World Bank, *Contracts, *Bids, Project management, Japan, Norway, Australia, Germany, Turbines, Generators, Powerhouse, Headworks, Hydraulic system, Rockfill dams, Consultants.

Project layout, headworks, hydraulic system, powerhouse complex, and contracting and financing arrangements are described for the Lubuge hydropower project on the Huangni River, China. This project, with a design capacity of 600 MW, is the first hydro project to be financed with a World Bank loan. It will comprise a 101 m-high rockfill dam, a 9 km-long power tunnel with an underground powerhouse, and is scheduled for completion in 1988. The contracting and bidding practices employed on this project followed international competitive bidding practice, which differed significantly from the methods used by the Chinese government in building more than 100 major hydro stations and 80,000 small hydro plants since 1949. An Australian consultant reviewed the design and cost estimate, a Japanese contractor received the contract to build the hydraulic system, a Chinese construction force works on the headworks and powerhouse complexes, and turbine from Norway and generators from Germany are being used. Some difficulties were encountered, but the success and merits of using foreign consultants have been acknowledged by people at various levels in China. (Rochester-PTT)
W86-05001

TECHNIQUES FOR SOVIET PUMPED-STORAGE PLANT CONSTRUCTION,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
L. P. Mikhailov.
Water Power and Dam Construction, Vol. 38, No. 3, p 20-23, March 1986. 10 fig, 2 ref.

Descriptors: *Pumped storage, *USSR, *Dam construction, *Hydroelectric plants, Concrete, Hydraulic engineering, Design, Conduits, Dikes, Cost analysis, Economies of scale, Powerplants.

The standardized approach to production of pumped-storage plants as carried out in the USSR is described. At present there are 11,700 MW of aggregate capacity under construction. For projects of similar construction geology and heads around 100 m it has been found practical to standardize the main structures to accommodate mass-produced 200 MW units designed for that head. Standardization of designs for pumped-storage stations leads to economies of scale and cuts the cost of design and engineering work. Reinforced concrete structures of powerhouses, water intake/outlets of the upper reservoirs, and penstocks were the first components to be standardized. Powerhouses of a conventional type are designed as a continuous structure that is divided into sections: central, standard, and side sections adjoining the abutments. The powerhouse construction is fully standardized below the level of the machine hall floor, with variations above this level adopted depending on the water level variation in the lower reservoir. One of the main standardized structures is the water conduit, with inner diameter of 7.5 m, maximum water static pressure of 1.23 MPa, and maximum dynamic pressure of 1.71 MPa. Conduit joints, concrete handling procedures, and dike protection measures also are described. (Rochester-PTT)
W86-05003

TIDAL POWER ENGINEERING IN THE USSR,

Vsesoyuznyi Gidroproektno-Izyskatel'ski i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
For primary bibliographic entry see Field 8A.
W86-05005

OPTIMUM CAPACITY AND TUNNEL DIAMETER OF RUN-OF-RIVER PLANTS,

Morrison-Knudsen Engineers, Inc., San Francisco, CA.
For primary bibliographic entry see Field 8A.
W86-05007

HYDRO PLANT FREQUENCY REGULATION,

Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland).
F. de Leva.
Water Power and Dam Construction, Vol. 38, No. 5, p 27-31, May 1986. 15 fig, 4 ref.

Descriptors: *Penstock, *Electric equipment, Hydroelectric plants, *Hydraulic engineering, Networks, Powerplants.

Penstock and generator design influence the frequency response of a hydroelectric powerplant. Means are provided for estimating the values that such parameters should have as a function of the desired quality of the frequency regulation. The behavior of a powerplant was simulated when a sudden load decrease occurs; the plant operates on an isolated network with resistive loads only. Although these assumptions are restrictive and the conditions described do not normally occur, the results are useful in cases of parallel operation of a plant with other units because comparative criteria can be established for the determination of the frequency regulation quality of a powerplant. Furthermore, the method presented also permits determination of the effects that changes in penstock and generator parameters have on the capacity to respond to load variation. Of primary importance to the quality of frequency regulation is the penstock inertia constant, which is defined as penstock length x steady-state flow/gravity acceleration x steady-state head x permanent penstock area. This parameter should be kept as low as possible because when its value is high, an increase in generator inertia has only a limited effect on improving the quality of frequency regulation. The value of the penstock inertia constant may be decreased by shortening the penstock or increasing its diameter to lower the water velocity. (Rochester-PTT)
W86-05009

PLATE SEPARATION - BUDDING CONVENTIONAL TECHNOLOGY,

Aqua Trend, Inc., Shawnee Mission, KS.
For primary bibliographic entry see Field 5D.
W86-05011

PUBLIC RELATIONS PLOYS HAVE TRANSFORMED REGULATORY ISSUE INTO CONSUMER CONCERN,

For primary bibliographic entry see Field 6E.
W86-05058

SMALL ASYNCHRONOUS HYDROGENERATORS AND THEIR CONTRIBUTION TO ENERGY RECOVERY IN THE WATER INDUSTRY,

Severn-Trent Water Authority (England). Soar Div.
G. H. Thorp.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 4, p 301-314, August 1985. 5 fig, 2 tab.

Descriptors: *Hydrogenerators, *Hydroelectric power, *Energy recovery, *Reservoirs, Hydraulic turbines, Turbines, Financial feasibility, Hydraulic properties, Electric power production, Electrical equipment.

The basic requirements for the optimization of hydrogenerator system performance are outlined with consideration of financial viability. The design, installation, and commissioning of a Hayward Ryler asynchronous submersible hydrogenerator at Gilroes reservoir is recounted and its effective contribution to energy recovery discussed. The energy recovery system is based on an average inflow to the reservoir of 162 L/sec which, allowing for an estimated recovery efficiency of 65%, gives an average energy recovery of 33 KW of usable electricity. After 6 mo. of operation the hydrogenerator system has proved to be practical. The use of solid state devices where possible has minimized the cost of the ancillary devices needed to operate the turbine. It is concluded that small hydrogenerators like the one installed at Gilroes are practical and, if reliable, are a cost effective contribution to energy recovery. (Peters-PTT)
W86-05077

SIMPLICITY IS MARK OF PUMP STATION IN THE ROUND,

W. Stevens, and W. Williams.
Water/Engineering & Management, Vol. 133, No. 4, p 21-22, 24-25, April 1986.

Descriptors: *Pumping plants, *Houston, *Sewer systems, *Wastewater facilities, Cylindrical lift station, Maintenance, Hydraulic equipment.

A pumping station, now in an advanced construction stage in Houston, TX, will become a key part of Houston's huge Northside wastewater project. The cylindrical configuration, of the 370 mgd facility, produces significant construction advantages. The cylindrical geometry permitted the entire facility to fit into the confines of a restricted site bounded by railroad rights of way and a major road. It also made it favorable to employ sunken caisson construction, which provided substantial economies. The peripheral wall is 66 ft in diameter while the interior wall, forming a central core, has an inner diameter of 34 ft. Entering the structure through a 132 inch diameter sewer line, the influent will pass to the central core which acts as a surge tank to dampen turbulence. The influent chamber is located at the base of the central core, and has an inlet structure 67 feet below grade. Its floor slopes from the center toward the central core wall. The effluent chamber is located within the central core, approximately 40 feet above the influent chamber liquid level. Effluent discharges directly from it into a 132 inch sewer, with its invert at the same elevation as the effluent chamber floor. The floor has a 2% slope toward the sewer for drainage. The submersible pumps ride on vertical guide bars and can be readily hoisted out of wet well without the need for fastening or unfastening. Liquid level is controlled by the number of pumps operating. Each rise or fall of 9 inches in liquid level is sensed by a bubble system and causes one pump to be turned on or off. The station will operate unmanned. (Peters-PTT)
W86-05120

AUTOMATIC THROTTLE HOSE - NEW FLOW REGULATOR,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 3F.
W86-05237

APPLICATION OF FUNCTIONAL ANALYSIS TO OPTIMIZATION OF A VARIABLE HEAD MULTIRESERVOIR POWER SYSTEM FOR LONG-TERM REGULATION,

Ain Shams Univ., Cairo (Egypt). Faculty of Engineering.
S. A. Soliman, and G. S. Christensen.
Water Resources Research WRERAO, Vol. 22, No. 6, p 852-858, June 1986. 1 fig, 7 tab, 10 ref. National Research Council of Canada Grant A4146.

Descriptors: *Functional analysis, *Varied flow, *Power head, *Reservoirs, *Hydroelectric power, *Long-term planning, Regulations, Mathematical analysis, Multi-purpose reservoirs, Water supply, Rivers, Stochastic hydrology.

Functional analysis and minimum norm formulation are employed to solve the optimal long-term problem of a hydro power system for maximum total expected benefits (benefits from energy generated by a hydro power system over the planning period plus the expected future returns from water left in storage at the end of that period). The method proposed in this paper has the ability to deal with large scale coupled power systems. Most of the current approaches use composite reservoirs. The proposed method takes into account the water head variation and the stochasticity of the water inflows. It is assumed that their probability properties are preestimated from past history. The expected value for these random inflows is used. Numerical results are presented for a real system in operation including up to six reservoirs for widely different water conditions. The computing time to get the optimal solution for this, using the proposed approach, was very small compared to the computing time using other techniques such as the Aggregation/Decomposition approach. (Lantz-PTT)
W86-05242

SOME DEVELOPMENTS IN PRESSURE REDUCTION,

Bristol Waterworks Co. (England).
S. G. Bessey.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 6, p 501-506, December 1985. 2 fig, 1 tab, 3 ref.

Descriptors: *Leakage, *Water pressure, *Hydraulic equipment, Pressure distribution, Process control, Automation, Computer, Flow, Pumpage.

The Bristol Waterworks Company has utilized a microprocessor-based telemetry system of flow compensated pressure reduction since 1976. The company has found several economic limitations to the application of the computer-controlled pressure reducing valve and has pioneered the development of a hydraulically operated alternative for smaller zones. The hydraulic flow compensating pressure reducing valve (PRV) uses an orifice plate bolted to a standard PRV to sense flow rate. At higher flows, the high pressure differential across the orifice plate is transferred to the relay unit which causes the valve to open, delivering a higher outlet pressure. Remote users are more easily accommodated in a segmented large zone under several hydraulic valves due to the shorter distance involved and the ability to set each valve individually. The company's first conversion of a small induction motor-pumpset to variable-speed drive resulted in a reduction of energy use of 23% and in pumped quantity of 14%. The company is currently assessing the conversion of a fixed-speed autopneumatic station to variable-speed duty with flow compensation. (Geiger-PTT)
W86-05318

SUBMERSIBLE PUMPS HELP IMPROVE WATER SUPPLY FROM DEEP LIMESTONE WELL,

Bluffton Electrical and Water Utilities Dept., IN.
E. C. Davis.
Public Works, Vol. 117, No. 2, p 58-59, February 1986. 1 fig.

Descriptors: *Pumps, *Pumping, *Wells, *Pump wells, Pumping tests, Pumpage, Pump testing, Deep wells, Water supply.

An additional 144,000 gallons of pumpage per day was made possible at the Bluffton waterworks after well cleaning, providing a deeper setting of the submersible pumping unit, and modifying the standard submersible system and its installation. An air-control type of relief valve used in the discharge pipe prevented too-rapid air discharge at start-up and joint locking compound was applied to each of the threaded column pipe points to prevent unscrewing of the pump column due to starting torque. Pump and motor construction were of materials to resist chemical attack, and the pump was supplied with sufficiently large pump impeller passages to permit handling of small slugs during the cleaning process. Following well cleaning, a two-stage Ni-Resist pump with 8-inch bowls driven by a 2-pole, 6-inch, 40-hp Franklin submersible motor with Ni-Resist construction was installed. The success of the present experiment seems to have implications for the rejuvenation of wells of similar kind. (Geiger-PTT)
W86-05320

8D. Soil Mechanics

ANALYSIS OF STRATIGRAPHIC CONTROL ON RIVER BANK FAILURE,

Nigeria Univ., Nsukka. Dept. of Geology.
For primary bibliographic entry see Field 4D.
W86-04748

INTEGRATED DEBRIS FLOW OBSERVATIONS,

Kyoto Univ. (Japan). Disaster Prevention Research Inst.
For primary bibliographic entry see Field 2J.
W86-04868

WORLD'S HIGHEST DAM CONQUERS HARSH ENVIRONMENT,

Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
I. Moiseev.
Water Power and Dam Construction, Vol. 38, No. 3, p 17-19, March 1986. 3 fig, 2 tab.

Descriptors: *Rogun dam, *Tadjik SSR, *Precipitation, *Snow, *Cold weather construction, *Dam construction, *Earth dams, *Rockfill dams, *Earthquake engineering, Hydroelectric plants, Tunnels, Gates, Permeability, Pore pressure, Soil water, Powerplant.

The main characteristics and special features of the 335 m-high Rogun earth- and rock-fill dam project in the Tadjik SSR are described. When complete the installed capacity will be 3,600 MW and the dam will be the highest in the world. The temperature at the site ranges from a maximum of 40 C to a minimum of -31 C, with annual precipitation reaching 816 mm, and with an average depth of snowfall in winter of 61 cm. The construction site is also in a zone of high seismic and tectonic activity. Among the noteworthy construction techniques are continuous cycle technique of dam construction, which calls for the combined use of vehicles and conveyer systems at the borrow area and at the dam. Other unusual design solutions include: the integration of discharge tunnels at the service outlet works with the surface and lower-level intakes, making one outlet system; the use of the end portions of the diversion tunnels as a tailrace tunnel; the use of the main gates in the diversion tunnels, designed for a head of up to 200 m; the use of the crane track supports in the gate chambers of the outlet works without the crane runway columns; and the use of cast concrete to fill the space behind the lining of the penstocks. The grade IX seismicity of the region dictated special measures to ensure dam stability, including: filling external dam zones with graded rock with a permeability coefficient of not less than 0.001 cm/sec; compaction of the material in the shells to an extent that prevents the development of dynamic pore pressure in the upstream shell in the event of subsidence deformation; and lower shearing strength characteristics of the soil material in the dam are adopted in the seismic impact stability analysis. (Rochester-PTT)
W86-05002

8E. Rock Mechanics and Geology

EVALUATION OF ELECTRICAL RESISTIVITY METHODS IN THE INVESTIGATION OF KARSTIC FEATURES, EL CAJON DAM SITE, HONDURAS,

Florida Univ., Gainesville. Dept. of Geology.
D. L. Smith, and A. F. Randazzo.
Engineering Geology, Vol. 22, No. 3, p 217-230, April 1986. 12 fig, 7 ref.

Descriptors: *Electrical resistivity, *Karst, *El Cajon Dam, *Honduras *Electrode arrays, *Faulting, *Fracture Zones, *Dissolution features, *Damsites, *Dam construction, Wenner array, Schlumberger array, Bristow array, Pole-Dipole array, Cost analysis, Field tests, Humuya River.

Wenner electrode array, Schlumberger array, and Bristow (pole-dipole) array configurations of electrical resistivity measurements were used to detect the presence of subsurface dissolution features at the El Cajon dam site in Honduras. The construction site, located on the Humuya River in a region of extensive karst development, faulting, and mineralization along fracture zones, posed a special challenge to the application of standard resistivity techniques because of the presence of a cofferdam and the advanced stage of construction. Transects were made parallel and perpendicular to the river valley floor. The best results were obtained with the Schlumberger and Bristow array configurations. Several zones of anomalously high resistivity were detected. Subsequent drilling confirmed the presence of subsurface dissolution features that could have seriously jeopardized the dam. These surveys represent an accurate, economic, and reliable procedure for regions where construction has progressed significantly and where complex geologic terrain exists. (Author's abstract-PTT)
W86-04747

DESIGN OF PERVIOUS PRESSURE TUNNELS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8A.
W86-05008

ON-SITE ASSESSMENT OF ROCK DISCONTINUITIES FROM RESISTIVITY LOGS. T-L LOG: A NEW LOGGING TECHNIQUE,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
G.-A. Tselentis.
Journal of Hydrology, Vol. 83, No. 3/4 p 269-283, March 1986. 1 tab, 12 fig, 5 ref.

Descriptors: *Rocks, *Resistivity, *On-site investigations, Discontinuities, Computers, Hydraulic properties, Fractures, Geophysical parameters, Rock properties.

The extent to which the discontinuities of a fractured formation can be assessed from parameters inferred from normal resistivity logs was examined. Using a microcomputer in series with the logging unit, a zonation process was applied to the logs, which were interpreted in terms of a series of beds, each having specific thickness and resistivity, and a new parameter defined by the difference between transverse and longitudinal resistivities was computed (T-L log). In almost all the cases in which the method was applied, the results were satisfactory and the microcomputer-based software and hardware package that was developed for the automatic processing of the data was very efficient. The logs were processed directly in the field by an ACORN-ATOM 8-bit, 32K microcomputer, and all the software necessary for data processing were kept in an EPROM Module. (Peters-PTT)
W86-05113

8F. Concrete

LARGE CONCRETE DAM CONSTRUCTION IN THE USSR,
Vsesoyuznyi Gidroproektno-Izyskatel'skii i Nauchno-Issledovatel'skii Inst. 'Gidroproekt', Moscow (USSR).
For primary bibliographic entry see Field 8A.
W86-05004

8G. Materials

EVALUATION OF ELECTRICAL RESISTIVITY METHODS IN THE INVESTIGATION OF KARSTIC FEATURES, EL CAJON DAM SITE, HONDURAS,
Florida Univ., Gainesville. Dept. of Geology.
For primary bibliographic entry see Field 8E.
W86-04747

PLASTIC LINING ON RIVERTON UNIT, WYOMING,
R. W. Wilkinson.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 111, No. 3, p 287-298, September 1985. 6 fig, 4 tab, 7 ref.

Descriptors: *Plastics, *Linings, *Riverton Unit, *Wyoming, Water conveyance, Polyvinyl-chloride, Irrigation engineering, Costs, Design standards, Construction, On-site investigations.

Since 1975, the Fureau of Reclamation has installed approximately 25.8 miles (41.5 km) of PVC (polyvinyl-chloride) lining in the distribution system of the Riverton Irrigation Project. The lining is part of a $40,000,000 rehabilitation program designed to stop waterlogging of adjacent farmland and conserve water. This paper describes this project through discussions covering: site investigations and surveys, design, specifications, construction, lining performance, and costs. The PVC sections have performed well. In the few occasions when the lining slid down the side slope, the slippage occurred either downstream of drop structures, or immediately upstream of inlet transitions for in-line structures. Final costs of 23 contracts involving the PVC lining are tabulated. (Peters-PTT)
W86-05240

8I. Fisheries Engineering

INNOVATIVE DESIGN OVERCOMES MULTIPLE INSTITUTIONAL BARRIERS AT HYDRO PLANT,
For primary bibliographic entry see Field 8C.
W86-04682

RIVER BASINS,
Food and Agriculture Organization of the United Nations, Rome (Italy).
R. L. Welcomme.
Available from the FAO, Via delle Terme di Caracalla, 001000 Rome, Italy. Price: $7.50. FAO Fisheries Technical Paper 202, 1983. 60 p, 22 fig, 3 tab, 40 ref.

Descriptors: *River basins, *Fisheries, *Fish populations, *Fish management, *Fishing gear, Fish, Ecology, Fishing, Fish stocking, Water resources development, Erosion, Hydraulic structures, Water quality, Aquaculture, Fish farming.

Rivers may be divided into fast-flowing, upland reaches and slow-flowing, lowland reaches. The ecology of a river depends to a great extent on its flood regime. Fish are highly adapted to these seasonally repetitive events. Lowland reaches of rivers usually support fisheries of exceptional value. Capture methods vary with seasonal changes occurring in the fish communities. In general, there are three main levels at which fish stocks may be evaluated. The first consists of using rapid methods for the approximate evaluation of fish stocks based on extrapolation from other similar river systems. The second consists of the evaluation of the fishery through frame surveys and catch assessment surveys. The third level consists of more traditional methods for assessment of the stocks by experimental fishing. Changes in the quality of water through pollution causes a direct effect on fish, whereas other processes such as sedimentation and the presence of hydraulic structures may indirectly affect fish populations. Management techniques to compensate for the effect of these changes included the careful control fo the fishery within the natural environment as well as the abiotic factors which affect the aquatic system. (Geiger - PTT)
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ANNUAL CUMULATED INDEXES TO VOLUME 19, 1986

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WATER RESOURCES
ABSTRACTS

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MARCH 3, 1849

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I

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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BEST COPY AVAILABLE

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BEST COPY AVAILABLE

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W86-04687	1911	5D
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W86-04836	1911	5D
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W86-04838	1911	5D
W86-04839	1911	5D
W86-04840	1911	5D
W86-04841	1911	5D
W86-04842	1911	5D
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W86-06142	1912	2I
W86-06143	1912	2H
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PART 2 OF 2

SELECTED WATER RESOURCES ABSTRACTS

ANNUAL CUMULATED INDEXES TO VOLUME 19, 1986

MARCH 3, 1849

PART 2 SUBJECT

U.S. DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

VL

SELECTED WATER RESOURCES ABSTRACTS (SWRA) is produced by the Geological Survey, U.S. Department of the Interior, and published monthly by the National Technical Information Service (NTIS), U.S. Department of Commerce.

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SELECTED
WATER RESOURCES
ABSTRACTS

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I

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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